Midwifery Group Practice and Standard Hospital Care: A cost and resource study of women with complex pregnancy

Roslyn Donnellan-Fernandez
RM MHN RN IBCLC BN MNg Grad Cert MIDW (Pharm)
School of Nursing and Midwifery
Faculty of Medicine, Nursing and Health Sciences
Flinders University

A thesis submitted for the Degree of Doctor of Philosophy
12 February 2016

‘Man is not a cog in a machine. Neither is he a statistic. He is an end in himself and must treat his fellow human as an agent of complete freedom.’

Immanuel Kant

DEDICATION

To my late father, Raymond

And my amazing mother, Elizabeth

Who both taught

One person can make a difference, and has an obligation to do so.

TABLE OF CONTENTS

LIST OF TABLES

TABLES APPEARING IN THE APPENDICES

LIST OF FIGURES

FIGURES APPEARING IN THE APPENDICES

SUMMARY

Background

Primary midwifery services access is a public health solution to the challenges of providing high-quality maternal and newborn care (Renfrew et al. 2014). National Maternity Services Plan recommends expanding access to integrated midwifery models for all women (Australian Government 2011). Only 8% of childbearing women in Australia have access to public midwifery models, often restricted to women with 'low risk' pregnancy. Comprehensive evaluation of maternity models analysing clinical outcomes, public cost and resource use for women with pregnancy complexities is therefore an important consideration for allocation of state and Commonwealth public health resources in Australia.

Methods

This study was a 2 armed quantitative non-experimental database analysis of outcomes for women in South Australia with pregnancies classified as 'moderate obstetric risk,' retrospective arm 2004–2010 (state based), and prospective arm 2010–2012 (Commonwealth based) in two maternity models. In this study, specific biophysical and psychosocial criteria that defined 'moderate risk pregnancy', as distinguished from 'low and high risk pregnancy' were used (Appendix 3.1a; p. 278). Women received services through either Midwifery Group Practice (MGP) or Standard Hospital Care (SHC). MGP is a model in which midwives supported each other in 4 group practices (6 full-time equivalent midwives per group) to provide caseload

continuity of care to 36 women per annum per midwife during pregnancy, birth and the postnatal period (Appendix 3.1b). Net benefit principles were used to analyse comparative clinical, cost and resource outcomes using linked data, including demographic characteristics. The retrospective arm (n = 13 462) matched a total of 12 406 records in three databases. Statistical analyses used a multivariate generalised linear model with log link function (adjusted for 18 confounders) to determine cost and revenue between MGP and SHC. Observed and adjusted cost modelling for 26 Australian Refined-Diagnostic Groups also was determined. The prospective arm (n = 206) examined two additional groups of women with complex pregnancies who completed care in MGP or SHC. Women consented to release and linkage of postnatal Commonwealth Medicare benefits and Pharmaceutical Benefits Scheme data with their state birth data in the four months after hospital discharge. Women's characteristics, patterns of service use and cost for MBS and PBS were explored using negative binomial regression and GLM models. Interpretation of data in both arms of the study applied the Donabedian SPO health evaluation framework.

Results

Retrospective arm analysis showed women in MGP were older (median age = 31 years [27–35]), compared with women in SHC (median age = 29 years [24–34]). Women in SHC had significantly more pregnancies and babies ($p<0.01$), also were more likely to have experienced caesarean surgery ($p<0.001$). Greater percentage of Caucasian women received MGP care compared with SHC (83% vs 64%), and fewer women from Asian

background (11% vs 19.4%) and other races, especially Middle East and Africa (4.7% vs 13%), and Aboriginal/Torres Strait Islander women (1.8% vs 4.1%); $p<0.001$. A higher percentage of women were represented in professional, paraprofessional and above trade occupations in MGP (34% vs 15.6%; $p<0.001$). Fewer percentage of MGP women resided in the statistical local area with the greatest social disadvantage, as compared with SHC (37.8% vs 53.1%; $p<0.001$). Fewer women in MGP had a BMI Obese III classification (2.2% vs 3.2%; $p<0.01$) or smoked (12.7% vs 18.7%; $p<0.001$). Unadjusted clinical effectiveness results and resource use showed significant differences. Women in MGP were 1.5 times more likely to achieve a spontaneous vaginal birth (95% CI 1.40–1.65), and less likely to experience routine interventions and childbirth morbidity such as PPH $\geq$ 500 ml, elective caesarean section, induction of labour, use of epidural, episiotomy. Adjusted Multivariate GLM models showed significant differences in costs for each group generated across AR- DRGs during 2004–2010. Cost by year and care type showed less cost per woman in MGP compared to SHC; A$863.92 less cost per woman for MGP in adjusted model ($\beta = 0.79$; 95% CI 0.76–0.82). Maternal and infant characteristics that increased cost in both models were identified. The prospective arm analysis showed the mean age of women in MGP (n = 95) was 1.8 years older than SHC (n = 111). Adjusted IRR showed a 41% lower rate of postnatal Medicare benefits visits for women in MGP than SHC (95% CI 0.46–0.76). Increasing gravid status of women, and elective caesarean section were predictors for increased Medicare benefits use in both groups. GLM models showed higher mean provider charges (A$48.24 [36.69] vs A$41.04 [33.21]; $p<0.001$) and higher mean out of

pocket costs (A$8.38([13.86] vs A$4.09([13.77]; p<0.001) for MGP women. Six times fewer PBS claims were recorded for MGP compared with SHC. Over half PBS claims related to six women, two from rural locations.

Results in both study arms demonstrated improved cost and clinical effectiveness in MGP compared to SHC; however, there was inequitable access to MGP for women with highest socioeconomic disadvantage.

Conclusion

Evaluation of maternity services in South Australia showed sub-optimal quality outcomes between two models of care for women with ‘moderate risk’ pregnancies. Evidence of significant cost savings and efficiency was shown in MGP compared to SHC, and improved clinical effectiveness. Improving equitable access to MGP and outcomes for women with socioeconomic disadvantage should be a critical public health objective to reduce costs and the burden of long-term chronic disease. Future allocation of resources should prioritise the expansion of public health midwifery models. This includes addressing state and federal cost shifting and funding barriers in Australia.

DECLARATION

I certify that this Doctorate of Philosophy thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Roslyn Donnellan-Fernandez

RM, RN, IBCLC, MNsg, Grad Cert Mid (Pharm), BN

ACKNOWLEDGMENTS

The encouragement, support and long-term vision of many others have made the completion of this thesis possible. I express my sincere thanks to the following people and organisations:

- The patience of my supervisors, Professor Sheryl de Lacey, Dr Ingrid Belan, and Dr Shahid Ullah in sustaining and guiding me through the various stages, challenges, and term of this research project is appreciated. They are a unique team whose commitment, combined skills and scholarship made the impossible, possible;
- Professor Simon Eckermann for early advice and encouragement;
- The Women's & Children's Hospital Foundation for support to undertake the research through the WCH Foundation Midwifery Fellowship;
- Former Divisional Director of Nursing & Midwifery, Women's & Babies Division WCHN, Christine Cornwell, the midwife who has provided the long-term inspiration, motivation, and capacity building for this project;
- The Public Health Research Unit (Associate Professor Peter Baghurst & Georgina Antoniou), Central Information Services (Ann Fitzgerald), Nursing & Midwifery Clinical Practice Development Unit (Dr Jennifer Fereday & Emilia Duggan), and

all staff of WCHN, Adelaide who helped – your assistance and support were invaluable;

- The women who consented to participate in the study and those committed to improving childbearing outcomes and maternity services for all families;
- My colleagues and friends from this country and many others – for contributing their time, attention, scholarly engagement and sound critique – your humour and insights enabled me to survive the journey to new knowledge, and to grow accordingly;
- Especially, I thank my parents and family for their ongoing motivation, care and love. Hess and Kalita, your dedication ensured what was started was finished. Amidst birth and death the work was completed.
- I acknowledge the assistance of a professional editor, Tina Thornton, Principal: Academic Editorial Services, who formatted the document according to Flinders University requirements.

WORKS ARISING FROM THESIS

Publications

2013	Donnellan-Fernandez, R (2013) 'Midwifery Group Practice v Standard Hospital care: a cost and resource study', *Australian Midwifery News*, vol. 13, no. 4, pp. 9–11 http://hdl.handle.net/2328/35035

Conference Presentations (Oral Papers and Posters)

2015	19–20 May Women's Healthcare Australasia, Insight Forum: 'Establishing and Sustaining your Midwifery Group Practice', Royal North Shore Hospital, Sydney, NSW, Australia **Invited Speaker/Oral Presentation** *'Best practice systems for monitoring midwifery group practice outcomes & supporting continuous quality improvement'*
1–5 June 2014	International Confederation of Midwives 30th Triennial Conference, Midwives: Improving Women's Health Globally, Prague, Czech Republic **Oral Presentation** '*Access to midwifery models in complex pregnancy: resource / cost findings in the prospective arm of an Australian data linkage project'*.
1–2 May 2013	27th Japan Academy of Midwifery Conference, Kanazawa, Japan **Poster Presentation & International Cultural Exchange**
2013	Donnellan-Fernandez, R. (2013) 'A retrospective study of moderate risk obstetric cohorts in a South Australian tertiary hospital: comparative outcomes for selected indicators in midwifery group practice and standard hospital care 2004–2010' [Poster] *Journal of Japan Academy of Midwifery*, vol. 26, no. 3, p. 84.
7 May 2013	Nurse's & Midwives Research Symposium – SA Health, University SA, Flinders University, and University of Adelaide **Oral Presentation** Abstract: *'A retrospective study of moderate risk pregnancies in one Australian hospital: a comparison of midwifery group practice and standard hospital care'* – Awarded Best Symposium Abstract
27 Feb 2013	Invitation accepted to deliver the Annual MS McLeod Research Oration, Women's & Children's Hospital, WCHN Adelaide **Oral Presentation** 'WCH Fellowship Project: *Accessing and using Medicare Australia's statistical information for health services research in midwifery and maternity reform.'*
18–19 Oct 2012	Australian Midwifery Models Conference, Grand Chancellor Hotel SA

	Oral Presentation
	'Retrospective study results: comparative outcomes for selected indicators in midwifery group practice and standard hospital care 2004–2010'
19–21 Oct 2011	ACM National Biennial Conference, Midwifery Odyssey 2011, Technology Park, Sydney, NSW
	Poster Presentation
	'Lifecourse measures to evaluate the equity of cost and quality in public health midwifery models' [Poster] Donnellan-Fernandez, R. (2011*) Women and Birth,* vol. 24, Supplement 1, S 36. http://hdl.handle.net/2328/26648
March 2011	Families @ Flinders Research Forum, Southgate Institute for Health, Society & Equity
	Oral Presentation
.	*'National maternity reform – why funding models matter'*

ABBREVIATIONS AND ACRONYMS

ABS	Australian Bureau of Statistics
ABSP	Alternative Birthing Services Program
ACIR	Australian Childhood Immunisation Register
ACM	Australian College of Midwives
AHMAC	Australian Health Ministers Advisory Council
AIHW	Australian Institute of Health and Welfare
ALOS	Average Length of Stay
AR-DRGs	Australian Refined-Diagnostic Related Groups
ASCCSS	Australian Standard Classification of Countries for Social Statistics
ASCO	Australian Standard Classification for Occupations
BMI	Body Mass Index
CI	Confidence interval
CDHA	Commonwealth Department of Health and Ageing
CDHS	Commonwealth Department of Human Services
CMSSD	Commonwealth Medicare Statistical Services Division
CYWHS	Children Youth and Women's Health Service
DR	Direct Room In
EREC	External Requests Evaluation Committee
GLM	Generalised Linear Model
HREC	Human Research Ethics Committee
HRPS	High Risk Patient Service
ICD	International Classification of Diseases
IHPA	Independent Hospital Pricing Authority
INB	Incremental Net Benefit
IRR	Incident rate ratio
IRSD	Index of Relative Socio-economic Disadvantage
ISAAC	Integrated South Australian Activity Collection
MBS	Medicare Benefits Schedule
MGP	Midwifery Group Practice

MSSD	Medicare Statistical Services Division
n=	Number
NB	Net Benefit
NHMRC	National Health and Medical Research Council
NHPA	National Health Performance Authority
NMB	Net Monetary Benefit
NRAS	National Registration and Accreditation Scheme
OECD	Organisation for Economic Co-operation and Development
OOP	Out of Pocket
OR	Odds ratio
PBS	Pharmaceutical Benefits Scheme
PHRU	Public Health Research Unit
POU	Pregnancy Outcome Unit
PPH	Postpartum Haemorrhage
QALYs	Quality Adjusted Life Years
RANZCOG	Royal Australian New Zealand College of Obstetricians & Gynaecologists
RCT	Randomised Controlled Trial
RDAA	Rural Doctors Association of Australia
SA	South Australia
SBR	Supplementary Birth Record
SBREC	Social and Behavioural Research Ethics Committee
SCBN	Special Care Baby Nursery
SEIFA	Socioeconomic Index for Advantage
SHC	Standard Hospital Care
SLA	Statistical Local Area
STATA	StataCorp Statistical Software Package
WCHN	Women's and Children's Health Network
WABS	Women's and Babies Services
WAS	Women's Assessment Service
WHO	World Health Organization

CHAPTER 1 HAVING A BABY IN SOUTH AUSTRALIA

Introduction

In high-resource countries, such as Australia, there is robust evidence to show that access to maternity care, and choice for consumers, are based on neither the preferences of citizens nor on scientific evidence (Amnesty International 2010; Benoit et al. 2010; Kildea et al. 2015; Kosiak 2014; Sakala & Corry 2008). Nor have they been guided by longstanding 'best practice' or improved quality performance outcomes in either health care or economics (Devane et al. 2010; Homer et al. 2014; Homer et al. 2001; Rowley et al. 1995; Russell 2008a; Sandall et al. 2015; Tracy & Tracy 2003; Twaddle & Young 1999). Instead, they have been dominated by biomedical models and a medical monopoly over health-funding arrangements (Baerlocher, Allan & Detsky 2009; Davis-Floyd et al. 2009; Senate Community Affairs Reference Committee 1999). In Australia, this has included powerful political influence and resistance to government effort to reform the maternity services (Australian Government 2009; Benoit et al. 2010; Commonwealth of Australia 2011; Gray Jamieson 2012; Zadoroznyj 2008).

These are frustrating facts. With a background of 20 years working in and managing midwifery caseload models small and large, I have been actively involved in expanding midwifery services options and choices for childbearing women that improve outcomes for mothers and babies of all-risk status. Initially, I sought to empower childbearing women as a private midwifery provider in the community (Donnellan-Fernandez 1996, 2000, 2001; Donnellan-Fernandez & Eastaugh 2003). Later, I and others led the evolution and expansion of the midwifery-led Birthing Centre services established by hospitals some 12 years previously. This included implementation of what is now known as the Midwifery Group Practice (MGP). Over a seven-year period, structural, attitudinal, professional, workforce and resource barriers were resolved to mobilise organisational change in moving from a small ‘low-risk’ model to a large ‘all-risk’ model accessible to women with complex pregnancies and providing care for 20 percent of all women birthing at the hospital (Cornwell, Donnellan-Fernandez & Nixon 2008).

The MGP is an all-risk model providing significant levels of continuity of midwifery care with a named midwife in the community and hospital for women with complex pregnancies. This includes choice of birthplace for women with low-risk pregnancy. Linkage with maternal/child health services is provided and integrated with access to a full range of tertiary maternity hospital services, including specialist medical and allied health referral (Cornwell, Donnellan-Fernandez & Nixon 2008; Turnbull et al. 2009).

The model was independently evaluated after one year of operation and demonstrated favourable outcomes for clinical effectiveness, women’s satisfaction, and midwives’ satisfaction (Fereday et al. 2009; Fereday & Oster 2008; Government of South Australia: Children Youth and Women's Health Service 2006; Turnbull et al. 2009).

One of the biggest challenges and frustration confronting me as a manager were the large numbers of women seeking access who were excluded from the model due to the lack of resources (approximately 50 women per month since 2006). These were frequently women who presented late for pregnancy care, who experienced multiple areas of disadvantage, and who often did not engage with dominant mainstream maternity service models. When opportunities for site service expansion stalled indefinitely, the impetus for this study was born.

All hospital-based service models remain vulnerable within the centralised acute care hospital budgets under which their funding is governed. Although clinical outcomes had been evaluated and could be used to lobby for extended services for childbearing women, an economic analysis of 'costs' associated with implementing and sustaining the MGP model was not available. This is an important absence because it is a reasonable expectation that publicly funded services satisfy rigorous cost–benefit tests. This allows the application of a coherent analytical framework to enable decision-makers to accurately assess whether net benefits are likely to exceed costs (Banks 2009 p.10). It was this challenge that drove me to consider a study of the cost-effectiveness of the MGP practice.

There are ongoing threats to the public funding of midwifery-led services. While new opportunities based on midwifery access to the Medicare Benefit Schedule offer significant promise, the new privatised midwifery models they have enabled may yet prove vulnerable (Wilkes et al. 2015). In South Australia, a rationalisation of health care funding and health care service provision is currently taking place (Australian Nursing & Midwifery Federation 2014; Government of South Australia 2012, 2015; Paxton Partners Pty Ltd 2008). It is likely that the future holds changing policy, review of the Medicare Benefit Schedule, and ongoing lack of professional indemnification for midwife-specific services, for example, birth at home (Australian College of Midwives 2015; Williams et al. 2015). An in-depth examination of health care funding and cost-effectiveness is therefore paramount to inform decisions being made about which service models can address equitable access to services and good health outcomes for women with complex pregnancy.

Having a baby in Australia

In 2012, there were 312,513 babies born in Australia. This constituted a 3.4% increase on numbers for 2011 and a total increase of 21.5% since 2003 (Hilder et al. 2014). The number of births that occurred in South Australia totalled 20,666 (Hilder et al. 2014, p. 6). The national maternal mortality ratio was 7.1 deaths per 100,000 births (Australian Government 2015, p. viii), whereas the national perinatal death rate was 9.6/1000 live births (Hilder et al. 2014, p. 90).

Safety in pregnancy and childbirth encompassing a live mother and a live baby are a rational expectation of all citizens within developed health systems. Statistics from the Organisation for Economic Co-operation and Development (OECD) have indicated that for the past 10 years Australian health outcomes demonstrate lower maternal and perinatal mortality than the majority of comparator countries (Organisation for Economic Co-operation and Development 2007). These findings have supported the view that, based on maternal and infant death indices, Australia is a safe country in which to give birth and be born (Australian Government 2009; Commonwealth of Australia 2011). However, while mortality rates are an important measure, they do not provide complete evidence of safe pregnancy and childbirth services, nor of long-term health outcomes (Bar-Zeev et al. 2012; Bar-Zeev et al. 2014; Department of Health and Ageing 2012; Jongen et al. 2014; Sayers & Boyle 2010). Moreover, reporting from the Australian Institute of

Health and Welfare (AIHW) shows the maternal death rate in Australia has been increasing each year since 2008 (Australian Government 2015). This could be associated with the changing demographic profile of women who are giving birth, or with other factors including social determinants of health and lack of access to safe, local maternity services (Kildea et al. 2015).

Many age related risks and complications associated with pregnancy and childbearing increase significantly for women after 35 years (Hilder et al. 2014). This includes associated risks for the baby. The average age of pregnant women (30 years) has increased by 7.9% since 1991. For 2012, the proportion of teenage mothers was only 3.6% as compared with the proportion of older mothers (aged 35 years and over) which was 22.4%, and for those over 40 years it was 4.3% (Hilder et al. 2014, p. 20). In contrast, 1 in 6 Aboriginal and Torres Strait Islander mothers giving birth were teenagers (4% of all women) and had poorer outcomes compared to the rest of the population (Hilder et al. 2014, p. 12).

While some important risk factors for adverse perinatal outcomes, such as smoking, have shown an overall national reduction, others – including geographical location of the mother's residence (rural and remote), maternal country of birth, body mass index, use of assisted reproductive technology, and previous birth by caesarean surgery –have all shown significant variation or increase over the past decade (Hilder et al. 2014). Data show that maternal and infant outcomes are demonstrably worse for those who reside in rural and remote areas (Kildea et al. 2015; Pilcher, Kruske & Barclay 2014). Of women who gave birth in 2012, some 31.2% were born in countries other than Australia (15.2% from an Asian country) (Hilder et al. 2014, p. 16; Yelland et al. 2015). Obesity, a known risk factor for increased perinatal morbidity and mortality (Dodd et al. 2011) was identified in 20.7% of women who gave birth (Hilder et al. 2014, p. 28). Assisted reproductive technology (ART) was used by 4% of pregnant women. The majority who used ART were older primiparous women (58.1%) and therefore at increased risk of developing complications (Hilder et al. 2014, p. 22). Furthermore, 28.8% of all multiparous women giving birth had a history of previous caesarean surgery (23% had experienced the surgery more than once) (Hilder et al. 2014, p. 21). Medical intervention rates were higher in particular geographical locations, in privately insured women, and in private hospital settings (Hilder et al. 2014; Toohill, Gamble & Creedy 2013).

There is long-term evidence of skewed rates of increased medical interventions for privately insured women and babies in Australia who received care in biomedical models (Homer 2002; Roberts, Tracy & Peat 2000; Shorten & Shorten 2000; Tracy, Sullivan & Tracy 2007). Maternal and fetal morbidity also have been shown to increase with socioeconomic advantage and when undertaking care in the private sector (AIHW 2008a, 2008b; Laws et al. 2007). This has included increased use of induction of labour and elective caesarean section, and higher rates of epidural analgesia, episiotomy and birth assisted with instruments (Dahlen et al. 2012; Shorten & Shorten 2007; Toohill, Gamble & Creedy 2013; Tracy et al. 2007; Tracy et al. 2014). This has led researchers and policymakers to draw a correlation between rates of escalating biomedical birth interventions and the introduction of neoliberal health reforms that encouraged uptake of private health insurance during the mid-1990s. These trends and their associated increased cost and resource use continued unchecked for over a decade until a change of federal government in 2007 (McAuley & Lyons 2015; Reiger 2006; Zadoroznyj 2008).

The Australian health care system has always relied on a mix of public and private services to deliver quality in health care to diverse population groups. These groups are spread across challenging geographical regions. In 2012, those aged 18 years and over comprised 57% of the population who had private health insurance (Australian Bureau of Statistics [ABS] 2015). The optimal mix of public and private health insurance and service delivery (including maternity care), is the subject of many influences and remains a contentious area of public and professional debate (Armstrong et al. 2007; Duckett & Willcox 2011, pp. 64–5; Fitzgerald 2015; McAuley 2008; McAuley & Lyons 2015; Menadue 2007). However, there has been an abject failure of the health care system, both public and private, to address divergent population outcomes in maternal and infant health (Australian Government 2015, p. 15; Commonwealth of Australia 2014; Hilder et al. 2014, p. 55; 90). Alarmingly, recent trends show a rising maternal mortality rate for pregnant women with identified complex physical and psychosocial co-morbidities and/or decreased access to services (Australian Government 2015; AIHW 2008b; National Health Performance Authority [NHPA] 2014).

Health inequity is significantly worse for specific groups of mothers and their babies. These include Aboriginal and Torres Strait Island populations, women of non-English-speaking background, women who reside in rural and remote areas, and women in families with multiple social disadvantage (AIHW 2007, 2008b, 2008c, 2009; *Close the Gap: Indigenous Health Equality Summit: Statement of Intent* 2008; Hancock 2006, 2007; Kildea 1999; Kildea, Pollock & Barclay 2008; National Strategic Framework for Aboriginal and

Torres Strait Islander Health [NATSHIHC] 2003; Pilcher, Kruske & Barclay 2014; Raith, Jones & Porter 2015; Yelland et al. 2015). The incidence of complex pregnancy with increased comorbidity, including the burden of future chronic disease, is also higher in these populations (Hilder et al. 2014). The government has acknowledged the problems and the need to address these challenges (Australian Government 2009).

In November 2007, the federal government committed to the development of the National Maternity Services Plan. An objective of the plan was that it would provide a nationally consistent approach to the implementation and delivery of maternity services. Increased choice for consumers was also promised (Commonwealth of Australia 2011). These commitments were articulated in several earlier government documents. Notably, there was emphasis was on primary maternity services, and on improving maternity models and provider integration at primary, secondary and tertiary levels. This included expanded access to midwifery care delivered via continuity models (Australian Government 2008; Australian Health Ministers Advisory Council 2008a; National Health and Medical Research Council [NHMRC] 2010).

At the time the discussion paper was released the Federal Minister responsible for the Commonwealth Department of Health & Ageing stated,

> As Health Minister, I recognise that Australia is one of the safest places to give birth or to be born, but I also feel that current arrangements for the delivery of maternity services in Australia are not serving all Australian women as well as they should. (Australian Government 2008 p.1)

While claiming that mortality and morbidity averages in maternity care across the population had improved, the government also recognised that outcomes were disparate for different groups of Australian women (Australian

Government 2008 p.4). Indigenous women and their babies experienced rates of maternal and infant mortality more than double that of the general population (AIHW 2007; Hilder et al. 2014, p. 93). Some researchers have provided evidence to substantiate that the above figures have been underestimated (Barclay et al. 2008; Jongen et al. 2014; Kildea, Pollock & Barclay 2008). Likewise, it was shown that higher rates of maternal, fetal and neonatal death rates were experienced by rural and remote families when compared to their metropolitan counterparts (Australian Government 2015; AIHW 2008c). Whereas 50% of rural maternity units in Australia (130 units) have been closed since 1997 (Dietsch et al. 2008; Kildea et al. 2015; Menadue 2011; Rural Doctors Association of Australia [RDAA] 2007; Rural Health Workforce Australia et al. 2007), rates of childbirth intervention increased in private hospitals (Laws et al. 2007). Appropriate resource allocation and implementation of policy and service models that meet the needs of these groups is therefore an important strategy to address inequitable health outcomes.

Addressing inequitable maternal and infant health outcomes is an important public good. This includes public accountability for policy and resource allocation that impacts service delivery (Davies, Daellenbach & Kensington 2011). Inequity in access, as well as long-term iatrogenic effects of ineffective health practice and current service models are also important considerations (Duckett et al. 2015; Illich 1976; Wennberg 2014). Whereas care in midwifery continuity models have been shown to optimise physiologic birth and safe outcomes for mothers and babies (McLachlan et al. 2012; Sandall et al. 2015; Van Lerberghe et al. 2014), unnecessary interventions applied in biomedical models are costly, wasteful, and have caused harm (Amnesty

International 2010; Gibbons et al. 2010; Tracy 2011). Problems associated with biomedical models have included: the routine medicalisation of pregnancy and birth; a technocratic risk-averse culture; centralisation of services; delivery in institutionalised, industrial settings; and depersonalised care with increased incidence of maternal birth trauma (Bryers & van Teijlingen 2010; Buist et al. 2008; Creedy, Shochet & Horsfall 2000; Davis-Floyd et al. 2009; Kitzinger 2006; Kitzinger et al. 2006; Klein et al. 2006; Plante 2009; Reiger 2001; Smith, Plaat & Fisk 2008).

One example of routine biomedical intervention that has received cross-disciplinary comment and research in recent decades is the harmful effects of escalating rates of surgical birth, particularly elective caesarean section (Bryant et al. 2007; Cardwell et al. 2008; Gibbons et al. 2010; Hyde et al. 2012). Analyses that have attempted to explain the increased use of caesarean section in industrialised countries – including Canada, the United States and Australia – have asserted that 'practices surrounding birth are consistent with community values, conceptualisations and beliefs,' that aim to reaffirm all the actors in a technocratic society (Cherniak & Fisher 2008 p.275). Internalised beliefs about women and childbirth by clinicians working in biomedical models aid construction and cultural reinforcement of a professional authoritative knowledge base. This has included reinforcement of the dominant biomedical maternity model, risk culture, and use of routine medical interventions. The effect has been to embed obstetric interventionism at a social level (Campo-Englestein et al. 2015). These effects are exacerbated for women with complex pregnancies, limiting their choices and access to services and affecting their and their babies' health outcomes (Beck 2000; Bryers & van Teijlingen 2010).

The application of routine medical intervention to women with complex pregnancies defines, affirms and reinforces professional culture and practice within the biomedical model and the health system (Kotaska 2011). This has occurred even when there is a lack of scientific evidence (or existing contrary evidence) to support the beliefs and harmful practices and policies of the service delivery model (Bryers & van Teijlingen 2010; Cherniak & Fisher 2008 p.271; Newnham, McKellar & Pincombe 2015; Reiger & Morton 2012). However, the systemic institutionalisation of biomedical models in maternity services is now widespread in high-resource settings (Davis-Floyd et al. 2009; Davis-Floyd et al. 2010). Routine application of risk-screening guidelines often excludes women from accessing primary care midwifery services. This has occurred even where evidence supporting increased safety for access has been strong (Davis et al. 2011; Devane et al. 2010; Monk et al. 2014; Ryan et al. 2013; Sutcliffe et al. 2012; ten Hoope-Bender et al. 2014; Van Lerberghe et al. 2014). The beneficial effects of professionally delivered health services are therefore being negated by system- and clinician-initiated iatrogenic effects (Bewley & Cockburn 2002a; Bewley & Cockburn 2002b; Kitzinger et al. 2006; Klein et al. 2006; Kotaska 2011; Wennberg 2014).

An important and related problem for women with complex pregnancy is that the iatrogenic effects become compounded in specific population groups. Lack of culturally safe services for Aboriginal women close to home is one example of this. These women experience increased biomedical intervention and surgical birth in tertiary hospitals (Carter et al. 2004; Kildea & Van Wagner 2012; Kildea & Wardaguga 2009). A higher rate of induction of labour and babies born by the roadside also occurs for women from rural settings having to travel away from their homes to city hospitals (AIHW 2008c; Kildea et al. 2015; Pilcher, Kruske & Barclay 2014). Responsibility for poor health outcomes, including long-term chronic illness, are consequently removed from individuals and society and blamed on the 'health system' (Illich 1976; Newman 2008b). This severely undermines public health messages, as demonstrated by contemporary commentaries on the construction of 'the natural caesarean' (Newman & Hancock 2009; Smith, Plaat & Fisk 2008). Recent evidence contests the assertion of 'consumer choice' as the main driver responsible for increased rates of surgical birth (Campo-Englestein et al. 2015). The real issue is that women are being denied access to safe, local maternity services of their choice.

Women with identified 'risk' factors are more often 'screened out' and excluded from care in midwifery continuity models (Davison et al. 2015; Dawson et al. 2015; Deputy State Coroner Anthony Ernest Schapel 2012; Rigg et al 2015). This state of affairs aligns with the view expressed 30 years ago that 'the impact of modern medicine may constitute one of the most rapidly expanding epidemics of our time' (Illich 1976, p.13). This critique asserts that the indiscriminate institutionalisation of health care has the opposite effect of its objectives. Furthermore, it expropriates power from citizens in exercising responsibility and choosing services that will effectively meet their health care needs (Illich 1976). Current evidence demonstrating regional variation in all aspects of maternal health care delivery in Australia – for example, unequal access, inequitable outcomes, and overuse of harmful surgical procedures – gives this critique ongoing contemporary relevance (Duckett et al. 2015; Hilder et al. 2014; Jongen et al. 2014; Kildea et al. 2015; NHPA 2014; Wennberg 2010, 2014).

Absence of universal access to midwifery services in Australia is an unresolved issue that has been contested in the public domain for the past two decades. It featured both in the opening paragraph of the Commonwealth overview of the *Rocking the Cradle Report* (Senate Community Affairs Reference Committee 1999 p.1) and was also noted by Brodie in an address to a national midwifery models of care conference held in Adelaide a year earlier. This included recommendations that health departments needed to ‘mainstream’ midwifery continuity models to enhance equity and access opportunities for all groups of Australian women and their families (Brodie 1998).

The same issues were iterated in 2009 in public submissions to the national Senate Inquiry into the Health Legislation Amendment (Midwives and Nurse Practitioners) Bill 2009 (Dahlen et al. 2011; Dahlen, Jackson & Stevens 2011; Homer, Brodie & Leap 2008; The Parliament of the Commonwealth of Australia 2009). Over a 30-year period women and families in all eight Australian health jurisdictions have actively pursued increased options for antenatal, birthing and postnatal services that would enable local, funded access to comprehensive primary midwifery service models (Australian Government 2008; Boxall & Flitcroft 2007; Dahlen et al. 2011; Gray Jamieson 2012; Maternity Coalition 2002, 2008; Newman, Reiger & Campo 2011; Senate Community Affairs Reference Committee 1999).

In 1996, a national report from the NHMRC entitled *Options for effective care in childbirth* (NHMRC 1996) outlined women’s ongoing requests for greater choice, continuity and control in childbirth and detailed a comprehensive set of recommendations for change after broad public and professional consultation. This report built on the 1989 Federal Labor Government’s funded commitment to an Alternative Birthing Services Program as part of broader national women's health policy (Office of the Status of Women Department of Prime Minister and Cabinet 1993; Thorogood & Thiele 1998). The initial NHMRC report was followed up with a subsequent report *Review of services offered by midwives* (National Health and Medical Research Council 1998). The latter publication recommended implementation of admitting rights and clinical privileging for midwives in Australian public sector hospitals. A primary goal was to enable a broader role for midwives, including the ability to order diagnostic tests and prescribe within the midwifery scope of practice for women seeking continuity of midwifery care.

Frustrated with the lack of progress, a 2004 editorial from the national peak consumer organisation for maternity care advocacy in Australia, Maternity Coalition (currently Maternity Choices Australia 2015), identified 32 two government reports and inquiries into maternity services in Australian states and territories produced over the previous decade (Caines 2004 p.3)(Appendix 1.1). All had recommended major reform to enable women's choice, continuity and control of pregnancy, birth and postpartum services, including greater access to midwifery services (Maternity Coalition 2002). None had been systemically actioned. Continued production of government reviews, reports and senate inquiries after implementation of the Alternative Birthing Services Program (ABSP) was further confirmation that access for most women seeking mainstream reform to maternity services had not changed or improved (Barclay et al. 2003; Gray Jamieson 2012, pp. 187–8). These publications provide evidence that despite proliferation of a range of innovative non-recurrent 'pilot projects' funded under the ABSP initiative in all Australian states and territories, ongoing public policy inertia and resistance in implementing and mainstreaming midwifery models has persisted (Appendix 1.1) (Gray Jamieson 2012, p. 190; Guilliland & Tracy 2015, pp. 16–22; Newman, Reiger & Campo 2011).

Seventeen years later it is strategic lobbying by consumers that has engaged government and other significant stakeholders, and driven systemic national review and reform of maternity services. However, despite extensive effort to develop policy, legislation, education, workforce and services redesign, the result has been further barriers and only small-scale change (Australian College of Midwives 2015; Dawson et al. 2015; Government of NSW 2012; Government of South Australia: Children Youth and Women's Health Service 2006; Hartz, Foureur & Tracy 2012; Hartz et al. 2012; Kildea et al. 2015; Pairman et al. 2015; Queensland Government 2012; Teakle 2014; Wilkes et al. 2015). With the National Maternity Services Plan due to conclude in 2015 (Commonwealth of Australia 2011) significant scepticism remains regarding the lack of national maternity services' redesign and implementation of service models accessible to the majority of childbearing women in Australia, particularly those who already experience deep inequity (Donnellan-Fernandez et al. 2013, 2008; Parliament of South Australia 2015). These problems are all embedded in the context of Australian health care funding and maternity practice.

The Australian context of maternity care

In Australia, maternity care is provided by midwives, general medical practitioners and obstetricians, in both public and private settings. The current mix of services, including their impact on issues of access and equity for women who experienced pregnancy complications, is heavily influenced by the way the Australian Health System is structured and funded. Because governance in Australia consists of eight federated states and territories, the arrangements for maternity care services provision is complex. Within the federation Commonwealth governance responsibilities are delineated by the Australian Constitution; this results in complex health-funding arrangements. For example, the majority of births in Australia occur in hospitals (99%), the greatest percentage in public hospitals (71%)(Hilder et al. 2014, p. 57). While public hospitals receive a quantum of funding from the Commonwealth benchmarked against a nationally efficient price for services, they remain the responsibility of state and territory governments under the Commonwealth Constitution (Duckett & Willcox 2011, p. 42; NHPA 2015).

Historically, each state and territory have utilised different weightings and funding formulae to resource health facilities (Podger 2006). There are tensions between federal and state/territory governments due to two-tier structural arrangements, bureaucracy, and jurisdictional inconsistencies. As a consequence, responsibilities for various areas of the health system are contested. Politicisation, cost-shifting and fragmentation related to shifting responsibilities for provision of health resources (financing) and health services was extensively documented in *The Blame Game Report* (The Parliament of the Commonwealth of Australia 2006).

Despite the establishment of a national Independent Hospital Pricing Authority (IHPA) by the Commonwealth government in 2011, and a National Health Performance Authority (NHPA) in 2012, health outcomes for particular groups in Australia continue to demonstrate longstanding evidence of inequity (Bar-Zeev et al. 2013; Raith, Jones & Porter 2015). The variation in outcomes include a higher incidence of premature birth, babies of lower birth weight, and higher rates of maternal and perinatal mortality, (AIHW 2007, 2008c; *Close the Gap: Indigenous Health Equality Summit: Statement of Intent* 2008; Hancock 2006, 2007; Kildea, Pollock & Barclay 2008; NATSHIHC 2003). Systemic inefficiency in the delivery of specific health services, including ambulatory/out of hospital services has also been well documented (Drummond 2003; Duckett & Willcox 2011, p. 303), as has service access for rural populations (Brown & Dietsch 2013; Dietsch et al. 2008; Kildea et al. 2015; Menadue 2011).

Despite inequity and inefficiency, policy analysts have claimed that the majority of Australians are able to access quality health care, systems and services through Medicare, the universal government insurance scheme (Australian Government Department of Human Services 2014). Based on principles of universal access (Deeble 2009), the Medicare Benefit Schedule and complementary Pharmaceutical Benefit Scheme have been funded through the federal taxation system (Deeble 2002; Duckett & Willcox 2011, p. 300; Scotton 1999). Medicare, however, is a payment system, not a health service delivery system (McAuley & Menadue 2007).

Further complicating matters has been the longstanding historical dominance and entrenched structural power of the biomedical model towards healthcare delivery in Australia (Grbich 2004; Sax 1984; Willis 1983). This has often been at the expense of other modalities (Duckett & Willcox 2011). Moreover, policy commentators have demonstrated how the mix of services has been widely influenced. Influences have included changing ideologies; governments; economics; policy and workforce analysis; regulation; fluctuation in consumer demand for health services; and lobbying by powerful organised business, research and professional groups (Boxall & Leeder

2006; Duckett & Jackson 2000; Duckett 2007; Grbich 2004; McAuley & Lyons 2015; McAuley et al. 2006; Menadue 2008).

Until recently, midwifery in Australia has historically been located within an educational and practice paradigm of de facto regulation within the nursing profession (Barclay 2008; Barclay et al. 2003; Brodie & Barclay 2001; Donnellan-Fernandez & Eastaugh 2003; Fahy 2007; Summers 1998). This has included practice, employment, and industrial arrangements that have predominantly been located in acute care hospitals premised on nursing workforce models, including in rural settings (Barclay et al. 2003; Brown & Dietsch 2013; Tracy, S, Barclay & Brodie 2000). These configurations have continued to accommodate acute biomedical and industrial service delivery priorities rather than a primary health approach (Donnellan – Fernandez 2011; Newnham 2014; Pairman & Donnellan-Fernandez 2015).

The mainstream midwifery workforce is therefore currently configured and utilised to meet the labour requirements of the acute hospital sector and to service the dominant biomedical models in both the public and private sectors. Structurally, these arrangements have limited opportunities and stymied the capacity to respond to mainstream midwifery workforce and service reconfiguration effectively at a systems level. More recently, significant ‘waiting lists’ for public midwifery models in metropolitan settings have translated into a lack of access and equity for women and families who are often already disadvantaged by geography, education or socioeconomic status in regional and remote contexts (Menadue 2011; Morell et al. 2014; Rural Health Workforce Australia et al. 2007). Of the 30 per cent of mothers who reside in rural settings, many have no access to a local maternity service or their ‘choice’ may be a single medical provider (Kildea et al. 2015, p. 239; Wilson et al. 2009).

Prior to national regulation of health professionals and the introduction of Commonwealth legislation in 2010 enabling midwifery rebates payable from the Medicare Benefit Schedule, public access to direct midwifery services in Australia remained constrained to less than 3% of the childbearing population (Wilkes, Teakle & Gamble 2009; Wilkes, et al. 2015). Recent national surveys estimate current access to public midwifery group practice models at 8% (Dawson et al. 2015). In stark contrast, 81% of women in New Zealand choose publicly funded midwives as their lead maternity provider (Bartholomew et al. 2015). The absence of funding to resource demand for public health access to midwifery models has resulted in assertions that a medical monopoly exists in relation to structural funding provision for maternity services in both public and private sector settings in Australia (Barclay 2008; McIntyre, Francis & Chapman 2012; Zadoroznyj 2008).

Professional debates between provider groups have been polarised, and have focused on restrictive work practices, safety, uneven distribution of specialist workforce and restraint of trade claims (Australian College of Midwives 2005; Challis 2008; Maternity Coalition 2008; McLaren 2002; Teakle 2014). Midwives have argued that they have been curtailed from working to their full scope of practice and that their labour has been utilised to service the dominant medical interests supported by current funding and workforce structural arrangements (Donnellan-Fernandez 1996; Donnellan-Fernandez et al. 2013). Medical groups have contested both the abilities of professionally regulated midwives to provide safe maternity services as primary providers and to access government funding models without direct supervision from doctors (Barclay & Tracy 2010; Lane 2011). Amidst this, broader debate about the sustainability of the health workforce and health system has occurred (Health and Hospital Reform Commission 2009; Health Workforce Australia 2012).

National research and policy debate related to the sustainability of the maternity workforce and of current biomedical service models have called into question the current inefficient use of skilled midwifery workforce (Australian College of Midwives 2005; Australian Health Workforce Advisory Committee 2002, 2004; Barclay et al. 2003; Brooks & Ellis 2007; Brown & Dietsch 2013; Illife 2007; Productivity Commission 2005; Rural Health Workforce Australia et al. 2007; Tracy, Barclay & Brodie 2000; Wilson et al. 2009). This has included ongoing advocacy for the development of new workforce models and implementation of new service models that align with maternity consumers' demands for greater continuity, choice and control. Issues associated with replacing an ageing workforce and projected shortages in supply and distribution of both midwives and specialist medical practitioners have also been extensively canvassed (AIHW 2011; Crettenden et al. 2014; Health Workforce Australia 2012).

Significantly, there has been an ineffective government response in implementing health system change to address the current effect of maternity service provision in Australia. While maternity policy development has occurred, implementation of new public health maternity models to meet the needs of greater numbers of women has lacked political will. This may relate to a lack of understanding about how to implement the new public health maternity models or to administrative and funding inertia. Only recently has national mapping of maternity services occurred (Homer et al. 2011; Kildea et al. 2015). Investigation of the development of a rural birth index also was completed (Pilcher, Kruske & Barclay 2014). The mapping identified 278 maternity units managing more than 50 births per year, with significant variation across states and territories between institutional classification levels and the interventions or services available to populations (Homer et al. 2011). Review of the relevance of existing rural health services indexes for development of a rural birth index also identified the need for additional socioeconomic variables that take account of the service requirements for isolated high-needs populations and the 30% of Australian mothers who live outside major cities (Pilcher, Kruske & Barclay 2014). Currently, choice and access to maternity services including options for different models of care remain concentrated in metropolitan settings (Brown & Dietsch 2013; Kildea et al. 2015).

The emergence of midwifery models of maternity care

Mainstream medical services have not met women's requests for a named midwifery continuity provider across the childbearing continuum, or for increased access to a social model of birth (Australian Government 2009; Gray Jamieson 2012). Nor have the dominant biomedical models demonstrated that they can close the public health gap on disparate maternal and infant outcomes for different population groups, increase service access, or reduce rates of medical intervention or health care costs (Hilder et al. 2014; NHPA 2013, 2014, 2015; Scheil et al. 2013; Scheil et al. 2014). In contrast, models of midwifery care have aimed to enhance experiences and outcomes for women and their babies through provision of care that is safe and feels safe, care that is open and honest, care that is local or feels local, care that is integrated, care that belongs to consumers, and care that is delivered in environments where carers work together and communicate (Queensland Government 2008, p. 5).

At a state level the development of innovative and sustainable public service models that meet women's reproductive and sexual health needs was a priority area identified in the *South Australian Women's Health policy* (Government of South Australia 2005b). In recent years the implementation of new midwifery models, including the evidence to support expansion of these services, has also achieved serious policy attention in other Australian states (Department of Human Services Victoria 2004; Government of NSW 2012; Government of Western Australia 2007; Northern Territory Government 2008; Queensland Government 2012), and at the national level (Hartz, Foureur & Tracy 2012; McIntyre 2012).

As a policy initiative for South Australia, the development of innovative public maternity models remains consistent with both the challenge of sustainable health reform outlined in the *Generational Health Review – Menadue Report* (South Australia 2003) and longer term jurisdictional services and strategic planning that aim to address population inequities by 'transforming health'; for example, *South Australia's State Strategic Plan: Creating Opportunity*, *SA Health Care Plan 2007–2016* (Government of South Australia 2007); *Children Youth & Women's Health Service Strategic Plan 2005–2010* (Government of South Australia 2005a); *SA Health Strategic Plan 2008–2010 Extended to June 2014* (Government of South Australia 2009); *Hospital Budget Performance and Remediation Review* (Government of South Australia 2012), *Transforming Health* (Government of South Australia 2015). Transforming Health values are centred on six quality care principles: patient-centred, safe, effective, accessible, efficient, and equitable. It has been recognised that these principles run in parallel to the values and evidence base for primary midwifery care (Parliament of South Australia 2015).

What has been less well-established and researched is the capacity of the new public health midwifery models to actualise improved outcomes in maternal and infant populations experiencing physical and psychosocial complexities of pregnancy and childbearing. This should include consideration of clinical effectiveness, resource and workforce efficiency, potential economic benefits, and system sustainability. It was this knowledge deficit that provided motivation for the research study underpinning this thesis and that will inform health policy reform in the future.

Within an international context and as recognised by the World Health Organization (WHO) midwives, through their defined scope of practice, have been identified as the most appropriate primary level workforce to provide care for women experiencing healthy pregnancy, childbirth and the postpartum period (International Confederation of Midwives 2011; Renfrew, Homer, et al. 2014; Sandall et al. 2015). The midwifery scope includes the early identification of problems (Langer, Horton & Challamilla 2013; WHO 1996), timely medical consultation and referral (Australian College of Midwives 2013), in addition to collaborative care provided in accordance with standardised, evidence-based guidelines (NHMRC 2010). These principles support a practice scope reflected in the maxim: ‘appropriate care at the appropriate level by the appropriate service provider for the appropriate cost’ (Homer et al. 2014; McIntyre 2012; Van Lerberghe et al. 2014).

In recent years, innovative public health models providing named midwives and continuity of midwifery care for well women have been implemented in many high-resource countries, including Australia. This has occurred in response to scientific evidence, consumer demand and rising health costs (Davies, Daellenbach & Kensington 2011; Davis-Floyd et al. 2009; Government of NSW 2012; Queensland Government 2012). In Australia these midwifery models have been variously named ‘Know Your Midwife’, ‘Midwifery Caseload’, or ‘Midwifery Group Practice’ (Hartz et al. 2012; Homer, Brodie & Leap 2008; Turnbull et al. 2009).

Strong evidence for the clinical effectiveness of midwifery caseload models exist (Sandall et al. 2015). An international systematic review showed women who undertook midwifery care were less likely to experience fetal loss before 24 weeks. Moreover, rates of vaginal birth and breastfeeding initiation were improved. Women also experienced increased levels of satisfaction with their care. Reduction in costly obstetric interventions in the midwifery models included: reduced instrumental birth, fewer episiotomies, and reduced use of intrapartum analgesia and anaesthesia. The authors concluded that all childbearing women should be offered midwife-led models (Sandall et al. 2015). Long-term indices for health and wellbeing have also demonstrated improvement in public health midwifery models. These have included: extended breastfeeding, improved maternal psychosocial outcomes and preparation for parenthood, less postnatal depression, increased rates of immunisation, and enhancement on various social determinants, for example, indigenous equity measures (Hodnett 2004; McLachlan et al. 2015; New Zealand Information Service 2007; NSW Health 2006; Raisler & Kennedy 2005; Shields et al. 1997; Van Wagner 2007; Wagner 1998; Waldenstrom & Turnbull 1998).

With respect to place of birth, overseas studies confirm the safety of planned homebirths compared with planned hospital births for women with a low-risk pregnancy (Vedam et al. 2013). A retrospective cohort study of more than half a million women in primary midwifery care in the Netherlands demonstrated no difference in neonatal morbidity and mortality. The authors concluded ‘that women can safely choose where they want to give birth, provided the maternity care system is well equipped for homebirths,’ (de Jonge et al. 2009, p. 1182). These results have been supported by a large British study of over 64,000 births that found higher rates of vaginal birth, reduced medical intervention, and less cost for both homebirth and care in midwifery-led units for women at low risk of complications (Birthplace in England Collaborative Group 2011; Schroeder et al. 2012).

While the majority of women with complex pregnancies give birth in hospital, clinical effectiveness studies provide compelling evidence to support a more vigorous public health policy, research, and reform agenda to expand and fund midwifery services for this group of women at state/territory and Commonwealth levels in Australia. Since implementation of the maternity reform agenda only an estimated 8–10% of women have been able to access public midwifery-led services or continuity of care models (Dawson et al. 2015). Long-term evidence has identified that organisation of services and workforce in relation to maternity care in Australia has been suboptimal from both an efficiency and sustainability perspective (Australian Government 2009; Australian Health Workforce Advisory Committee 2002, 2004; AIHW 2008b; Barclay et al. 2003; Newton et al. 2014; Productivity Commission 2005; Wilson et al. 2009).

Despite suboptimal configuration of the maternity workforce, the development and evolution of midwifery care models in the Australian context has been well documented (Government of NSW 2012; Homer, Brodie & Leap 2001; Homer, Brodie & Leap 2008; Queensland Government 2012; Wilkes et al. 2015). A variety of midwifery service innovations have been implemented throughout Australian states and territories on an ad hoc basis within community health sectors and acute care settings (i.e. public sector hospitals). The models, small and large, have sought to meet diverse consumer demand and local lobbying. In many locations midwifery models were established to maintain local maternity services threatened by closure. In other areas they were implemented to target geographic socioeconomically disadvantaged populations or to provide culturally safe services for specific groups (e.g. Aboriginal and Torres Strait Islander), or to provide for specific service needs (e.g. survivors of childhood sexual abuse; women experiencing domestic violence). In some instances service models were utilised strategically to recruit, reconfigure, retain and develop midwifery workforce (Community Midwifery Western Australia 2006; Government of South Australia: Children Youth and Women's Health Service 2006; Hambly 1997; Nixon, Byrne & Church 2003; Power, Nixon & O'Donnell 2008; Scherman, Smith & Davidson 2008; Thorogood & Thiele 1998; Tracy et al. 2005).

Some midwifery models that were established as pilot programs with Alternative Birthing Services Plan seed funding have evolved, transformed and matured. These programs have survived using federal Public Health Outcomes Funding arrangements (Gray Jamieson 2012; Guilliland & Tracy 2015), or new Commonwealth funding arrangements for Medicare-eligible private midwifery (Teakle 2014; Wilkes, et al. 2015). Many other midwifery services have closed, or remain dependent on the goodwill of local health authorities and state health departments on who they rely for ongoing sustainable funding. This includes invisible ‘in-house’ financial arrangements that are attached to and entwined with acute care hospital budgets. Within existing hospital budgets (e.g. state public hospitals) expansion of midwifery models have remained limited, with service resourcing unable to meet geographical or population demand (Donnellan-Fernandez et al. 2008).

Purpose and aims of the study

The broad purpose of this thesis was to evaluate a particular maternity service in order to compare the economic and health outcomes of maternity care when delivered by a mainstream biomedical service versus a midwifery model of care. The study that forms the centre of this thesis sought to specifically analyse systemic efficiency, accountability and the gaps in comparative best practice in two public health models of maternal and newborn services for women with complex pregnancies.

Specifically the study aimed to:

- compare and contrast obstetric outcomes between MGP model and Standard Hospital Care (SHC) model for women whose pregnancy was classified as moderate risk
- examine resource use and cost-effectiveness between MGP and mainstream obstetric care
- evaluate inequity in access among women with different socioeconomic characteristics

Core to the project was the assumption that social determinants of health encompassed both structural elements and human behaviour. These included models of care and health services financed, access to services, and relationships between services, including the clinical outcomes, resource use, and costs they generated. Moreover, intersecting relationships among these factors in the health system also had the capacity to influence social gradient health inequalities both negatively and positively for individual women and for groups of women in the population (Australian Health Ministers Advisory Council 2008b; Boxall & Leeder 2006; Commission on Social Determinants of Health 2007; Graham 2009; Newman 2008a, 2008b; Russell 2008b).

The significance of the research

Previous public sector evaluations of Australian maternity services have not measured cost and resource consumption across all-risk hospital-based services, using the combined approach of retrospective and prospective data linkage of health outcomes and costs for mothers and babies. Nor have they incorporated state and Commonwealth funding perspectives in the same study. Critical appreciation of integrated evidence on comparative cost, productivity, efficiency, quality, clinical effectiveness and equity delivered through differing models of public sector services is important for decision-makers. It facilitates informed policy initiatives, transformative action (and relationships) on the part of citizens and professionals, and sustainable systems change. The approach used in this study therefore offered a significant contribution to the achievement of net benefit principles in the implementation of reform being undertaken in the Australian maternity services. Net benefit principles, including their relevance and application to maternity services evaluation is defined in the methods chapter.

Overview of the thesis

The following chapters outline how the thesis is constructed. In Chapter 2 a critical review of the literature on the cost and quality of services for women with complex pregnancy is presented. The review considered the evidence base, methods, and current gaps in the literature that examine cost-effectiveness, resource use and clinical effectiveness of midwifery continuity models for women with identified pregnancy risk factors.

Chapter 3 outlines the methods that were applied to a large-scale public sector database analysis of women whose pregnancies had been classified as 'moderate obstetric risk' and describes the evaluation framework that was used to interpret the study results, Donabedian SPO Model (Donabedian 2003).

Chapters 4 and 5 report the findings of this analysis. Chapter 4 reports the findings of the retrospective analysis of data (state-based), while Chapter 5 reports the findings of the analysis of prospective data (Commonwealth-based).

Chapter 6 provides a discussion of the findings in relation to the assumptions that underpin service provision, including how results from both arms of the study informed the structure, process, outcomes of the Donabedian evaluation model and the seven pillars of quality health care (Donabedian 1990, 2003, 2005).

Chapter 6 provides a conclusion to the thesis and recommendations for decision-makers with regard to future policy development and maternity services implementation.

CHAPTER 2 : LITERATURE REVIEW. HOW COST-EFFECTIVE IS MIDWIFERY CARE?

Introduction

Given the current questions in the public domain about the cost-effectiveness and transformation of health care as outlined in Chapter 1, there is a need for evidence about the cost-effectiveness of midwifery models, including relationship to clinical care outcomes and resource use. Likewise, comparison is needed between midwifery models of care and other models of care for childbearing women who experience complexity in their pregnancy. The literature review described in this chapter provides a context for the significance of the research study, including the methods chosen (Craswell 2005; Kennedy 2007; Kirby, Greaves & Reid 2006). Moreover, it demonstrated how this study contributes to the existing body of knowledge in the field of best practice maternity and midwifery service models by addressing the significant gaps of previous studies (Boote & Beile 2005; Booth, Papaioannou & Sutton 2012).

Purpose of the Literature Review

The purpose of this literature review was to critically assess the evidence base for the combined cost-effectiveness, resource use and clinical effectiveness of midwifery continuity models for women experiencing complex pregnancy and their babies. This included evidence applicable across the continuum of antenatal, intrapartum and postnatal care. The review critically evaluated the methods and quality of studies undertaken in the field. This included their capacity to support public health policy and implementation of improvements to maternity services for women in Australia (Australian Government 2009; Commonwealth of Australia 2011).

In addition to identifying gaps in the research, it was important to synthesise the existing literature in the field to improve evidence-based decision-making (Callahan 2014; Greenhalgh & Peacock 2005; Whittemore & Knafl 2005). While the characteristics of different types of literature reviews vary (Hemingway & Brereton 2009; Rocco & Plakhotnik 2009; Torraco 2005; Tranfield, Denyer & Smart 2003), five characteristics of rigorous reviews were identified, namely to be concise, clear, critical, convincing, and contributive (Callahan 2014, p. 272).

Approach and method for cost-effectiveness literature review

To meet the characteristics of a rigorous review this literature review utilised the matrix method described by Garrard (2007). Use of the matrix method entailed creating a structured system for each article selected for the review (see Appendices 2.1; 2.2) (Booth, Papaioannou & Sutton 2012; Garrard 2007). This improved the rigour, quality and clarity of the final literature review by providing a systematic framework for data (article) collection, organisation and analyses (Torraco 2005; Denyer & Pilbeam 2013). The matrix method enabled presentation of the review as a thematic summary critique of identified issues in relation to the main area of interest. The area of interest was the combined cost-effectiveness, resource use, and clinical effectiveness of midwifery models compared to other models of maternity care. Use of the matrix method facilitated a systematic approach to critical reflection and evaluation of the methodological approaches adopted by studies in relation to their strengths and weaknesses (Callahan 2014; Rocco & Plakhotnik 2009). Furthermore, it enabled identification of deficits and gaps in the current knowledge base and recognition of inconsistencies in the methods used to assess the combined effect of clinical outcomes, resource use, and cost for models of care for pregnant women experiencing complexity across the childbearing continuum (see Appendix 2.2 for the summary Tables of literature included in this review). A discussion of the themes that were identified from the review will follow. They have been critically analysed to justify the need for the current study.

The following section describes the approach and methods used for the combined resource and clinical and cost – effectiveness review, the exclusion and inclusion criteria, the literature search and selection strategy, the databases sourced, the critical appraisal framework that was applied, and the outcome of the review.

Literature search strategy

The literature search was conducted using electronic databases. Key words and search terms are in Table 2.1. Databases that were searched included:

- Medical Literature Analysis and Retrieval System Online (MEDLINE)
- Cumulative Index to Nursing and Allied Health Literature (CINAHL)
- Midwives Information and Resource Service (MIDIRS)
- Database of Abstracts of Reviews of Effectiveness (DARE)
- ExerptaMedica Database (EMBASE)
- NHS Economic Evaluation Database (NHSEED)
- INFORMIT
- PROQUEST
- OVID
- PUBMED
- Science Direct
- Cochrane Database of Systematic Reviews (CDSR).

Selection strategy for retrieval/inclusion and exclusion criteria

Articles for possible inclusion were identified using combinations of key words and explosion of Medical Subject Heading (MeSH) terms and text words, combined with the Boolean operator. Relevant articles were selected or excluded after initial screening of titles and abstracts based on the inclusion and exclusion criteria identified in Table 2.1.

Table 2-1 Inclusion and Exclusion Criteria for Literature Retrieval

Inclusion criteria	Exclusion criteria
Published between 1994 and 2015	Publication date older than 1994
English language publications only	Non-English language publication
Article contained key search words or combined search terms: midwifery, midwife-led units, nurse-midwifery, birth centres, cost, cost-effectiveness, economic evaluation, economic outcomes, pregnancy risk classification, maternal outcomes, neonatal outcomes, clinical outcomes, maternity services	Article did not contain key search words or combined search terms
Primary research article or Systematic Review/Meta-analysis or Integrative Review Economic analysis secondary to RCT accepted	Articles other than Primary research article or Systematic Review/Meta-analysis or Integrative Review
Peer-Reviewed Journals	Non-peer-reviewed journals and websites
Population sample of childbearing women and/or their babies where risk classification profile is described or defined	Population sample of childbearing women and/or their babies where risk classification profile is undescribed/undefined
Measurement of at least one economic outcome measure combined with clinical and/or other outcome measures, in midwifery care units or integrated midwifery continuity models that included either antenatal, birthing and/or postnatal services, singly or severally, compared to other maternity service models. Economic perspective is funder/health service.	No measurement of any economic or clinical outcome or combination of these, in midwifery care units or integrated midwifery continuity models that included antenatal, birthing and/or postnatal services, singly or severally. Economic perspective is woman/family.

The selection criteria included primary research articles published in the English language between the years 1994–2015 in peer-reviewed journals. A 20-year time frame was selected for the review as this marked the beginning of an era in which the first studies to investigate and include the cost-effectiveness of midwifery care began to appear, including the first Australian studies (Kenny et al. 1994; Rowley et al. 1995; Sandall et al. 2015). Non-English language papers were excluded as were those focused exclusively on developing countries. These exclusions were justified on the basis of the limited generalisability of findings from these studies to western health systems. While some European studies that were included may also have limited generalisability to the Australian context, these health systems shared some common features, for example, the organisation and funding of maternity care and services based on medical models (Bellanger & Or 2008; Davis-Floyd et al. 2009).

Specifically, published reports were included if they measured at least one defined economic and clinical outcome or other outcome measure (e.g. resource use), for women and babies who received care in midwifery-led units or integrated midwifery continuity models as compared to other maternity models. This included mixed-methods studies and encompassed antenatal, birthing and/or postpartum services. Studies included:

- systematic reviews and structured reviews of the literature
- economic evaluations that were piggy-backed to randomised controlled trials
- economic evaluations undertaken as secondary analysis to randomised controlled trials
- Level III and IV evidence (National Health and Medical Research Council 2008) (Appendix 2.1, Table 2.1.1)
- economic and econometric modelling based on productivity and efficiency tools and techniques that used original data.

In addition to the above database search, the reference lists of articles found were scanned to identify additional relevant primary research sources. This method of 'snowballing', tracking references in articles and using reverse citation tracking that cited articles identified as relevant to the review, circumvented the limitations of a search strategy based on use of databases and key words alone (Callahan 2014). Such predefined search strategies may fail to identify key evidence (Greenhalgh & Peacock 2005, p. 2). Of the articles found, the most common reason for exclusion was that papers did not include original research data but were commentary or opinion pieces on results reported elsewhere, or were not reported in English, or the research was confined to clinical effectiveness outcomes only and did not incorporate cost and resource results.

Appraisal of studies

A total of 43 articles met the selection criteria identified in Table 2.1. The search strategy identified 326 articles of potential relevance. Studies that were excluded based on their title and abstract totalled 245. This left 81 full text papers that were retrieved and read. An additional six studies were found from the reference lists of the full text papers. Thirty - three studies were automatically excluded as they did not meet the inclusion criteria for this literature review. With the exception of a costing analysis, the remaining 54 papers met the inclusion criteria. Forty – three of the 54 articles included a specific cost analysis as part of their study and fulfilled all inclusion criteria for this review. The process of selecting studies for inclusion in the literature review is summarised in Figure 2.1.

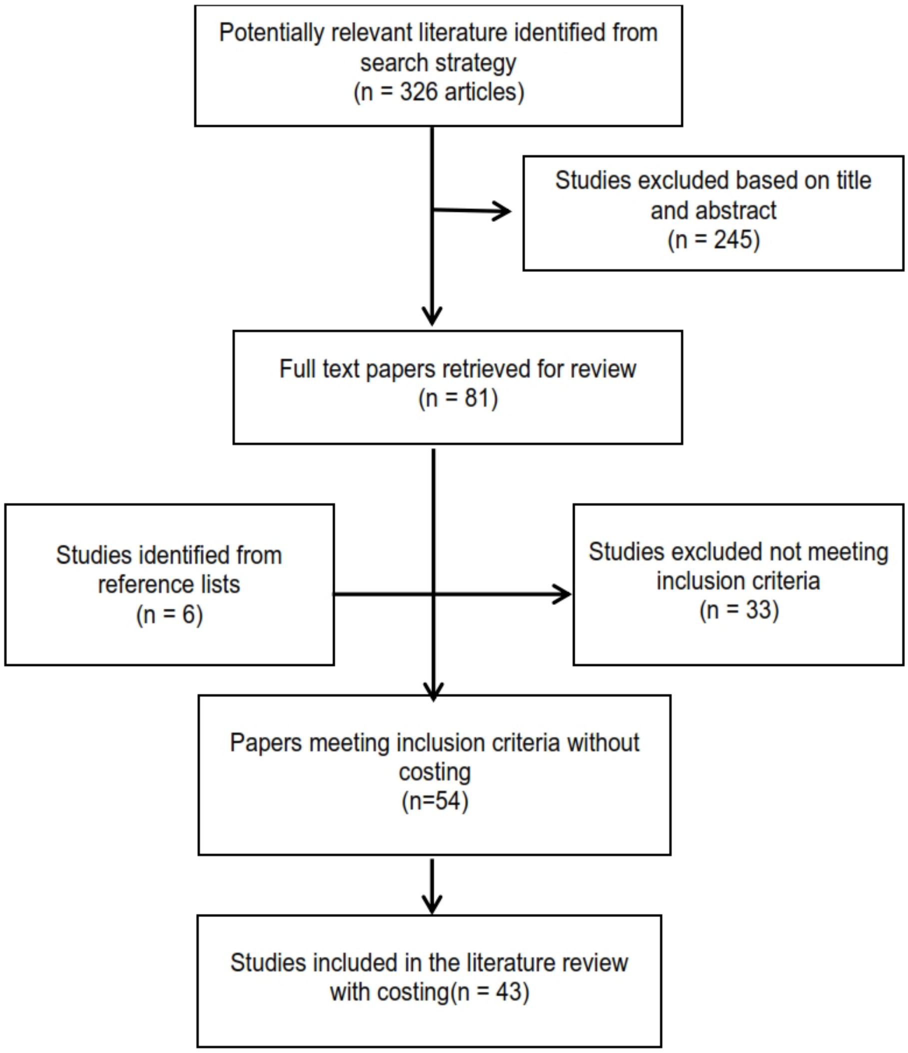


Figure 2-1 Flow chart illustrating the process of selecting studies for inclusion in the literature review

The critical appraisal processes that were used and characteristics of all papers have been summarised at Appendix 2.2 in Tables 2.2.1 and 2.2.2 (see p. 247 and 255 respectively). The appraisal process included consideration of the study's aims, setting and sample size, design and methods, major findings, strengths and limitations. A recommended checklist for appraising economic evaluation studies described in 'How to compare the costs and benefits: evaluation of the economic evidence' (National Health and Medical Research Council 2001) was consulted. From this resource eight quality appraisal questions were used to provide a critical assessment, summary and synthesis of the knowledge in the field (Garrard 2007; Torraco 2005) (Appendix 2.1, Table 2.1.2). The PRISMA checklist was the assessment tool that guided evaluation of the systematic reviews and integrative reviews as it was recognised as the premium quality assessment tool for these reviews (Greenhalgh & Peacock 2005; Hemingway & Brereton 2009; Moher et al. 2009) (Appendix 2.1, Table 2.1.3).

Appraisal results

The published literature was categorised according to the level of evidence, the study design and method. Of the 43 papers included in the review 35 papers were primary sources, and 8 were systematic and integrative reviews. Table 2.2 provides a summary of studies that were included in the review and their level of evidence.

The review of the cost-effectiveness of different models of maternity care was updated in 2015. It identified three recent additional primary source articles from the Australian literature (Gao et al. 2014; McLachlan et al. 2012; Tracy et al. 2013) and one from the international literature (Schroeder et al. 2012) that met the inclusion criteria. There were also three recent systematic reviews added that were relevant to evaluating the cost-effectiveness and clinical effectiveness of maternity and midwifery service models (Ryan et al. 2013; Sandall et al. 2015; Sutcliffe et al. 2012).

Table 2-2 Summary of Studies Included in the Literature Review

Evidence hierarchy level	Cost studies included in the literature review
Level I: Systematic Review	Devane et al. 2010; Henderson & Petrou 2008; Henderson et al. 2001; Ryan et al. 2013; Sandall et al. 2015*; Stewart et al. 2005; Sutcliffe et al. 2012; Villar et al. 2007
Level II Randomised Controlled Trial with Economic Evaluation	Byrne, Crowther & Moss 2000; Homer et al. 2001; Homer et al. 2001*; Kenny et al. 1994*; McLachlan et al. 2012; Rowley et al. 1995*; Tracy et al. 2013* – Australian studies Begley et al. 2011; Bernitz, Aas & Oian 2012; Henderson et al. 2000; Hundley et al. 1995; Morrell et al. 2000;Petrou et al. 2004; Petrou et al. 2002; Ratcliffe, Ryan & Tucker 1996; Villar, Ba'aqeel & Piaggio 2001; Young, Lees & Twaddle 1997*
Levels III and IV Quasi-experimental Cost Studies (cohort, cross-sectional, case control, non-randomised prospective, retrospective audit)	Gao et al. 2014; Jan et al. 2004; Toohill et al. 2011; Tracy et al. 2014 – Australian studies Anderson & Anderson 1999; Henderson & Mugford 1997; Hendrix et al. 2009a; O'Brien et al. 2010; Petrou & Glazener 2002; Ratcliffe 2003; Reinharz et al. 2000; Schroeder et al. 2012; Stone, P et al. 2000; Stone, PW & Walker 1995; Walker & Stone 1996
Econometric Studies – predictive cost, productivity, resource models using datasets	Bellanger & Or 2008; Gibbons et al. 2010; Mooney et al. 2008; Tracy & Tracy 2003

*6 of 15 studies included in Sandall et al. 2015 review included cost/economic analyses – 5 of these cost studies were included in this review. Flint et al. 1987 was excluded based on justification in Ryan et al. 2013 and Devane et al. 2010 – see Appendix 2.2, Table 2.2.1

Significantly, eight of the articles published in the last 15 years were systematic reviews or integrative reviews related to specific aspects of economic evaluation of midwifery models. Despite this, none of these studies have focused exclusively on women with complex pregnancies and most were completed in the United Kingdom (Devane et al. 2010; Henderson et al. 2001; Henderson & Petrou 2008; Ryan et al. 2013; Sandall et al. 2015; Sutcliffe et al. 2012). While the British studies provide strong evidence for clinical and cost effectiveness of midwifery - led units (including birthing centres and home birth), as compared to obstetric - led units, specific economic analysis of outcomes and cost for pregnant women with risk factors were not included. Further, the Australian maternity services are not organised in the same configuration as maternity services in the United

Kingdom, where clear delineation between midwifery – led units and obstetric – led units are a recognised and established feature of the health system. However, four of the Australian studies that were part of the systematic review of midwifery-led continuity models versus other models of care for childbearing women included in the clinical effectiveness review undertaken by Sandall et al. (2015) included women of mixed obstetric risk status (Homer et al. 2001; Kenny et al. 1994; Rowley et al. 1995; Tracy et al. 2013) (seeTable 2.2).

Quality of studies included in the review

Economic evaluations that were undertaken alongside randomised controlled trials constituted the most robust cost-effectiveness evidence available (Drummond et al. 2005; National Health and Medical Research Council 2001, 2008). However, only 16 studies included in the total of 35 primary source articles selected for this literature review fulfilled those criteria (see Appendix 2.2, Table 2.2.2, p. 255. RCTs are highlighted in yellow). Six of the 16 RCT studies (37.3%) had relevance to the Australian context.

Of the eight systematic and integrative reviews included, two specifically focused on the cost-effectiveness of midwifery models (Devane et al. 2010; Ryan et al. 2013). With the exception of Flint et al. (1987) and Lubic (1983), all studies included in these two systematic reviews were included in this literature review (Begley et al. 2011; Hundley et al. 1995; Young, Lees & Twaddle 1997). Both studies fell outside the date range selected for the review. Furthermore, Flint et al. (1987) reported costs for only 49 of 1001 women in a randomised controlled trial, and on this basis has been excluded from other cost reviews (Devane et al. 2010; Ryan et al. 2013). Results from all the other studies were from randomised controlled trials and therefore constituted the most robust evidence for the cost-effectiveness of midwifery models. Additionally, the four Australian mixed-risk classification RCTs included in the systematic review of 15 studies undertaken by Sandall et al. 2015 (Homer et al. 2001; Kenny et al. 1994; Rowley et al. 1995; Tracy et al. 2013), were also included in this literature review. These four Australian RCTs were the only studies that examined cost results for midwifery models, apart from one UK RCT (Young, Lees & Twaddle) (Table 2.2). While the systematic review of patterns and comparative cost of care between midwife and medical providers undertaken by Villar et al. (2007) was limited to cost of care in the antenatal period, it too was based on studies from RCT evidence and therefore was robust (Jadad & Enkin 2007).

Of three integrative reviews of the literature, the first focused on the cost-effectiveness of models of maternity care for birth (i.e. home births and birth centres) (Henderson & Petrou 2008), the second on costs associated with midwife birth centres (Stewart et al. 2005), and the third on an economic evaluation of alternative modes of delivery that compared the costs of caesarean birth with the costs of vaginal birth (Henderson et al. 2001). The quality of cost, resource use and clinical effectiveness evidence in the integrative reviews was also high as these reviews included mainly RCT evidence, but they also incorporated study results from Levels III & IV of the evidence hierarchy (Table 2.2).

Other study designs included in this literature review considered cost evidence of varying levels of quality. Based on the NHMRC evidence hierarchy, the studies, in order of decreasing quality included, quasi-experimental cost studies (Stone et al. 2000); cross-sectional studies (Tracy et al. 2014); cohort studies (Reinharz et al. 2000; Schroeder et al. 2012);

non-randomised prospective studies (Toohill et al. 2011); bottom-up costing (Ratcliffe 2003); matched controls (O'Brien et al. 2010); cost analysis (Jan et al. 2004), and retrospective records audit (Gao et al. 2014).

Econometric studies were also included that demonstrated robust economic modelling. This included use of long-term internationally validated cost ratios for method of birth (Clark, Mugford & Paterson 1991) where midwifery services were a significant component of the model/health system analysed (Petrou & Glazener 2002; Tracy & Tracy 2003). These studies encompassed recent public health analyses and predictive cost-modelling estimates based on standardised international resource approaches (Bellanger & Or 2008; Gibbons et al. 2010). They incorporated methods that used both recognised econometric techniques (Baum 2013; Drummond et al. 2005), for example, use of productivity/efficiency frontiers (Coelli et al. 2005; Heshmati 2003; Mooney et al. 2008), and new cost-modelling approaches, for example Net Benefit principles (Ryan et al. 2013).

A thematic narrative analysis of the literature was justified (Callaghan 2014; Garrard 2007) when significant variation and limitations associated with the methods used by studies to evaluate cost were identified by the review (Drummond 2003; Drummond et al. 2005). These included selective risk sampling, varying quality in study design, the variables selected for measurement, focus on different areas and episodes of the childbearing continuum, use of varying cost methodologies and study assumptions, incomplete and missing data replaced with estimates and analyses that used statistical imputation methods, and variation among populations, setting and health systems (Appendix 2.2).

Some of the specific issues associated with the limitations of the methods were samples that predominantly and/or exclusively included women with ‘low-risk’ pregnancy classification only, thereby limiting the generalisability of results to specified ‘low-risk’ pregnancy classification groups (McLachlan et al. 2012; Reinharz et al. 2000; Stone et al. 2000; Schroeder et al. 2012; Sutcliffe et al. 2012). Moreover, comparison among study results was complicated by significant variation in the quality of the study design and the results generated. As discussed above, robust economic evaluations conducted alongside a randomised controlled trial were considered to have high validity and reliability (National Health and Medical Research Council 2008) (Begley et al. 2011; Bernitz, Aas & Oian 2012; Byrne, Crowther & Moss 2000; Homer et al. 2001b; Kenny et al. 1994; Rowley et al. 1995; McLachlan et al. 2012; Ryan et al. 2013; Tracy et al. 2013). This was in contrast to non-randomised retrospective audit studies (Gao et al.. 2014; Jan et al. 2004), and use of predictive models based on cost estimates (Bellanger & Or 2008; Gibbons et al. 2010; Mooney et al. 2008). Challenges to validity also were created by studies where various statistical imputation methods and or expert opinion or estimates were used to account for missing data (Gao et al. 2014; Gelman & Hill 2006; O’Brien et al. 2010).

Additional challenges associated with study methods included the selection of different resource and cost variables for analyses. This varied according to country and setting – namely, home, hospital or community – and included fluctuations dependent on the availability of data and data sources (Bellanger & Or 2008). Inter-study comparisons were further limited by the varied foci and measurement of different episodes of the childbearing continuum; such as antenatal (Mooney et al. 2008; Villar et al. 2007), birth (McLachlan et al.

2012; Tracy et al. 2014; Toohill et al. 2011), or postnatal episodes of care (Morell et al. 2000; Petrou et al. 2002; Petrou et al. 2004). As shown, this complicated interpretation of results within the same study where different models exhibited cost-effectiveness in one area of the childbearing continuum, for example birth (Hundley et al. 1995), but the comparator demonstrated superiority in another, for example postnatal care (Hendrix et al. 2009).

Use of various cost methods and approaches, for example ‘top-down’ costing that used diagnostic related groups cost weights (Rowley et al. 1995; Tracy et al. 2013; Walker & Stone 1996); or, ‘bottom-up’ costing that included measurement of specified resource components – for example equipment, consumables, staff salaries, caseload numbers, infrastructure costs (Homer et al. 2001; Kenny et al. 1994; Ratcliffe 2003; Reinharz et al. 2000; Young, Lees & Twaddle 1997), or predictive cost models based on estimates (Bellanger & or 2008; Gibbons et al. 2010) – were other factors that further complicated valid cost comparison among studies. Additionally, while some Level III and IV studies (Table 2.2) did use methods that adjusted for confounders (Toohill et al. 2011), others did not (O’Brien et al. 2010), nor did they differentiate for specific risk stratification when their sample included pregnant women of mixed-risk classifications even when overall study design was robust (Tracy et al. 2013).

Other limitations associated with study methods included many of the assumptions on which predictive models and costs were based. Missing and incomplete cost data that were replaced with estimated data may have contributed to results that were misleading where the estimated costs and resource use were inaccurate. Methodological inconsistencies notwithstanding, inherent variation between settings, populations and health systems limited the generalisability of most study results even when study design was robust.

Identified themes

The following section summarises and critically synthesises the main results of the studies included in Appendix 2.2 (Tables 2.2.1 and Tables 2.2.2). Results have been grouped according to identified themes (see Table 2.3).

Eight major themes were identified:

1. comparisons of midwife-led versus obstetric consultant-led units for cost and clinical effectiveness

2. economic effects of different modes of birth (e.g. surgical birth via caesarean section, vaginal birth assisted with instruments, and unassisted vaginal birth)

3. economic implications of place of birth, for example, birth centres and home birth

4. costs of caseload midwifery (also called ‘Midwifery Group Practice’) and/or Team Midwifery compared to Standard Care services (various services that included standard hospital care and medical models)

5. cost-effectiveness of midwifery models for Aboriginal women (Australia)

6. patterns of antenatal care for low-risk women and comparative provider costs (i.e. medical consultant or GP, or midwife)

7. cost of postnatal care midwifery models (home or hospital)

8. between-country and within-country cost-modelling comparisons for mode of birth, cascade of birth interventions, and group prenatal care.

Each of the eight major themes identified in Table 2.3 were considered in the review that follows, including the limitations of methods used in the studies.

Table 2-3 Themes identified from articles included in the Literature Review

Themes identified from the literature	Articles that included costing analysis thematically grouped
Comparisons of midwife-led versus obstetric consultant-led units for cost and clinical effectiveness	Begley et al. 2011; Bernitz, Aas & Oian 2012; Devane et al. 2010 ; Hundley et al. 1995; Ryan et al. 2013 (included: Begley et al. 2009; Hundley et al. 1995; Young et al. 1997); Schroeder et al. 2012; Young, Lees & Twaddle 1997
Comparison of different modes of birth (caesarean vs vaginal): economic impact	Henderson et al. 2001; Petrou, Henderson & Glazener 2001; Tracy & Tracy 2003
Comparison between place of birth: economic implications	Anderson & Anderson 1999; Bernitz, Aas & Oian 2012; Byrne, Crowther & Moss 2000; Henderson 2005; Henderson & Mugford 1997; Henderson & Petrou 2008 (included: Anderson et al. 1999; Byrne et al. 2000; Henderson et al. 1997; Hundley et al. 1995; Lubic, 1983; Ratcliffe, 2003; Reinharz et al. 2000; Stone & Walker, 1995; Stone et al. 2000; Walker & Stone, 1996; Young et al. 1997); Hendrix et al. 2009a; Hundley et al. 1995; Ratcliffe 2003; Reinharz et al. 2000; Schroeder et al. 2012; Stewart et al. 2005 (included: the 11 studies in Henderson & Petrou 2008 + Henderson et al. 2000; Homer et al. 2001; Morrell et al. 2000; Petrou et al. 2004; Ratcliffe et al. 1996; Rowley et al. 1995; Tracy & Tracy 2003; Villar et al. 2001); Stone et al. 2000; Stone & Walker 1995; Toohill et al. 2011; Walker & Stone 1996; Young, Lees & Twaddle 1997
Comparisons of low and mixed risk Caseload (Midwifery Group Practice) and Team Midwifery versus Other Model (Standard Care, Medical): cost implications	Begley et al. 2011; Homer et al. 2001; Hundley et al. 1995; Kenny et al. 1994; O'Brien et al. 2010; Rowley et al. 1995; Ryan et al. 2013; Sandall et al. 2015 (cost studies included: Homer et al. 2001; Kenny et al. 1994; Rowley et al. 1995; Tracy et al. 2013; Young et al. 1997); Stewart et al. 2005; Sutcliffe et al. 2012 (included: Brown & Grimes 1995; Hatem et al. 2008; Villar et al 2001); Toohill et al. 2011; Tracy et al. 2014; Tracy & Tracy 2003; Young, Lees & Twaddle 1997
Cost-effectiveness of midwifery models for Aboriginal women	Gao et al. 2014; Jan et al. 2004
Patterns of antenatal care services and provider costs	Bernitz, Aas & Oian 2012; Henderson et al. 2000; Homer et al. 2001; Ratcliffe, Ryan & Tucker 1996; Toohill et al. 2011; Villar, Ba'aqeel & Piaggio 2001; Villar et al. 2007 (updated review included: Binstock & Wolde-Tsadik 1995; Giles et al. 1992; Majoko et al. 1997; McDuffie et al. 1997; Munjanja, Lindmark & Nystrom 1996; Turnbull et al. 1996; Walker & Koniak-Griffin 1997); Young, Lees & Twaddle 1997
Costs of postnatal care services and models	Morrell et al. 2000; Petrou et al. 2004; Petrou et al. 2002; Petrou & Glazener 2002; Homer et al. 2001; Kenny et al. 1994; Rowley et al. 1995; Tracy et al. 2013; Young et al. 1997
Between-country and within-country cost modelling	Bellanger & Or 2008; Gibbons et al. 2010; Mooney et al. 2008; Tracy & Tracy 2003; Tracy et al. 2014

Theme One Comparisons of midwife-led vs obstetric consultant-led units: cost and clinical effectiveness

Seven studies discussed data relevant to this theme. This included two of the systematic reviews from the United Kingdom where midwifery-led and obstetric consultant-led maternity models were common (Devane et al. 2010; Ryan et al. 2013), and five primary studies (Begley et al. 2011; Bernitz, Aas & Oian 2012; Hundley et al. 1995; Schroeder et al. 2012; Young, Lees & Twaddle 1997). In the two systematic reviews costs were calculated using robust economic evaluation measures of Incremental Net Benefit (INB), Net Monetary benefit (NMB), Net Health Benefit (NHB), and Quality Adjusted Life Years (QALYs) (Drummond et al. 2005; Eckermann 2007). While cost models were based on trials that recruited women with low pregnancy risk, subgroup analysis included women from trials of mixed pregnancy risk classification. This included three of the primary studies (Begley et al. 2011; Hundley et al. 1995; Young, Lees & Twaddle 1997).

An estimated mean cost saving for each eligible woman of £12.38 was found in the midwifery-led model. This gave an aggregate health saving of £1.16 million per year for the health system if only half of all eligible women undertook midwifery-led care (Ryan et al. 2013, p. 368). However, Ryan and colleagues (2013) noted that the results were highly sensitive to assumptions, particularly changes in the rate of fetal loss and neonatal death, as well as the midwife’s caseload. The caseload needed to be sufficiently large to attain operational efficiencies, otherwise the cost per maternity increased. The conclusion was that the evidence base for cost-effectiveness of midwifery-led services was therefore limited (Devane et al. 2010, pp. 5–7).

In contrast, the economic evaluation included as part of the *Birthplace in England* national prospective cohort study (n = 64,548) used cost-effectiveness acceptability curves (Willan & Briggs 2006, p. 51) to calculate a range of total unadjusted mean cost savings in women who received midwifery care or obstetric care across 233 units and trusts that were stratified by size and geography (Schroeder et al. 2012). Generalised linear regression adjusted for sociodemographic factors determined costs per woman as: Home (£1,066) vs Free Standing Midwifery Unit (£1,435) vs Alongside Midwifery Unit (£1,461) vs Obstetric Unit (£1,631) (Schroeder et al. 2012, p. 1). While nationally agreed design and reporting guidelines were used (Appendix 2.2, Table 2.2.2), these results remain confined to women with low-risk pregnancies (Birthplace in England Collaborative Group 2011). The remaining study from Norway had cost findings similar to Schroeder et al. (2012). However, these were confined to low-risk women and were not dominant across all outcomes, for example, mode of birth and complications requiring treatment in an operating theatre (Bernitz, Aas & Oian 2012).

Theme Two Comparison of different modes of birth (caesarean vs vaginal): Economic impact

The economic costs of mode of birth (i.e. caesarean section and vaginal delivery comparison) were calculated using combined primary and secondary data (direct and indirect costs) from results of randomised controlled trials, large observational studies, and survey data collected in industrialised countries (Petrou, Henderson & Glazener 2001). These analyses used data from all-risk pregnancies to show that birth by caesarean surgery costs substantially more than vaginal birth (Henderson et al. 2001). Based on the 42 included studies, the cost for an uncomplicated vaginal birth was calculated at a range of £629–£1,298 versus caesarean delivery cost range of £1,238–£3,551 (1998–1999 prices) (Henderson et al. 2001). International cost ratios for mode of birth have subsequently been validated in Scotland, England, and Australia as equivalent to: vaginal birth = 1; instrumental birth = 1.3; caesarean = 2.5 (Tracy & Tracy 2003). However, few of the studies that were included in the structured review conducted by Henderson et al. (2001)

report costs for consumables or equipment, nor did they differentiate between costs of elective and emergency caesarean surgery. Moreover, only short-term health costs were considered; long-term costs associated with adverse maternal and neonatal outcomes were not calculated.

Theme Three Comparison between place of birth: economic implications

Studies from Norway, Australia, United Kingdom, Canada, and the United States demonstrated the cost-effectiveness of birth centres when compared to hospital births (Bernitz, Aas & Oian 2012; Byrne, Crowther & Moss 2000; Ratcliffe 2003; Reinharz et al. 2000; Stone et al. 2000; Toohill et al. 2011). Findings in each of these studies included safe outcomes for women and newborns, more efficient use of resources (including reduced hospital stay), and higher levels of satisfaction with care received by women in birth centres. In the United States, United Kingdom and The Netherlands, outcomes for low-risk women who birthed at home with midwives have also demonstrated reduced costs of care compared to hospital birth (Anderson & Anderson 1999; Henderson & Mugford 1997; Hendrix et al. 2009a; Schroeder et al. 2012). However, results from all studies in this section were focused on women with low-risk pregnancy classification. Birth for most women with identified pregnancy risk factors occurs in a hospital environment.

The lack of rigorous economic evaluation of different models of maternity care for women at high risk of complications has been emphasised in two integrated reviews (Henderson 2005, p. 76; Henderson & Petrou 2008). Henderson and Petrou (2008) critically examined the literature and cost data in relation to care provided in birth centres and at home with midwives (Anderson & Anderson 1999; Byrne, Crowther & Moss 2000; Hundley et al.

1995; Ratcliffe 2003; Reinharz et al. 2000; Stone & Walker 1995; Walker & Stone 1996; Young, Lees & Twaddle 1997). The review noted that the studies were of mixed quality and selection bias was identified as a significant issue in many studies. There also was an absence of data on the effects of new care models and short-term perspectives were often adopted. Different studies included different costs and consequently produced contradictory results. Variable results were attributed to differences in health systems, methods used, and the costs included (Henderson & Petrou 2008, p. 136). These findings were similar to those of Henderson (2005).

Theme Four Comparisons of low- and mixed-risk Caseload (Midwifery Group Practice) and Team Midwifery versus Other Model (Standard Care, Medical): cost implications

Over the past two decades studies in several Australian states have highlighted both the economics of current maternity service provision, and short and longer term health outcomes for women, their babies and families within different service models. Some of these studies have demonstrated cost savings associated with the implementation of public health models of midwifery care, in addition to high rates of clinical effectiveness. They have also shown decreased morbidity associated with corresponding reductions in common, costly obstetric interventions in childbirth, for example, caesarean section and induction of labour, to name but two (Homer et al. 2001; Kenny et al. 1994; McLachlan et al. 2012; Roberts, Tracy & Peat 2000; Rowley et al. 1995; Tracy et al. 2007; Tracy & Hartz 2005; Tracy et al. 2013; Tracy & Tracy 2003).

A number of economic evaluations conducted alongside randomised controlled trials in Australia have compared the costs of midwifery models with standard hospital care in the same setting. Some of these studies focused on ‘team midwifery’ (Homer et al. 2001a, 2001b; Kenny et al. 1994; Rowley et al. 1995) while others have evaluated continuity of care models; for example, Caseload Midwifery and Midwifery Group Practice (McLachlan et al. 2012; Tracy et al. 2013). In a ‘team model’ there is no primary care provider and the level of continuity is variable, as compared to Caseload and Midwifery Group Practice models where named midwives provide services for women across the full continuum of antenatal, birth and postnatal care (Sandall et al. 2015). The cost evaluations of team midwifery cited above and one cost evaluation of caseload midwifery services in Australia have included pregnant women of all-risk status (Tracy et al. 2013). Other Australian randomised controlled trial studies of caseload midwifery have been confined to women of low pregnancy risk classification (McLachlan et al. 2012).

The most recent all-risk Australian trial identified safe outcomes for mothers and babies between groups and a median cost saving of A$566 for women who received caseload midwifery as compared to standard hospital care services (Tracy et al. 2013, p. 7). This trial did not identify any significant differences between caseload midwifery and standard care for primary outcomes including use of epidural analgesia during labour, number of caesarean sections, instrumental vaginal births or unassisted vaginal births) (Tracy et al. 2013, p. 7) (Appendix 2.2, Table 2.2.2).

Similarly, an earlier rigorous cost analysis of community-based team midwifery model for all-risk women in Australia identified mean cost savings per woman of A$804 in the midwifery model (Homer et al. 2001a). After neonatal costs were excluded in this study, mean cost savings continued to favour women and babies in the midwifery model by A$139 (Homer et al. 2001a). While it was not possible to determine optimal volume based on caseload numbers, it was identified that the volume of women booked for care in the midwifery model was one of the important keys to cost-effectiveness. The reason for this relates to efficiency and savings generated by the number of women able to be allocated to a maternity model in relation to the staff ratio required to provide maternity services (Ryan et al. 2013; Sandall et al. 2008, pp. 37-8).

Earlier team midwifery RCT studies also identified safe outcomes, reduced levels of birth intervention, and modest cost savings for women of all-risk cared for in the midwifery model. One study used Australian Diagnostic Related Groups ‘top-down costing’ that showed a mean cost reduction for birth of 4.5% for women in the midwifery group, including reduced birth interventions (Rowley et al. 1995). The other study analysed discrete costs (‘bottom-up costing’) for each episode of service (i.e. antenatal, birth, and postnatal care) in the midwifery model versus standard hospital care (Kenny et al. 1994). Specific costs for high- and low-risk pregnancies across each episode in the latter study are shown in Appendix 2.2, Table 2.2.2. The study by Kenny et al. (1994) was the only Australian example that reported and separated the risk stratification profile of the women in their all-risk pregnancy sample. All the studies suggested a cost saving in intrapartum care in the midwifery model. One study suggested higher cost and one study no difference in cost of postnatal care in the midwifery model when compared with the medical-led model.

The primary outcome analysis of another recent Australian trial has demonstrated significantly reduced rates of caesarean section in women who received Caseload Midwifery Care compared to Standard Maternity Care (19.4% vs 24.9%; RR 0.78; 95%CI 0.67–0.91; $p = 0.001$) in addition to reduced rates of other birth interventions (McLachlan et al. 2012, p. 5). However, the study only included a low-risk sample and results for the secondary analysis economic evaluation have not yet been published.

A variety of methods (cross-sectional, matched control, prospective non-randomised) have been used in other studies conducted in Australia and internationally to compare outcomes and costs for women receiving midwifery continuity of care (O'Brien et al. 2010; Toohill et al. 2011; Tracy et al. 2014). With the exception of evaluations that have considered midwifery models for Aboriginal women (considered separately below), these studies have all focused on women with low-risk pregnancy classification. Some of the studies showed reduced rates of birth intervention (Toohill et al. 2011; Tracy et al. 2014). While all studies showed cost savings per woman in the midwifery caseload models when compared with standard hospital care (hospital saving: A$825 $p < 0.001$; government saving: A$919 $p < 0.001$ [Toohill et al. 2011]; total saving: CAD$1,172 [O'Brien et al. 2010]; public patient saving A$1,590; private patient saving A$1,375 [Tracy et al. 2014]), these results reflect measurement of different resources and remain limited to women with low-risk pregnancy classification.

Theme Five Cost-effectiveness of midwifery models for Aboriginal women

Two studies only were identified that specifically measured the cost-effectiveness of midwifery services in identified Australian populations with higher pregnancy risk status (Gao et al. 2014; Jan et al. 2004). Gao et al. (2014) comprised a retrospective record audit that used a baseline cohort measured against a prospective cohort of pregnant Aboriginal women (all-risk status) to identify cost changes from the first antenatal visit through to six weeks postpartum after introduction of a Midwifery Group Practice. While there was a trend for cost savings of A$703 for women at 6 weeks, these were not significantly different from baseline costs. Limitations of the study included the small sample size, cost assumptions (hostel and transport were not included), and missing data (51% of all cases). While no significant difference in major birth outcomes was identified, antenatal attendance and hospital admissions increased and average length of special care nursery stay for the babies of the women decreased.

An earlier cost analysis of a metropolitan, Aboriginal-controlled, community midwifery service (all-risk) estimated direct program costs and downstream savings in the health sector of A$1,200 per woman using combined qualitative and quantitative methods (Jan et al. 2004). Downstream savings referred to the longer term cost benefits that were gained, for example, reduction in resource use experienced by associated services. The study used Australian National Diagnostic Related Group cost weights (Commonwealth Department of Health and Ageing 2010) and cost data from Medicare and the Pharmaceutical Benefits Schedule (Australian Government Department of Human Services 2014) and sensitivity analysis to model uncertainty. The costs included were broader than those used in conventional economic analysis. Among these additional cost considerations were clinical outcomes for birth, antenatal attendance in a subsequent pregnancy, and subtraction of cost savings to other centres. There were no statistically significant differences in birth weights or perinatal survival between those who received midwifery services and those who received hospital services. While recent clinical evaluation of midwifery models of care for Aboriginal women have demonstrated significant improvement in infant birthweight and perinatal survival, specific cost analysis of the benefits were not undertaken as part of the study (Bertilone & McEvoy2015).

Theme Six Patterns of antenatal care services and provider costs

International randomised controlled trials have demonstrated similar clinical effectiveness for antenatal care among providers (midwife, general practitioner, obstetrician) for primary outcome measures of low birthweight, pre-eclampsia/eclampsia, severe postpartum anaemia, and treated urinary tract infection (Villar, Ba'aqeel & Piaggio 2001). The updated Cochrane review (Villar et al. 2007) included 10 randomised controlled trials (n > 60, 000); seven trials evaluated the number of antenatal clinic visits (Binstock & Wolde-Tsadik 1995; Giles et al. 1992; Majoko et al. 1997; McDuffie et al. 1997; Munjanja, Lindmark & Nystrom 1996; Turnbull et al. 1996; Walker & Koniak-Griffin 1997) and three evaluated the type and cost of care provider by including a secondary economic analyses (Henderson et al. 2000; Ratcliffe, Ryan & Tucker 1996; Villar, Ba'aqeel & Piaggio 2001). Antenatal care provided by midwives and general practitioners have shown significantly reduced cost in some studies and greater satisfaction of women (Ratcliffe, Ryan & Tucker 1996; Villar, Ba'aqeel & Piaggio 2001).

Other studies have also found that women receiving midwifery-led care, including Caseload and Midwifery Group Practice care required fewer antenatal visits, thus resulting in significant cost savings for services in the short term (Bernitz, Aas & Oian 2012; Homer et al. 2001; Toohill et al. 2011; Villar et al. 2007; Young, Lees & Twaddle 1997). However, this may not be the case where pregnant women have increased medical and/or psychosocial risk factors, or are from groups with poorer morbidity and mortality outcomes in pregnancy and childbearing (e.g. Aboriginal and Torres

Strait Island) (Gao et al. 2014). Consideration of ‘downstream’ savings, including measures and methods that are broader than those used in conventional economic analysis, for example long term modelling of disutility costs associated with the onset of chronic disease states (Drummond et al. 2005), have been demonstrated to be important in estimating both program and health sector costs accurately, particularly where access and significant health inequities have been identified (Jan et al. 2004). The limitations of current studies in measuring these effects may be better assessed by use of alternate methods in health economics, for example ‘discrete choice experiment’ which has been proposed as a more reliable method for eliciting women’s preferences for aspects of maternity care (Petrou & McIntosh 2011). Discrete choice experiment assesses and measures the costs associated with different consumer preferences for health care by asking the service users, in this case, pregnant women.

Theme Seven Costs of postnatal care services and models

Economic evaluation of the comparative cost of midwife-based postnatal models were the focus of four primary source articles that reported research conducted in Switzerland and the United Kingdom. Three of the studies were randomised controlled trials with economic evaluations (Morrell et al. 2000; Petrou et al. 2004; Petrou et al. 2002). The fourth was an observational cohort study (n = 1242) conducted in Scotland (Petrou & Glazener 2002).

The Swiss study (n = 459) compared the cost-effectiveness of early postnatal discharge with traditional postnatal hospital stay in the month after birth. Results showed the policy of early postnatal discharge combined with home midwife support had weak economic dominance over traditional institutional care (bootstrap mean difference CHF1524 [95%CI 675–2403]), with no compromise to clinical or psychosocial outcomes (Petrou et al. 2004).

One of the studies conducted in the United Kingdom (n = 623) measured the cost-effectiveness of an intervention (postnatal support workers in the community who provided an additional 10 home visits in the month after birth) in addition to usual care provided by community midwives (Morrell et al. 2000). There was no significant improvement in health status (as measured by rates of breastfeeding and postnatal depression); however, at both six-week and six-month follow-up, mean total National Health Service costs were significantly higher in the intervention group versus the control group (£635 vs £456, p = 0.001; £815 vs £639, p = 0.001).

A second UK study used combined pooled data from a high-risk sample of women (n = 206) enrolled in a randomised controlled trial for a preventive intervention for postnatal depression (Petrou et al. 2002). The study, which screened 1242 women with a validated, predictive index, estimated the economic costs of postnatal depression by calculating net costs per mother/infant dyad over the first 18 months postpartum. The mean costs for women who had postnatal depression were estimated at £2,419 vs £2,026, p = 0.17 for those who did not. Mean cost differences reached statistical significance (p = 0.01) for women with and without postnatal depression who received the community services intervention, with costs being higher for women who had an extended experience of postnatal depression.

The final study in this group evaluated the economic costs of alternative routes of birth (vaginal, instrumental, and caesarean) in the first two months postpartum (Petrou & Glazener 2002). While statistically significant differences for the three birth routes were identified in hospitalisation costs, readmission costs, community midwifery costs and general practitioner costs, total post-discharge health costs did not vary significantly in the short term (Petrou & Glazener 2002).

Theme Eight Between-country and within-country cost modelling

The final group of studies included in the review were those that used economic cost-modelling approaches to evaluate aspects of comparative cost in different maternity services and systems that included midwifery services. Five studies addressed this theme: two studies compared costs between countries (Bellanger & Or 2008; Gibbons et al. 2010) and three studies modelled costs within one country (Mooney et al. 2008; Tracy & Tracy 2003; Tracy et al. 2014).

Between-country cost modelling

Two studies included between-country comparative cost models for route of birth. One study compared costs and prices for non-assisted vaginal birth across nine European countries (Bellanger & Or 2008). The purpose was to identify the main factors for cost variation across providers within and among countries. The second study estimated the resource use and global cost implications of ‘needed’ and ‘excess’ caesarean sections required in countries with lower than recommended national rates and those performed in countries where the procedure may be being overused (Gibbons et al. 2010).

Bellanger and Or (2008) used a ‘standardised patient’ and a sample of 47 hospitals across nine European countries to calculate the average total cost for unassisted vaginal birth at €1,260 (all countries). National currencies were converted into euros using the 2005 exchange rate. The method was a multilevel modelling approach based on two main cost components, personnel and overheads. Significant cost differences within and among countries was identified (Range: €342 Hungary to €2,365 Germany). At the country level differences in cost were the result of prices not resource use, whereas at the hospital unit level cost was the result of average length of bed stay (Range: 0.84 days in Netherlands to 4.9 days in France) and medical and nurse pay levels. A 10% increase in length of stay resulted in 6% increase in unit costs. In countries that employed more midwives and nurses in lieu of obstetricians, costs were lower (Bellanger & Or 2008, p. S55).

Gibbons et al. (2010) also used a standardised ingredient/resource approach to calculate the direct costs associated with performance of caesarean surgery. Internationally recommended upper (15%) and lower (10%) rates for caesarean section were applied across 137 countries (estimated 95% of global births) to calculate the costs and barriers to universal coverage. Fourteen countries only were within the recommended caesarean rate of 10–15%. Sixty-nine countries had a caesarean rate above 15% and 54 countries had a rate less than 10%. The cost of global ‘needed’ caesarean was calculated at US$34 million and the cost of global ‘excess’ caesarean was calculated at US$2.32 billion. The conclusion was that countries that had levels of excess caesarean surgery could finance countries that needed caesarean surgery five times over (Gibbons et al. 2010). The validity of the analysis was dependent both on the accuracy of data collection and reliability that 15% and 10% constitute the correct upper and lower thresholds for caesarean surgery.

Within-country cost modelling

Cost results modelled on outcomes for the 'standard, low-risk primipara' in different maternity services was considered under caseload midwifery versus other models (Tracy et al. 2014). An earlier Australian study used population data (n = 171,157) from one state to estimate and model the costs of increased obstetric intervention in childbirth for three types of care for women screened as 'low risk'. These included: private obstetric care in a private hospital, private obstetric care in a public hospital, and routine public hospital care (Tracy & Tracy 2003). Cost models were constructed for primiparous and multiparous women that applied four groups of birth interventions (no intervention; induction of labour or augmentation; epidural; epidural and induction or augmentation).

Results showed that costs of birth increased by up to 50% for primiparous women and up to 36% for multiparous women as interventions accumulated (i.e. 'the cascade of intervention') in the three models of care. Private obstetric care was associated with the highest incremental costs (9% increase for primiparous women and 4% increase for multiparous women) and routine public hospital care (where the majority of birth care for low-risk women is provided by midwives) was associated with the lowest incremental costs (Tracy & Tracy 2003).

Mooney et al. (2008) also constructed a within-country cost analysis model for a small, rural, community access hospital in New Hampshire, United States. The model compared the economic performance of group prenatal care with one-to-one prenatal care for pregnant women by certified nurse-midwives and physician providers. Volume, cost and revenue estimates were tested based on differing group sizes in the models. These were plotted across productivity/efficiency frontiers for time and provider cost for prenatal care. Replacing physician attendance at birth with midwife attendance at birth was also modelled. Results of the models were found to be highly sensitive to both the volume of births in addition to the prenatal group size that was required to exceed the time efficiency. A breakeven point of minimum births per year (315) with all women receiving group prenatal care was identified in order to shift services to the lower cost nurse-midwives and the results were not able to be generalised to other sites (Mooney et al. 2008).

Discussion of issues identified from the review

It has become increasingly necessary for health systems to justify that the services they provide deliver quality outcomes as well as value for money (Smith 2009); this includes quality maternity care (Caird et al. 2010; Carter et al. 2010; Pittrof, Campbell & Filippi 2002). While the measurement and methodology of value for money is a contested field, initiatives to establish a firm evidence base for decision-making regarding the comparative cost-effectiveness of service delivery in health and across the continuum of maternity services is a current reality in both high- and low- resource settings (Homer et al. 2014; Ovretveit 2009; Renfrew et al. 2014).

Recent cross-country comparison of the costs of childbirth have demonstrated significant variation (Bellanger & Or 2008). Paradoxically, while research has shown resource inputs and cost ratios for mode of birth to be relatively consistent among countries (Petrou, Henderson & Glazener 2001; Tracy & Tracy 2003), the factors that have been associated with inter-country cost increases relate specifically to workforce provider salary rates and provider charges in fee-based health systems (Bellanger & Or 2008). Furthermore, overuse and underuse of birth interventions, for example surgical birth, have demonstrated significant variation and remain subject to multiple influences, including health provider, health system, and funding model (Gibbons et al. 2010).

Place of birth has also been shown to have an association with higher costs (Birthplace in England Collaborative Group 2011; Schroeder et al. 2012). This is compounded in facilities and medical models of care where increased rates of surgical birth, especially caesarean section, and other routine medical practices associated with the cascade of intervention in childbirth increase morbidity for women (i.e. epidural usage, episiotomy, postpartum haemorrhage) (Sandall et al. 2015; Tracy et al. 2014). These interventions and morbidity are more frequent in women with complex pregnancies (Hilder et al. 2014).

Longer bed stays associated with the above interventions increase morbidity for both women and their infants and result in increased rates and length of hospitalisation admission and readmission, whether in the antenatal, intrapartum, or postpartum period (Hendrix et al. 2009; Mooney et al. 2008; Petrou et al. 2004; Petrou & Glazener 2002; Tracy et al. 2014; Villar et al. 2007). Moreover, other important behaviours and measures linked with longer term community health outcomes, for example initiation of early breastfeeding, maternal–infant bonding/positive adaptation to parenthood, promotion of mental health and reducing rates of posttraumatic stress disorder associated with negative birth experiences, have demonstrated short- and long- term costs for individuals, health systems, and society when compromised by over-intervention (Austin, Kildea & Sullivan 2007; Bartic & Reinhold 2010; Brew et al. 2012; Fenwick et al. 2009; House of

Representatives Standing Committee on Health and Ageing 2007; Hyde et al. 2012; Moore et al. 2012; Schlinzig et al. 2009).

Evidence for cost-effectiveness of low-risk midwifery models

In the critical evaluation of articles considered by this review it was evident that the majority of published studies have focused on women and babies considered at low risk of developing complications. Traditionally, these groups have been considered most suitable for midwifery-led care, with robust evidence from international and Australian studies demonstrating improved clinical outcomes for these childbearing women and their babies across a number of key areas, notably physiological vaginal birth (Sandall et al. 2015; Sutcliffe et al. 2012). Moreover, the research has also established that midwife-led services for women and babies at low risk of complications have demonstrated high levels of maternal satisfaction (Bartholomew et al. 2015; Coyle et al. 2001a, 2001b; Davison et al. 2015; Fereday et al. 2009; Mc Lachlan et al. 2015).

Within these models a trend to variable cost savings in health services, where volume has been sufficient to achieve efficiency and economies of scale, has also been shown (Devane et al. 2010; Ryan et al. 2013; Schroeder et al. 2012; Young, Lees & Twaddle 1997). The literature specifically demonstrates that savings accrue where caseloads are maintained at an upper threshold of 40 women per midwife per annum (Ryan et al. 2013). High-volume institutional settings optimise savings in these models when antenatal hospitalisation rates are kept low, when the vaginal birth rate is maximised, and when women and infants undertake early discharge (precluding occupancy of high cost hospital bedspace), and receive postnatal follow-up at home or in the community (McIntyre, Chapman

& Francis 2011; McLachlan et al. 2012; O'Brien et al. 2010; Ryan et al. 2013; Tracy et al. 2013).

Conclusions drawn from the literature review

Critical evaluation of the literature in this review identified significant limitations associated with the evidence and methods used by previous studies to evaluate cost and resource use in maternity models. In contrast with women who experienced low-risk pregnancy, until recently there has been limited Australian and international research that has directly addressed the relationships between clinical outcomes, resource use and cost-effectiveness in maternity models that provide care for women with identified complexities of pregnancy and childbearing. This deficit has included a lack of evaluation of midwifery-led continuity models compared with other services (Sandall et al. 2015).

Only 11 of the 35 primary source articles in this review included women with pregnancy classification of 'all-risk' or 'mixed-risk' status in their samples. Moreover, substantive gaps in the methods and evidence that examined comparative differences between cost-effectiveness and clinical outcomes in different services for these groups was identified across the childbearing continuum.

Specific challenges that were identified in the literature included a focus on separate costing of 'episodes of care' (antenatal, birth, and postpartum episodes) rather than comprehensive costing of services across the full care continuum. More importantly, this deficit included a lack of consideration of the links and longer term costs associated with increased morbidity and chronic illness where a healthy start to life is not optimised for mother and baby. These issues require detailed research as the health burden, systems cost, and resource use in different groups of women is significant (Bar-Zeev et al. 2013; Bar-Zeev et al. 2014; Department of Health and Ageing 2012; Jongen et al. 2014; Pilcher, Kruske & Barclay 2014; Sayers & Boyle 2010). Long-term chronic illness is expensive both in health terms and in the societal resources required for treatment and support of chronic ill health across the life course (Commonwealth of Australia 2014; Lynch 2011).

Other limitations identified in many Australian and international studies included selective risk sampling; varying quality in study design; different variables selected for measurement; absence of methods that adjusted for confounders; lack of specific risk stratification in reporting results; and a focus on varying episodes of the childbearing continuum. Additionally, limitations related to use of variable costing methodologies (e.g. direct vs indirect costs) and study assumptions; incomplete and missing data replaced with estimated cost and resource data; and significant variation among populations, setting and health systems thereby limiting comparability and generalisability of studies (Appendix 2.2). A significant oversight, particularly in the Australian context, was the failure to address the effect of mixed state/federal funding mechanisms across different episodes of the childbearing continuum. This includes the effect this had on access to services and inequitable health outcomes for different population groups.

Summary

Chapter 2 has critically reviewed and evaluated the literature on the evidence and methods for the cost-effectiveness and clinical effectiveness of midwifery models. The analyses included critical examination of the relationships between clinical care outcomes, cost and resource use when compared with other models of maternity care. Rigorous analytical methods were used that included use of the Evidence Hierarchy and accepted assessment tools (Garrard 2007; Moher et al. 2009; National Health and Medical Research Council 2008).

The literature review established there have been limited studies that have addressed rigorous economic evaluation of models of care for women and their babies who experienced complexity and high risk of pregnancy complications (Henderson 2005; Henderson & Petrou 2008). While robust systematic review has demonstrated strong evidence of clinical effectiveness in midwifery models for women with low-risk pregnancy, the evidence was less clear in relation to women who experienced pregnancies with increased risk. Caution has been advised in applying the results of trials of women at mixed risk to women with significant medical or obstetric complications (Sandall et al. 2015). Moreover, while a limited number of studies that have included pregnant women of mixed-risk status indicated cost savings in the midwifery model, the absence of specific risk stratification reporting and the limitations associated with problems of confounding limit the application of these results to high-risk groups and their generalisability to all populations and settings in Australia (Homer et al. 2001; Kenny et al. 1994; Rowley et al. 1995; Tracy et al. 2013).

In addition to the limitations of prior studies and the application of their results to women with complex pregnancies, no Australian studies have used methods that analysed the combined effect of state and federal funding mechanisms between models of maternity care across the childbearing continuum. This provided a strong justification for the current study, which aimed to determine comparative clinical outcomes, resource use, and cost benefits in different public sector maternity service models for women with moderate complex pregnancies in South Australia. The following chapter describes the research approach taken in meeting the aims of this study.

CHAPTER 3 METHODS QUANTITATIVE DATABASE ANALYSES – CLINICAL OUTCOMES, RESOURCE USE AND COST IN MGP AND SHC FOR WOMEN WITH COMPLEX PREGNANCY: RETROSPECTIVE STUDY ARM 2004–2010 AND PROSPECTIVE STUDY ARM 2010–2012

Introduction

This chapter describes the methods that were applied in this study to undertake an evaluation of maternity services in the public sector in South Australia using net benefit principles. This was a quantitative non-experimental database analysis of database outcomes between two service models for women with complex pregnancies at one metropolitan tertiary hospital site. The purpose of the database analysis, the research questions, and the characteristics of non-experimental research and net benefit principles are discussed. This is followed by a summary of the research design and methods used in each arm of the study, (retrospective study arm 2004–2010 and prospective study arm 2010–2012), and includes a justification for the database analysis. A description of the study setting, the maternity models that were compared, the risk classification profile of the women, and the ethical approvals obtained, are provided. A detailed explanation of the methods used for each arm of the study then follows. The chapter concludes with a description of the evaluation framework that was used to interpret the results of this study, the Donabedian SPO Model (structure, process, outcome), and seven pillars of quality healthcare (Donabedian 1966, 1990, 2003, 2005).

It has been strongly suggested that quality measurement is a key driver in transforming the health care system and that clinicians at the front line need to be actively engaged with improving quality at multiple levels (Government of South Australia 2015; Kilbourne, Keyser & Pincus 2010). Quality measures are essential to ensure uptake and delivery of evidence – based maternity care. Quality cannot be improved without monitoring how maternity care is delivered. This includes its organisation, processes, and outcomes for women and babies (Menke et al. 2014). Monitoring and selecting a robust approach to assessing system performance in comparative maternity services, as described in the National Maternity Services Plan (Commonwealth of Australia 2011), therefore was important. Rationale for choice of the Donabedian Model was that it is a validated quality assurance approach that has been widely and successfully applied in health services research across a range of areas and disciplines (Glickman et al. 2007).

In developing a model Donabedian described the predominant methods and approaches that had been used to evaluate quality in health care (Donabedian 1966, 2005). Of many issues identified, the lack of a comprehensive and integrated consideration of the system as a whole was significant. This included the absence of a range of diverse quality measures and their dynamic, interactive effect on individual and population health outcomes. While each type of quality measure has its strengths and limitations the Donabedian Model is internationally recognised as a robust and comprehensive framework for evaluating specific core components of the health system (Donabedian 1982, 1983, 1985; Glickman et al. 2007). These include structure, process, and outcomes. Specific features and characteristics of the framework, including how they were applied to the comparative models of maternity care in this study is described further in the chapter. The strength of the framework is that when all components (i.e.

Structure, Process, Outcomes) are considered as part of an integrated model they provide an effective tool and a focused lens that informs synthesis of data interpretation in comparative health service models. In contrast, the weaknesses of the framework if these components are considered separately, or their influence and effect on each other is inadequately measured, is that comprehensive assessment of quality of health care, including short and long term public health impact and the capacity for responsive systems change will be limited.

Purpose of the Quantitative Database Analysis

The study used a quantitative non-experimental database analysis that compared outcomes between two public health maternity models Midwifery Group Practice (MGP) and Standard Hospital Care (SHC), for women with pregnancies classified at ‘moderate obstetric risk’ (see Appendix 3.1a for a summary of the pregnancy risk classification criteria that was used at the hospital during the period covered by this study and Appendix 3.1b for detail of the model of MGP). The purpose of the two-armed database analysis was to compare clinical outcomes, resource use, cost, and equitable access between two public health maternity models in South Australia using state data (retrospective arm 2004–2010), and federal data (prospective arm 2010–2012), to answer the research question:

> *How effective on productivity/efficiency measures across a defined time horizon was Midwifery Group Practice compared to Standard Hospital Care in achieving net benefit for quality, measured by clinical effectiveness, resource use, cost and equity in a group of women with pregnancies classified as ‘moderate obstetric risk’ and their babies?*

The research questions in each arm of the study were:

- Was there a difference in net benefit outcomes for women with pregnancies classified as moderate obstetric risk and their babies in MGP compared to SHC across a seven-year timeframe (2004–2010) for clinical, resource and cost variables? ***(Retrospective Arm 2004–2010)***
- Was there a difference in cost and resource consumption for women with pregnancies classified as moderate obstetric risk in the MGP compared to the SHC after discharge from hospital for Commonwealth Medicare benefit items and pharmaceutical benefit items in the four-month period following birth? ***(Prospective Arm 2010–2012)***

The objective of the database analysis was to provide information that would inform decisions to maximise allocative efficiency in the use of scarce health resources. Allocative efficiency is concerned with ensuring the best allocation of resources in the health system, to yield the best possible outcomes from those resources (Duckett & Wilcox, p.304) (see Appendix 3.2 for a full definition of efficiency and how it was applied in this study, including the distinction between allocative and technical efficiency). Database analysis that seeks to provide information that will maximise allocative efficiency is a purpose that is supported by the dual principles of net benefit and priority setting (Drummond et al. 2005; Eckermann 2009a, 2009b; Folland, Goodman & Stano 2007). Net benefit principles support quantifiable measurement of efficiency, not only through analysis of cost and resource use, but also through analysis of additional quality attributes and benefits that are important in health care, including clinical outcomes (Eckermann & Coelli 2008, 2013; Standards Australia 2016).

Net benefit

A broad definition of net benefit includes taking into account the costs and benefits related to criteria such as public health and safety, social and community impact, and economic impact, in a way that demonstrates positive net benefit to the community. Principles of net benefit entail providing a quantifiable value or benefit that exceeds the costs that are likely to be imposed on an individual or an organisation (Standards Australia 2016). These principles are especially relevant in public health in relation to decision making about resource allocation (Drummond et al. 2005; Eckermann 2009a, 2009b). This includes the equitable distribution of public goods and services (Baumgartner & Quaas 2010; McAuley & Lyons 2015; Schram & Caterino 2006). More complex definition of net benefit has been used in the area of health economics. This includes the application of a range of statistical methods and models used in specialised health economic evaluations that measure the comparative performance, efficiency, cost and outcomes (i.e. quality attributes) of different medical treatments and service models, health technologies, and providers, such as hospitals (Eckermann & Coelli 2008, 2013). While specialised net benefit economic evaluation methods lie beyond the scope of this study, the broader principles of net benefit are used to inform and guide the design of the study. This includes selection of the range of variables, data sources and statistical models applied in the database analysis of MGP and SHC maternity models.

Net benefit principles applied in the database analyses of maternity services enables measurement of comparative efficiency and cost in two maternity models for women with complex pregnancies in relation to their clinical outcomes. This is important because while economic efficiency measures and their use in benchmarking and funding mechanisms are essential in the allocation of public health resources, ensuring quality of health outcomes and being able to quantify these is an equally important objective for decision-makers (Eckermann & Coelli 2013, p. 160). Analysis that encompasses Net benefit principles interpret quantifiable efficiency to include consideration and measurement of cost and resource use, as well as consideration and measurement of other quality attributes, for example, clinical effectiveness, efficacy, equity, optimality, legitimacy, and public acceptability. Many of these principles, which include the optimisation of quality health care, are shared with the health evaluation framework used to interpret the data in this study (Donabedian 1990, p. 1115). The evaluation framework is described fully later in this chapter.

Inclusion of net benefit principles and analysis of a range of variables that reflect quality outcomes in maternity models provides a clearer, more comprehensive picture of factors that influence quality, costs and outcomes in hospital based maternity services (Eckermann 2009a). This enables informed decision making in relation to efficient public expenditure principles, including equity considerations for groups whose health outcomes are poorer (Folland, Goodman & Stano 2007). The quality attributes applied in this study are defined in accordance with the supporting literature (see Appendix 3.2 for definitions of quality attributes from the literature, including clinical effectiveness, cost, quality, productivity, efficiency, and equity). The methods described in the current chapter specifically aimed for transparent comparison of outcomes and funding implications for state and federal government in public, hospital based maternity models.

Characteristics of Non-Experimental Research

This study used a non-experimental research design to compare two maternity models. In non-experimental studies the researcher does not have the capacity to manipulate the independent variable (i.e. the model of maternity service received, MGP or SHC); control the intervention; or randomise participants to groups (Jadad & Enkin 2007). In contrast, experimental designs do possess all these characteristics and they are considered the most robust attributes for testing cause-and-effect relationships and for maintaining full experimental rigour (Webb & Bain 2011). While non-experimental descriptive database analysis does not establish causation, this type of study design does enable rich description of associations and relationships between independent and dependent variables of interest (in this study: cost, quality, efficiency/productivity, clinical effectiveness, equity). The research design therefore was appropriate because applying the features of experimental design was not possible (Shields & Watson 2013).

When quantitative method and statistical tools in health economics are used to draw inferences, Folland and colleagues have asserted the following principles,

> No matter how sophisticated the method used, good statistical analysis depends on the ability to address the following four criteria and stands (or falls) on the success in fulfilling them: state the research question clearly; choose a sample suitable to the task of testing; calculate the appropriate measures of central tendency and dispersion: the mean and the standard

> error of the mean for both groups, and draw the appropriate inferences. (Folland, Goodman & Stano 2007 p. 56)

In economic evaluation, cost-effectiveness studies have usually been linked with randomised controlled trials investigating clinical effectiveness (Drummond et al. 2005; McLachlan et al. 2008; Tracy et al. 2011). However, as established in Chapters 1 and 2 of this thesis, extensive international randomised controlled trial evidence already exists to support clinical effectiveness in relation to midwifery continuity programs for women considered of low obstetric risk (Sandall et al. 2015).

Robust evidence of the clinical and cost–benefit for women experiencing complex pregnancy, however, has been more limited, including access and outcomes for different groups of women. Randomised Controlled Trials are the gold standard in quantitative clinical studies however women have demonstrated unwillingness to participate in randomisation studies where they have a clear preference for a particular model of care (Hendrix et al. 2009; Jadad & Enkin 2007). A study using database analysis to determine comparative aspects of cost, efficiency, clinical effectiveness and equity of access to different maternity models therefore was an alternative option.

Summary of Study Design and Methods

A two-arm non-experimental research design that used both retrospective and prospective data linkage was selected on the basis that it would strengthen the rigour of descriptive comparative findings on quality, as related to productivity, efficiency and economic aspects of the study (Eckermann 2009a) (see Appendix 3.2 for definitions of the quality attributes). This included increased data options for analyses of potential confounders where lack of randomisation may have contributed to selection bias in the populations of the different service models (Miettinen 1985). It was also based on the assumption that past resource use provided reliable guidance for future resource use (Duckett & Willcox 2011).

The database analysis measured and described outcomes and services provided during the antenatal, birthing and postnatal periods for women with moderate-risk pregnancy classification in two maternity models, MGP and SHC, at the same hospital. Measurement of both state and federal costs and funding was undertaken. The time frame for the data collected included the calendar years 2004–2010 (retrospective arm), and 2010–2012 (prospective arm). In the retrospective arm cost data was only able to be supplied in fiscal years (i.e. 2003/04 – 2010/11), and results from the data analysis in this arm clearly indicate this (see Chapter 4). Clinical effectiveness, resource use, cost, and equity were chosen as the principal quality measures and examined in a priori selected variables of interest as these were recommended by the National Hospital Cost Data Collection (Commonwealth Department of Health and Ageing 2010).

The quantitative analyses used statistical software package STATA to compare descriptive statistics for population characteristics and resource use (StataCorp 2013). Logistic regression was used for analyses of clinical outcomes (Hilbe 2009), and generalised linear models (Gaussian family) with log link function were used for econometric cost comparisons of Australian Refined Diagnosis Related Groups in the retrospective arm of the study (Hardin & Hilbe 2012; Tabachnick & Fidell 2013). In the prospective arm, STATA software was applied to analyse population characteristics, clinical outcomes and patterns of Commonwealth Medicare benefit and pharmaceutical benefit use and cost. This arm used negative binomial regression modelling to report adjusted incidence rate ratio for predictors of Medicare Benefits Schedule use (Hilbe 2011). The prospective arm also used generalised linear model with Gaussian family and log link function to analyse cost for provider charge, scheduled fee, benefit paid and patient out-of-pocket cost between the two groups of women. Descriptive statistics were used to analyse pharmaceutical benefits use. The variables included, method of measurement, and the statistical tests and models used for the analyses in each arm of the study are detailed in the sections that follow.

Justification for Database Analysis

Identifying best practice public health initiatives, preventive care strategies and clinical services aimed at optimising whole-of-population health, equitable distribution of resources and a sustainable health system is recognised as an important public good (Davies, Daellenbach & Kensington 2011; Tracy 2015, pp. 109–11). The design and database analysis methods used in this study were aligned with epidemiological principles in public health and data linkage (Hitzler & Janowicz 2013; Kelman, Bass & Holman 2002; Webb & Bain 2011). They incorporated a study of factors that significantly affect the life course health and illness trajectories of populations (Brinkman, McDermott & Lynch 2010; Lynch 2011). The net benefit approach used for the database analysis was justified as it provided a systematic framework for linking the cost and health effects of maternity services using theory and principles applied in health economics, for example, opportunity costs and Pareto principles (Drummond et al. 2005).

Opportunity costs and Pareto principles are important considerations for decision-makers when prioritising and allocating resources for health services. Opportunity costs consider the value of opportunities forgone as a result of using resources in one health service or activity, rather than another. Pareto principles, also referred to as ‘welfare economics’, consider the effects of policy change and decision-making on equity that result from a redistribution of scarce resources from one health service or activity to another (Drummond et al. 2005; Folland, Goodman & Stano 2007). The applied theory and principles of the Net benefit approach provided coherent linkage of cost, quality measures, and allocative efficiency in public sector resource use that informed both opportunity cost and Pareto principles (Drummond et al. 2005; Duckett & Willcox 2011; Eckermann 2009a, 2009b; Eckermann & Coelli 2008).

The MGP that was the subject of study in this research has been continuously oversubscribed since the implementation of the model in 2004 (Government of South Australia: Children Youth and Women's Health Service 2006). Despite firm geographic boundary limitations and two service expansions since 2004, the MGP has continued to experience significant waiting lists (Buttery 2015). Wait lists exceed the allocated workforce and resource capacity to service a designated geographic region. Practically, this has meant that at least 50 women per month within the catchment wishing to access the midwifery caseload service have been unable to receive placement. It therefore was considered unethical, costly and impractical to conduct another randomised controlled trial or experimental effectiveness study at this site (Jadad & Enkin 2007). Demonstrated community preferences for care with increased access to midwifery continuity services and models made it highly unlikely women would be willing to participate in studies or be randomised to models of care for which they have clearly expressed a longstanding alternate preference (Hendrix et al. 2009; Petrou & McIntosh 2011). Analysis of funding, service supply issues and outcomes in relation to public health equity and access to maternity services, however, was appropriate.

Study Setting

The annual birth rate for the state of South Australia was 20,666 for the 2012 calendar year (Scheil et al. 2014). The site at which both arms of the study was conducted was the largest public maternity referral hospital in the state of SA and provided care for 4992 of these birthing women (Scheil et al. 2014, p. 19). Childbearing women came from a diverse cross-section of population groups. While approximately half the number of women who gave birth at SA public metropolitan teaching hospitals was Caucasian (50.9%), higher percentages of women from Aboriginal (60.9%), Asian (83.0%), and other races (83.2%) also used public metropolitan hospitals for pregnancy and birth care (Scheil et al. 2014, p. 21).

Description of the Service Models Being Compared

Midwifery Group Practice (MGP)

This service was an integrated public sector maternity service model offering women continuity of care across the antenatal, birthing and postpartum care continuum (to 4–6 weeks post-birth) with a named midwife. Each midwife worked within a small group (6–8 midwives) where she was supported with on-call, rostered days off and 6 weeks annual leave for her caseload. The midwifery practice provided comprehensive care for women of all obstetric risk classifications. Integrated medical, allied health consultation, referral and collaborative care was provided in addition to midwifery continuity of care for women in moderate- and high-risk classifications with support from core hospital staff and discrete units in the Women’s & Babies Division at the hospital. Each full-time equivalent (FTE) midwife averaged primary care for 36–40 women/year and ‘backup’ for a similar number within their midwifery partnerships and group. Caseload was dependent on client complexity and acuity with proportional salary and caseload adjustments made for part-time staff.

As a maternity service model, the MGP comprised a midwifery workforce reconfiguration and adaptation from a Birth Centre low-risk model at the hospital to a continuity midwifery caseload model of collaborative care providing services for women of all-risk status. It was funded directly from the existing hospital acute care budget. MGP commenced in January 2004 with two group practices providing services for 500 women and babies per year. This was expanded to three groups providing care for 750 women and babies per year in 2005 and four groups providing care for approximately 1000 women and babies per year in 2006 (Cornwell, Donnellan-Fernandez & Nixon 2008). In mid-2008, the four MGP groups were reconfigured to three groups, albeit within the same service delivery, resource and funding model. There was no further approval for expansion of the model at the hospital until August 2015. The service remains one of the longest and largest sustainable ‘all risk’ public health midwifery caseload models in Australia (Buttery 2015; Donnellan-Fernandez 2013).

Standard Hospital Care (SHC)

While located in a metropolitan area, the hospital in this study provides integrated specialist medical, midwifery, nursing and allied health services to women across South Australia and to surrounding territories and states. In

2007 ‘zoning’ of services based on women’s residential postcode was introduced by the government. Hospital-based care and adjunct services were available under a variety of arrangements, including Commonwealth Medicare-funded General Medical Practitioner ‘shared care’ for women experiencing uncomplicated pregnancies. These women were booked at the hospital for acute care state-funded birthing and postnatal services. Birthing and postnatal care was publicly financed and predominantly provided by a state workforce comprising public sector midwives and doctors employed on shift-work arrangements.

Standard Hospital Care for public sector pregnant women (whether for high-risk medical care or low-risk midwifery care) was provided within a framework of discrete ‘modules’ of service. This involved provision of episodic antenatal, birthing and postpartum care from different staff members and a variety of staffing mix. Women and their babies were typically assigned to a named obstetric or neonatal clinic where validated audit data indicated they were seen by many different staff, (typically up to 30–40 midwifery and medical staff), during the combined outpatient and hospital care continuum. Staffing allocation within the standard care model was dependent on rostering cycles in the antenatal clinic, labour and delivery suit and postnatal wards. Women in both study arms fulfilled moderate-risk obstetric criteria (Table 3.1).

Table 3-1 Moderate-Risk Obstetric Criteria for Women in Study

Category 2 Moderate-risk factors	
Obstetric history	**Medical**
Scarred uterus	Anaemia < 105
Mid-trimester abortion	Minor cardiac disease
Three or more 1’st trimester abortions	Minor/Moderate hypertension
Previous difficult labour/delivery	Sexually transmitted diseases
Previous low birth weight infant	Epilepsy (mild controlled)
Previous perinatal death/non-recurrent	Asthma (mild controlled)
Previous pre-term birth	Previous venous thrombosis/embolism

Category 2 Moderate-risk factors	
Previous pre-term rupture of membranes Previous retained placenta Previous postpartum haemorrhage	Rheumatoid arthritis Glucose intolerance including: *diet controlled gestational diabetes *impaired carbohydrate metabolism
Obstetric Complications (current) Mild pre-eclampsia Uncomplicated twin pregnancy Suspected cephalo-pelvic disproportion Pregnancy greater than 42 weeks Malpresentation, including breech Polyhydramnios Grande multipara Premature pre-term rupture membranes Threatened pre-term labour < 37 weeks Pregnancy related skin disease (herpes) **Assisted Reproduction Pregnancy**	**Medical History** Previous eye surgery Family history pre-eclampsia/eclampsia **Anaesthetic Risk Factors** Women with potential airway problems **Age** Teenage < 20 years Mature > 35 years **Height** < 150 cm **Weight – underweight/overweight** < 45 kg > 90 kg **Minor Substance Dependence** Drugs, alcohol, tobacco > 10 cigs/day **Previous Psychotic Illness**

As discussed in Chapter 2, moderate-risk criteria indicated significant additional complexity for women during childbearing and their babies. Guidelines for multidisciplinary care, including current levels of evidence, screening, assessment, and risk classification are detailed in the National Midwifery Guidelines for Consultation and Referral (Australian College of Midwives 2013 pp. 31–57), the National Guidance on Collaborative Maternity Care (National Health and Medical Research Council 2010), the South Australian Perinatal Practice Guidelines (SA Health 2015) as well as other multidisciplinary evidence-based guidelines (Australian Health Minister's Advisory Council 2012).

Ethical considerations

Approval to conduct the study was provided by the Human Research Ethics Committee at the hospital (see Appendix 3.3), by the Social and Behavioural Research Ethics Committee at Flinders University in South Australia (see Appendix 3.4), and by the External Review Evaluation Committee (EREC), Commonwealth Medicare Statistical Services Division (CMSSD) Australian

Government Department of Human Services Canberra (see Appendix 3.19). The principles and procedures that guided conduct, collection, linkage and analyses of data in both arms of this study were those outlined in the Australian Code For The Responsible Conduct Of Research (National Health and Medical Research Council, Australian Research Council & Universities Austalia 2007a), and described in the National Statement on Ethical Conduct in Human Research (National Health and Medical Research Council, Australian Research Council & Australian Vice-Chancellors' Committee 2007b). The study also complied with the Hospital Code of Conduct for Research, including the principles of pursuit of truth and evidence, in addition to demonstrating integrity, professionalism, fairness and equity (Government of South Australia 2009).

Database Analysis Methods

The research process and database analysis methods that were used in each arm of the study are described below. These include the sampling strategy and population of interest, inclusion and exclusion criteria, sample size, data linkage, coding, collection and features of each dataset, the variables selected, the statistical analyses, tests and models that were applied, and issues of reliability and validity. The chapter concludes with considerations of rigour and the assumptions of the study design.

Methods – Retrospective Arm 2004–2010

Research question

Was there a difference in net benefit outcomes for women with pregnancies classified as moderate obstetric risk and their babies in MGP compared to

SHC across a seven-year timeframe (2004–2010) for clinical, resource and cost variables?

Sampling strategy and population of interest

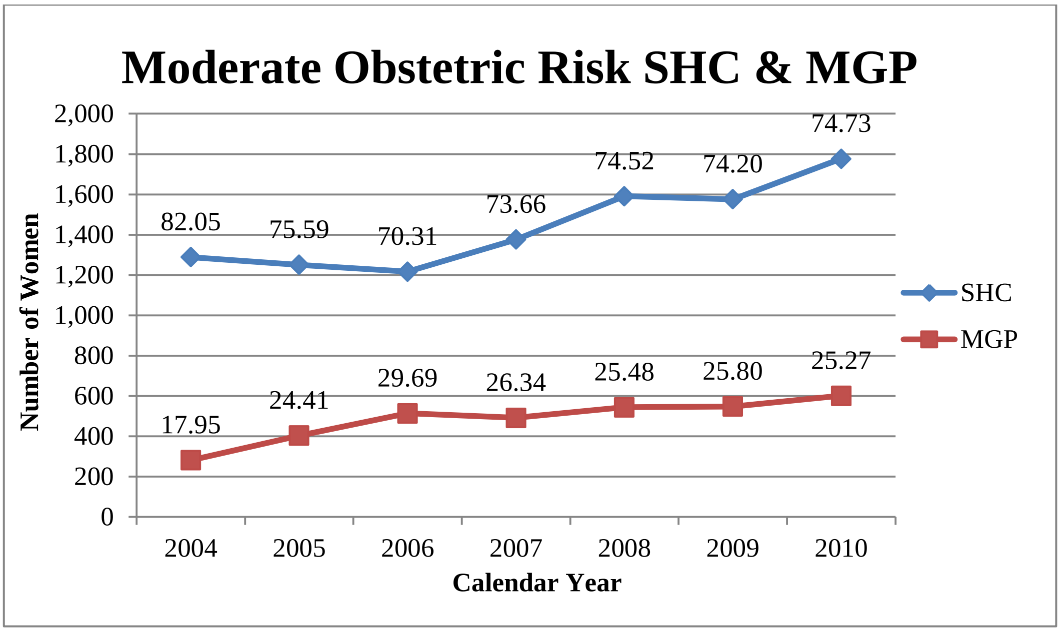
Case records for all women and babies who received care through either MGP service or SHC service during the period 2004–2010 as shown in the inclusion and exclusion criteria were included in the data collection (Table 3.2). A total of 13 462 case records for women who resided within the metropolitan postcode ranges 5000–5174 at the time of booking at a South Australian tertiary maternity hospital were identified by the Public Health Research Unit as eligible for inclusion. The postcode range identified was selected as it defined the geographical service boundaries of the public health MGP.

Table 3-2 Inclusion and Exclusion Criteria – Retrospective Arm 2004–2010

	Inclusion criteria	Exclusion criteria
Retrospective arm	Category 2 Moderate-Risk Factors as per Table 3.1 HRPS* classification	Category 1 Low/No Risk Factors
	Delivery Year – 2004 to 2010 at hospital Metropolitan Adelaide postcodes 5000–5174	Category 3 High to Very High-Risk Factors as per Appendix 3.1 HRPS classification
	Public patients only	Delivery Year not between 2004 and 2010 Non-Metropolitan/Non-SA postcodes
	All women booked with: Hospital Midwifery Group Practice (MGP) or Standard Hospital Care (SHC)	Women booked as private patients, or with services outside hospital MGP & SHC e.g. Local Medical Officer (LMO) share care and LMO antenatal care

Key. *HRPS = High-Risk Patient Service

Of the total number of records that were eligible for inclusion, 12 406 were matched in all datasets; 9442 women received care through the SHC model and 2 964 women received care through the MGP model. The two service population groups were compared for significant differences including age, parity, race, country where born, occupational and socioeconomic status, identified via the Supplementary Birth Record (SBR) (Appendix 3.5). Formal risk classification standard processes adopted by the hospital were common across both groups (Appendix 3.1). The frequency distribution of women with moderate pregnancy risk classification in each service, SHC versus MGP, for the years 2004–2010 is shown in Figure 3.1.



Values show % of women in care model; SHC = Standard hospital care; MGP = Midwifery Group Practice

Figure 3-1 Moderate-Risk Service Profiles: SHC and MGP 2004–2010

As illustrated above, the proportion of women with 'moderate' risk pregnancy classification being cared for in SHC and MGP models was similar, unlike other classifications. Table 3.3 details the risk classification profile of women in each maternity model at the hospital where the study was undertaken.

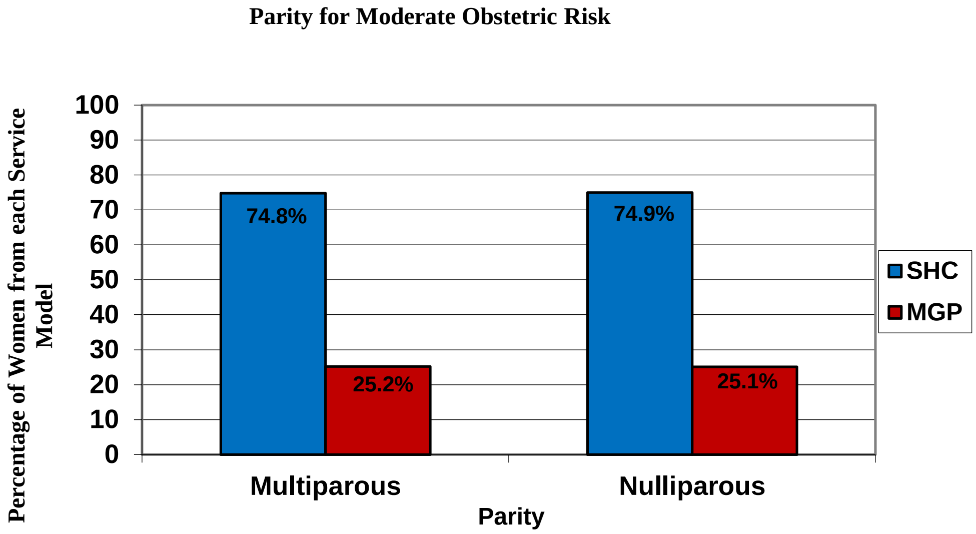
Table 3-3 Standard Risk Classification Profile of Women as a Percentage of Total Services Delivered at Tertiary Hospital: SHC vs MGP 2004–2010*

Risk profile	Low	Moderate	High	Totals*
SHC Women (%)	19% n = 3 191	60% n = 10 077	21% n = 3527	100% n = 16 795
MGP Women (%)	34% n = 1984	58% n = 3385	8% n = 467	100% n = 5836

Key. *Public Patients Only; SHC = Standard Hospital Care; MGP = Midwifery Group Practice

Parity of the moderate-risk sample

Parity has been recognised as a potential confounding factor that influenced outcomes for pregnant women and their babies, especially those who have experienced complexities (Kozuki et al. 2013; Shah 2010). A total of 7337 case records for multiparous women and a total of 5069 case records for nulliparous women were matched in the retrospective moderate pregnancy risk dataset. As shown (Figure 3.2) there were similar proportions of multiparous and nulliparous women within each of the service models ($\chi 2$ = 0.0229, p = 0.880).



Key. SHC = Standard hospital care; MGP = Midwifery Group Practice

Figure 3-2 Proportions of Multiparous & Nulliparous Women

Sample size

While the study was non- experimental in design, power analysis and sample size estimation were still important in determining the statistical significance levels for the study (Fisher & Schneider 2013, p. 252). In the retrospective arm, the total number of records that were eligible for inclusion and matched in all datasets, n = 12 406, enabled significance levels to be set at 0.05. Sample size therefore was sufficient, and the proportional distribution of multiparous and nulliparous women appropriate for the statistical analysis that was undertaken (Suresh & Chandrashekara 2012).

Data linkage, missing data, coding and features of the dataset

Data linkage

The data source/unit of analyses was patient records. De-identified records from three databases were used to create a single dataset. Information from two databases was collated and linked by a third party, the Public Health Research Unit at the hospital, and was supplied to the researcher. The databases included the High-Risk Patient Service clinical dataset and the South Australian SBR summary clinical dataset (Appendix 3.5). A third dataset, the Integrated South Australian Activity Collection [ISAAC] hospital separation (admission/discharge) cost dataset was supplied from SA Health Informatics and linked to the other two datasets using unique case record identifiers.

ISAAC contained state-wide data and recorded information about patients separated from public and private hospitals. In addition to forming part of the Admitted Patient Care National Minimum Dataset through annual submissions to the Australian Institute of Health and Welfare, ISAAC is an information resource used to fund, organise, evaluate and plan health services in South Australia (SA Health 2013). ISAAC data included the AR-DRGs' code for mode of birth for each woman identified with the revenue and costs generated for that code. Antenatal and other obstetric admissions were also a part of the ISAAC dataset. Independent bio-statistical support services enabled linkage of the cost and separation data with the clinical data provided by the Public Health Research Unit for the total of 13 462 case records. The researcher cleaned the dataset for duplicates and missing values (Hellerstein 2008; Tabachnick & Fidell 2013) and coded the dataset.

Data quality and missing data

Data quality has been identified as a potential issue when using existing datasets and secondary sources (Pelletier & Diers 2004). Arguably, however, this was offset by the advantages of systematic data collection that used validated instruments and reliable datasets, including data linkage that employed third-party processes that were independent of the researcher's influence (Holman 2012; Kelman, Bass & Holman 2002).

In this study missing data were coded as 'unknown'. The principal area of missing data identified was from the ISAAC dataset. Cost and revenue data for 253 case records were unmatched (i.e. 1.9% of the total sample in the retrospective arm). Advice of a bio-statistician was sought and a decision made that the percentage of the total sample did not warrant the application of missing-data imputation in the statistical analysis for cost. The analysis in this study, therefore, retained the cases with missing data, an approach that has been supported in the literature (Gelman & Hill 2006, p. 532). The effect of the missing data and its limitations, including potential bias was considered in the results.

Data coding

Residential postcode clusters were allocated for the analyses matched to statistical local areas outlined in the South Australian Social Health Atlas (Glover et al. 2006). One hundred and twenty-eight postcodes (Appendix 3.6) were clustered into six numeric regional codes for analysis – Adelaide Central Business District & North Adelaide; North and North-Eastern suburbs; Western and beach suburbs; Southern suburbs; Eastern suburbs; and Adelaide hills (Appendix 3.7). Codes were based on indices of socioeconomic advantage and disadvantage specified in the SA Social Health Atlas.

Additionally, 26 AR-DRG codes from the ISAAC cost dataset (Appendix 3.8) were allocated to 15 numeric codes for meaningful cost analyses. This included 13 discrete AR-DRGs with two combined categories for other codes with small count data and antenatal and other obstetric admissions (Appendix 3.9). Appendices 3.8 and 3.9 accounted for coding variations and code category changes that occurred during the study period when Version 6 AR-DRG Code Classifications replaced Versions 5.1 and 5.2 in July 2009 (Australian Government Department of Health and Ageing 2006, 2010).

The single dataset was then imported into STATA software – Version 13 (StataCorp 2013) for analyses. Advantages of using established datasets included time and cost savings as data were already de-identified, consistently collected and available for a seven-year period for each maternity model.

Features of the dataset

Features of the dataset contributed to the reliability of the study. Data collection instruments demonstrating high levels of stability, homogeneity and equivalence are considered reliable tools (Gillespie & Chaboyer 2013, p. 222). The electronic and paper instruments used for data collection in this study were all long-term validated tools with high levels of reliability. These included the South Australian Supplementary Birth Record (SBR), the generic instrument used by the Pregnancy Outcome Unit, Epidemiology Branch SA Health for collection and reporting of annual maternal and infant pregnancy and birth population outcome data (Appendix 3.5) (Pregnancy

Outcome Unit Epidemiology Branch SA Health 2008 p. 86). Data from this instrument were used in both the retrospective and prospective arms of the study. In addition to individual casenote review the SBR is one of the instruments hospital Clinical Information Services (CIS) coders use to compile aggregate outcome statistics for low-, moderate- and high- risk classification populations for Standard Hospital Services and MGP Services. Similarly, AR-DRG hospital separation data in this study were based on a national classification system (Versions 5 and 6 in this study) (Australian Government Department of Health and Ageing 2010). Separations for cost and revenue were reported centrally on the ISAAC database. As such, these were considered the most consistent and reliable instruments from which to compare hospital separation and costing data in both service models.

Validity, the extent to which a measurement method accurately collects and reflects what it intended to measure (Grove 2007 p. 97; Rees 2011), also was enhanced by recognition of internationally validated cost ratios for spontaneous vaginal birth, complicated/assisted vaginal birth and caesarean section. Consistent cost ratios for birth outcome have been confirmed in three robust obstetric studies in Scotland, UK and Australia (DOH New NHS – 2001 reference costs 2002; Petrou & Glazener 2002; Tracy & Tracy 2003), as well as in more recent studies (Ryan et al. 2013).

Variables analysed from the dataset

The linked dataset included information on age, race, country of birth, occupational status, residential postcode, parity, clinical outcomes and costs based on AR-DRG separation data. See Table 3.4 for the summary of clinical outcome information, resource use and costs relating to the variables that were examined.

Table 3-4 Variables of Interest by Category: Retrospective Study Arm

	Retrospective arm (2004–2010) Variables of interest by category	Statistical analysis
Clinical variables	• Induction of labour • Epidural analgesia • Episiotomy • Intact Perineum • 1st degree perineal tear • 2nd degree perineal tear • 3rd degree perineal tear • 4th degree perineal tear • Spontaneous vaginal birth • Instrumental birth • Elective caesarean section • Emergency caesarean section • Postpartum haemorrhage ≥ 500 mls • Postpartum haemorrhage ≥ 1500 mls • Maternal infections prior to discharge • Plurality of baby (singleton / twin) • Clinical gestation of baby at birth • Birth weight of baby • Congenital abnormality • Baby Outcome (mortality / transfer)	• Descriptive (chi-square test) • Logistic Regression (OR 95% CI)
Resource variables	• Number of antenatal visits • Frequency of antenatal presentation to Emergency Department/Women's Assessment Service (WAS) • Frequency of antenatal admission to hospital • Length of maternal bed stay (Birth) • Frequency of baby direct room in • Frequency of baby admissions to Special Care Baby Nursery (Acuity Levels 1, 2, 3)	• Descriptive (Mann–Whitney U test – median/interquartile range)
Cost variables	• AR-DRG (Australian Refined Diagnostic Related Group) coding for mode of birth and antenatal hospital admission. (Includes specific revenue and cost data for hospital generated for each woman, based on admission and separation data for mode of birth for the years 2004–2010)	• Descriptive (Mann–Whitney U test; median/interquartile range) • Multivariate generalised linear model s [Gaussian family] Log Link Function; mean; SD; 95%CI

The choice of variables (Table 3.4) was supported by evidence identified in previous studies of maternity care models undertaken in Australia and internationally (Birthplace in England Collaborative Group 2011; McLachlan et al. 2012; Tracy et al. 2013).

Selection of variables was based on evidence of their capacity to measure internationally recognised quality health care outcomes in maternity care, also consistent with quality pillars included in the Donabedian SPO evaluation framework (Donabedian 2005 pp. 692–694). This will be described below.

Table 3.4 outlines the variables selected in this study. Three categories of variables were analysed in the retrospective arm: clinical variables, resource variables and cost variables. These variables were recognised by the National Hospital Cost Data Collection as significant in terms of frequency, resourcing and cost in the funding of public sector hospitals (Commonwealth Department of Health and Ageing 2010). The clinical variables selected have been recognised internationally as standardised benchmarks for measuring rates of clinical effectiveness, morbidity and cost ratios in monitoring quality outcomes for childbearing women and their infants (Devane et al. 2010; Gibbons et al. 2010; Sandall et al. 2013; Tracy 2011). Further, analyses of the demographic characteristics of women and their babies were enabled through linkage of the South Australian SBR data. This contributed a more comprehensive picture of socioeconomic status and other determinants of health that may have influenced maternity services use, access, preference, outcomes, cost and equity for different groups of women.

Data collection and storage

Individual written consents were not required for this study arm. The retrospective arm was assessed as minimally intrusive to privacy. Given the aggregate, non-identifying nature of the data collection and the analyses proposed, the requirement for individual consent was waived in accordance with guidelines for retrospective studies (National Health and Medical Research Council, Australian Research Council & Australian Vice-Chancellors' Committee 2007b, pp. 19–24). Ethical approvals were obtained from the hospital Human Research Ethics Committee (name withheld in the interest of anonymity), and the Flinders University Social and Behavioural Research Ethics Committee, and the Commonwealth External Requests Evaluation Committee, Medicare Australia (Appendices 3.3, 3.4, 3.19 respectively).

Data collected was collated both in electronic (password-coded) and paper format and securely stored in two locked filing cabinets, one at the hospital and one at the University. The researcher was the only person with access to the filing cabinets.

Statistical analyses

The analysis of data in the retrospective arm was undertaken using the statistical software package STATA Version 13 (StataCorp 2013). Descriptive statistics (population and resource variables), logistic regression (clinical variables), and multivariate statistics – generalised linear models [Gaussian family] with log link function (cost/revenue variables) were used to analyse the linked data (Table 3.4).

Descriptive statistics

The analyses used descriptive statistics to describe demographic and population characteristics, including frequencies for age, race, parity, country/region of birth, residential postcode, and occupational status of women with moderate-risk pregnancies who recorded residential metropolitan Adelaide postcodes 5000–5174 during the years 2004–2010. See Appendix 3.6 for residential postcodes of all women included in the study and Appendix 3.7 for postcode clusters and socioeconomic index for area status by Statistical Local Area for South Australia (Glover et al. 2006). Where data were not normally distributed, for example, age groups (Plichta & Garzon 2009) the non-parametric Mann–Whitney U test was used (Corder & Foreman 2014).

In addition to providing a profile of the population of women in the dataset, descriptive statistics were also extracted to provide an overview of comparative clinical and resource outcomes for each model of care (Table 3.4). Key differences for women in each service group (MGP vs SHC) were examined.

The clinical outcome variables (Table 3.4) were tested for statistical significance using Pearson's chi-square test for the calculation of p values when the frequency and proportion between the two service groups were being measured. The chi-square test is a non-parametrical statistical test applied to sets of categorical data to evaluate how likely any observed difference between the groups arose by chance (Corder & Foreman 2014).

The analyses of resource use examined count data for variables such as number of antenatal visits and admissions, presentations to the women's emergency department, and numbers of babies who either directly roomed in with the mother or required admission to the Special Care Baby Nursery (Table 3.4). Count data were not normally distributed so the non-parametric test (Mann–Whitney U) was applied (Plichta & Garzon 2009).

Similarly, the distribution of obstetric hospital separation data for total cost incurred and revenue received based on AR-DRGs (ISAAC data) between groups was significantly skewed. Median and interquartile ranges therefore were calculated. The Mann–Whitney U test statistic was used to compare the continuous cost and revenue data in 26 AR-DRGs prior to undertaking multivariate statistical analysis (generalised linear model, Gaussian family with log link function) (Table 3.4).

A summary subanalysis of DRG separation episodes for combined hospital services was also completed using the ISAAC dataset. The purpose of the subanalysis was to provide institutional comparators for high volume/high cost DRGs from the site where the study was conducted, including another benchmark for costs in the maternity models compared in the study. Aggregate cumulative yearly averages based on cost minus revenue with standard deviation were reported for the period 2004–2010 (Appendix 4.4). Cost deficits for specific DRGs in the subanalysis were relevant to patterns of clinical outcomes and resource use reported in this study (Chapter 4).

Logistic regression

Logistic regression analyses relationships between one or more independent variables and a categorical dependent variable (Tabachnick & Fidell 2013). The independent variables in logistic regression can take any form as there are no assumptions about their distribution, nor must they be linearly related, or of equal variance within each group (Agresti 2007). Logistic regression has two main uses: calculation of group membership whereby the results of an analysis are expressed as an odds ratio; and providing knowledge of the relationships and strengths among the variables (Tabachnick & Fidell 2013). In the retrospective analyses it was used to determine odds ratios and 95%

CI that reflected the strength of association between groups for clinical variables identified with important intrapartum outcomes for women, for example, mode of birth and perineal status (Szumilas 2010; Webb & Bain 2011). Odds for interventions, including induction of labour, use of epidural and episiotomy were calculated, as well as odds for measures of morbidity, such as postpartum haemorrhage and infection (Table 3.4).

Multivariate regression models

While descriptive statistics enabled the features and characteristics of women in SHC and MGP to be described, as well as the strength of association with care type for selected clinical outcomes and resource use, multivariate statistical analysis was applied to the cost and revenue hospital separation data for AR-DRGs. The purpose of using multivariate analysis for the cost and revenue data was to understand the influence that confounding variables may have had on cost and revenue differences observed between groups, as determined from the hospital separation data (Hardin & Hilbe 2012; Katz 2006; Tabachnick & Fidell 2013).

Potential confounding variables

As discussed in chapter 2 there are many factors identified in the literature that influence pregnancy complexity, resource use and cost of services for pregnant women and their babies (Bellanger & Or 2008; Ryan et al. 2013) In this study, 18 maternal and infant variables that have been highlighted in the literature as having a potential confounding effect on childbirth outcomes, cost and resource use were included in the multivariate regression models for the period 2004–2010. These are shown in Tables 3.5 (maternal) and, 3.6 (infant) below. Where multiple subcategories of a variable existed, the referent that was used in the multivariate model has been identified.

Justification for inclusion of these confounders in the models was confirmed by descriptive statistical analysis of differences between groups.

Table 3-5 Maternal Variables included in Multivariate Regression Cost Models

Maternal variables	Referents
Age of woman	-
Race	
Caucasian Aboriginal, Torres Strait Island Asian Other (include Mid-East/Africa)	Caucasian
Country of birth	
Oceania & Antarctica Europe & USSR Middle East & Nth Africa South-East Asia North-East Asia Southern Asia Northern America South/Central America/Carribn Africa (excluding Nth Africa)	Oceania & Antarctica
Marital status	
Married/De facto Widowed, divorced, separated Never married Unknown	Married/De facto
Residential Postcode (6 SEIFA clusters)	
CBD/Nth Adelaide (SEIFA1) Nth/Nth-East suburbs (SEIFA 6) West/Beach suburb (SEIFA 4) Southern suburbs (SEIFA 5) Eastern suburbs (SEIFA 2) Adelaide hill suburbs (SEIFA 3)	CBD/Nth Adelaide SEIFA1
Maternal occupation	
Managers and Administrators Professionals Associate professionals Tradespersons/related wkrs Advanced clerical/service wkr Clerical, sales, service workers Production/transport workers Elementary clerical/sale/servc Labourers and related workers	Managers & Administrators
Tobacco status	
Non-smoker Smoker Quit before first pregnancy visit Unknown	Non-smoker

Maternal variables	Referents
Body mass index	
Normal (18–25) Low <18 Overweight (26–35) Obese II 36–40 Obese III ≥ 41O; >35 Ob II; >40 Ob III)	Normal (18–25)
Gravida	-
Parity	-
Nulliparity	-
Number of previous caesarean births	-

Key. SEIFA = Socioeconomic Index for Area; Body Mass Index (L = Low; N = Normal; O = Overweight; Ob II = Obese II; Ob III = Obese III)

Table 3-6 Infant Variables included in Multivariate Regression Cost Models

Infant variables	Referent
Plurality	-
Clinical gestation of baby at time of birth	
37–43 weeks 28–36 weeks 20–27 weeks	37–43 weeks
Birth weight of baby	
3000 grams + <3000 grams <2000 grams	3000 grams +
Congenital abnormality	-
Outcome for baby	
Discharged < 28 days of birth Fetal death or stillbirth Neonatal death (within 28 days) In hospital @ 28 days or transfer	Discharged <28 days of birth

Generalised linear models (Gaussian family) with Log Link Function

The multivariate models used for the cost analysis were generalised linear models (GLM) (Gaussian family) with log link function. The distribution of cost data was significantly skewed, therefore, justifying selection of these models (Hardin & Hilbe 2012). Linearity and additivity are important features of GLM models. In these models, pairs of variables are assumed to have a linear relationship with each other and the effects of multiple variables within a set of variables become additive to a prediction equation. Covariate (β) "weights" (coefficient values) determined how much the variable (*X*) contributes to prediction (Tabachnick & Fidell 2013, p. 915).

Use of GLMs enabled statistical linear regression modelling of variables that were not normally distributed (Hardin & Hilbe 2012). Generalised linear models have been commonly used to model binary or count data, but have not been widely used in applied econometrics (i.e. quantitative techniques used to assist economic decision-making), despite their suitability (Baum 2013; Toohill et al. 2011).

In this study, log link function was used to transform data for multiple maternal and infant covariates (see Tables 3.5 and 3.6 for maternal and infant variables, including the referent for multiple categories). This enabled robust analyses of the cost and revenue differences between groups. SHC was the referent group. The coefficient values (β) in the GLM models were important to interpret the percentage effect (measured in Australian dollars (A$)) that particular confounders (including their subcategories) may have had on the cost and revenue results shown in the models, including whether these were statistically significant (Tabachnick & Fidell 2013, p. 920). This included the fiscal years across which the analyses were conducted 2003/2004–2010/2011. Methods that were used in the prospective arm of the study have been addressed in the section below.

Methods: Prospective Arm 2010–2012

Research question

Was there a difference in cost and resource consumption for women with pregnancies classified as moderate obstetric risk in the MGP compared to the SHC after discharge from hospital for Commonwealth Medicare benefit items and pharmaceutical benefit items in the four-month period following birth?

The purpose of the prospective arm of the study was to describe and compare the postnatal pattern of Commonwealth-funded Medicare Benefits Schedule (MBS) and Pharmaceutical Benefits Scheme (PBS) use in women in MGP and SHC who had complex pregnancies in the initial months after discharge from a state hospital. The rationale was to use a robust national service/cost dataset that could be linked with state data to further analyse Commonwealth resource consumption between groups of women after they had given birth and were discharged from hospital (Appendices 3.10a; 3.10b indicate the statistical information available through Medicare, including the available data parameters). The analysis in this arm of the study provided a more comprehensive picture of resource use and cost across the childbearing continuum when integrated with the analyses of state resource use and cost that was undertaken in the retrospective arm. Furthermore, it enabled identification of differences in patterns of postpartum MBS and pharmaceutical benefit use by women in the MGP and SHC service models. Demographic and clinical characteristics that may have influenced patterns of use and cost between groups were also analysed.

Sampling strategy and population of interest

The setting for the prospective arm of the study was the same hospital and included the same maternity models, SHC and MGP, as the retrospective arm of the study. Prospective recruitment and consent of 500 women with pregnancies classified as moderate obstetric risk was the initial aim (see Appendix 3.1 for the obstetric risk classification used by the hospital), 250 women receiving caseload care through Midwifery Group Practice (MGP) service, and 250 women receiving Standard Hospital Care (SHC) (Appendix 3.10b shows the Medicare consent and data parameters). As with the retrospective sample, equivalent numbers of primiparous and multiparous women from each service model were sought to avoid the potential confounding effect of parity (Kozuki et al. 2013; Shah 2010). Inclusion and exclusion criteria have been detailed below in Table 3.7.

Table 3-7 Inclusion and Exclusion Criteria: Prospective Arm 2010–2012

	Inclusion criteria	Exclusion criteria
Prospective arm	Category 2 Moderate/High-Risk Factors as per Table 3.1 HRPS* classification	Category 1 Low/No Risk Factors
		Category 3 High to Very High-Risk Factors as per Appendix 3.1 HRPS classification
	Metropolitan Adelaide postcodes 5000–5174	Non-Metropolitan/Non-SA postcodes
	Public patients only	Women booked as private patients, or with services outside hospital MGP & SHC e.g. Local Medical Officer (LMO) share care and LMO antenatal care
	Any woman booked with: Midwifery Group Practice (MGP) or Standard Hospital Care (SHC) is eligible for recruitment in third trimester and up to time of birth from June 2010–March 2012	
	Valid Hospital + Valid Medicare Consent Form	Invalid Hospital or Medicare Consent Form
		Baby birthed after 1 March 2012

Key. *HRPS = High-Risk Patient Service

Sample size

Adequate sample size and power is considered optimal for the identification of relationships among variables and differences in groups that are significant statistically (Burns & Grove 2005; Suresh & Chandrashekara 2012). Based on a power analysis and examples of Medicare Benefit Schedule costing studies undertaken in other areas (Eckermann 2009), it was calculated that 500 women with pregnancies classified as moderate obstetric risk was required. Bio-statistical support was sought as these aspects were important in the design phase of this study (Meysamie et al. 2014).

Sample size for the prospective arm of the study was calculated based on the population size of 20 000 (annual birth rate for SA) with 80% power (Suresh & Chandrashekara 2012). A Type 1 error was considered as 5% level of significance. Number of Medicare visits and MBS cost for women was used to calculate the sample size. There were no published data available to inform the sample size calculation for our proposed study. The study assumed that the incident rate ratio for number of visits was almost 40% lower in the MGP group as compared to the SHC group. The study also assumed that the average number of visits in the SHC was about six. On the basis of 40% lower incidence rate in the MGP group and on average of six visits in the comparison group (SHC), at least 50 women are needed in each group to find the significant difference of visits between two groups. However, the study needed almost 100 women in each group to detect almost A$10 of significant differences of costing between MGP and SHC groups. Therefore, it was decided that at least 100 women in each group would be recruited. Only 100 women were recruited in the first 12 months. Because of small numbers of recruitment the recruitment was extended for another 12 months to reach the total of at least 200 participants

Recruitment of participants

The location for recruitment of participants was the same tertiary maternity hospital and MGP/SHC services that provided case record data for the retrospective arm of the study. The recruitment strategy was for midwives to consent women from both the Standard Hospital Care antenatal clinic and the Midwifery Group Practice in the third trimester of pregnancy until the desired numbers for each arm were reached. Recruitment was undertaken using the approved Letter of Introduction, Participant Information Sheet, consent forms (hospital and Medicare Australia), and Recruitment Poster (see Appendices 3.11; 3.12; 3.13; 3.14; 3.15). These included permission to link non-identifiable Commonwealth Medicare Benefit Schedule (MBS) and Pharmaceutical Benefit Scheme (PBS) data with pregnancy and birth data from the state SBR (see Appendix 3.5).

Women were recruited and consented between the dates 30 June 2010 up to 30 June 2012. Due to insufficient numbers of women being recruited in the first round (30 June 2010–30 June 2011), permission from the External Requests Evaluation Committee of the Commonwealth Statistical Services Branch, Medicare Australia, to extend the recruitment phase for a further year (30 June 2011 to 30 June 2012) was sought (see Appendix 3.16). Permissions were granted by the three ethics committees who provided initial institutional review of the project (External Requests Evaluation Committee (EREC), Commonwealth Medicare Statistical Services Division (CMSSD) and hospital and University ethics committees). Dates on the original Medicare consent form (see Appendix 3.14) were amended to reflect dates congruent with the second round of recruitment undertaken from 20 June 2011–30 June 2012. Moreover, 18 women recruited in the first round were followed up and completed a second consent form when it became evident that the date the women had given birth was inconsistent with the stated end date for data extraction (30 June 2011) listed on their original consent.

Due to the extended recruitment phase, at close of recruitment in 2012, total numbers in this arm of the study were 206 women; n = 95 (MGP) and n = 111 (SHC) (Appendices 3.17 & 3.18). The proportions of primiparous and multiparous women was similar between groups, 55.79% vs 57.66% and 44.21% vs 42.34% (MGP vs SHC) respectively. However, violation of exclusion criteria (recruitment of six women from rural/regional postcodes), challenged the internal validity in this arm of the study (see Appendix 5.1 for a map showing the outlying postcodes for these 6 women). Due to limited data available for PBS analysis, a decision was made to retain these women's data as part of the analysis, and a descriptive subanalysis of the women who were rural outliers is clearly identified in the results and Tables accompanying chapter 5.

Data linkage, data quality, coding and features of the dataset

Data linkage

National legislation and Commonwealth data extraction procedures (see 'data collection and storage', p.112) required use of unique participant identifier numbers to maintain the privacy and confidentiality of all women and their records. A participant identifier number coded for group and parity was assigned for each woman with a moderate pregnancy risk classification booked with MGP or SHC who provided their consent for individual MBS and Pharmaceutical Benefit Scheme data extraction (Appendix 3.14). The unique participant identifier number enabled the CMSSD to extract each woman's MBS and PBS data (consistent with the permissions provided by the signed consent forms) using her Medicare number. Valid consents provided authorisation for supply of confidential information on MBS/PBS use for the first six months after giving birth for each woman in a non-identifiable format, and included permission for linkage with clinical and demographic data from the state SBR (Appendix 3.5).

The unique identifier numbers for each woman were used to create an Excel dataset (version 1 June/2012) of individual extraction request dates (based on the date each woman gave birth), for supply of Medicare and pharmaceutical benefit data. The researcher provided the extraction request dates dataset to Commonwealth Medicare Statistical Services Division (CMSSD) in 2012 (see Appendix 3.17) in a password-protected electronic file with all original hospital and Medicare consent forms (Appendices 3.13; 3.14) as required.

Data matching and collation was undertaken by CMSSD after independent validation of all original consent forms. Only one consent form was deemed invalid, as the Commonwealth Medicare consent form was not accompanied by a signed hospital consent form for this woman. CMSSD supplied the researcher with an electronic password-protected file with separate MBS and PBS Excel datasets for the individual extraction request dates for each woman based on the unique identifier numbers (Appendices 3.18; 3.19). Bio-statistical support enabled the researcher to merge and code the MBS, PBS, clinical and demographic data provided from the three separate Excel datasets, namely, the Medicare Benefits Schedule dataset (MBS); the Pharmaceutical Benefits Scheme dataset (PBS); and the Supplementary Birth Record (SBR) dataset. Data linkage was completed using the unique participant identifier numbers to create a single dataset.

Data quality

Appendix 3.10a, p. 1 contains information about Medicare. Medicare publishes a range of health statistical information in line with its responsibilities in administering a range of national government health and payment programs. The purpose of these is to ‘improve the health and wellbeing of Australians by delivering information and payment services' (Australian Government Department of Human Services 2014). Medicare Australia has a legal obligation to collect information in a fair and lawful manner, to check the accuracy of information before it is used, and to store it securely and confidentially, while recognising that health information in the hands of health care decision-makers has the potential to improve health outcomes.

Data collected by Medicare Australia for Medicare and pharmaceutical benefit claims are only held for the last five years and only include services that qualify for Medicare benefits and for which claims have been processed. No information about services that have been provided in public hospitals to public patients or services provided in outpatients or emergency departments of public hospitals is collected, therefore, diagnostic or clinical information is not available. Moreover, pharmaceutical benefit data are restricted to data recorded from prescriptions where the cost of the drug was greater than the cost of the consumer contribution and where the pharmacist required reimbursement. It is also dependent on the pharmacist identifying consumers by their correct entitlement number (i.e. Medicare or Health Care Card) and prescribers by their correct prescriber number on claims for payment (Appendix 3.10b). Nevertheless, the Medicare and pharmaceutical benefits datasets represented robust Commonwealth information where de-identified, individual data on national Medicare and pharmaceutical use and cost per woman could be provided. Linkage of this data with clinical data from the state SBR provided a comprehensive picture of Commonwealth-funded services accessed by women after discharge from state-funded hospital services.

Data coding

Data coding was undertaken by the researcher with bio-statistical advice and support. This commenced with assignment of unique participant identifiers on consent forms that coded for group and parity, as well as coding of clinical and demographic variables from the Supplementary Birth Record.

Medicare Benefit Schedule coding

From the Medicare Benefits Schedule dataset, the researcher identified 126 separate MBS Item Numbers/Codes. These are detailed in Appendix 3.20. These were clustered into six-item code categories to enable meaningful statistical analyses of count data using negative binomial regression modelling (see Table 3.8).

Table 3-8 Medicare Benefits Schedule Item Clusters

1. Short or Standard Consultations A & B
2. Long or After Hours Consultations (C & D), or Comprehensive Initial Consultations
3. Blood Tests & General Biochemistry; Pathology, Pregnancy Tests & Histopathology
4. PAP Smears, Cervical Screening and Insertion of Intrauterine Contraceptive Device
5. Psychological Assessment and/or Mental Health Treatment Plans
6. Other: included initiation of patient episode; initial specialist consultation or further follow-up attendance; consultations by health professionals other than GP; other tests, minor operations and dental/oral health treatment

Pharmaceutical benefit coding

From the Pharmaceutical Benefits Scheme dataset the researcher identified 56 separate PBS Item Description Codes. These are listed in Appendix 3.21. These were clustered into eight drug groupings for count analyses, given the small sample and data available. The eight PBS drug groups have been summarised in Table 3.9.

Table 3-9 Pharmaceutical Benefits Scheme Use–Major Drug Groups

Antibiotics
Contraceptives
Analgesics/Anti-inflammatories
Inhalers (asthmatic medication)
Anti-depressants
Lactation stimulants
Iron supplements
Other: included oral hypoglycaemic; topical ointments; anti-epileptic; anti-hypertensive; antimalarial; thyroid medication (see Appendix 3.21 for a comprehensive listing)

Statistical analysis was undertaken after coding and importation of the single dataset into STATA statistical software package – version 13 (StataCorp 2013).

Features of the dataset

The data parameters, including data definitions supplied by Medicare statistical services, have been detailed in Appendix 3.10b, pp. 2–5. The data supplied met the data parameters described, namely, de-identified, itemised Medicare benefit and pharmaceutical benefit data, cost, and service dates for each woman. Provider charges, scheduled fee, benefit paid and patient out-of-pocket cost were included. The features of the linked dataset included demographic information on age and residential postcode, gravida, parity, maternal and infant clinical outcomes for birth. In addition, the dataset included the itemised Medicare and pharmaceutical claims and costs incurred during the four months after discharge from hospital. See Table 3.10 for the summary of variables that were analysed for all women, n = 206, who fitted the moderate-risk inclusion criteria and their babies, where valid consent forms were provided.

As with the retrospective study arm, the data collection instruments in the prospective arm were considered reliable tools (Gillespie & Chaboyer 2013, p.222). The data collection processes that were used also were objective and systematic, with common instruments and time parameters applied to comparisons between the maternity models. Approved Commonwealth data parameters and processes were used, namely Commonwealth Standard Report Layout for collating MBS claims and pharmaceutical benefit claims and cost data. These constituted accepted and validated instruments for standardised supply of MBS/PBS data and cost information in relation to a wide range of health services (Appendix 3.10b).

Variables analysed from the dataset

The three categories of variables analysed in the prospective arm included clinical variables, resource variables and cost variables. Variables of interest included in count data analyses were: Medicare Benefit Schedule utilisation, pharmaceutical utilisation, and Commonwealth costs incurred for service consultations and pharmaceuticals for each group of women in each service model. These are outlined in Table 3.10.

As with the retrospective arm, choice of clinical and resource variables was supported by evidence identified in previous studies of maternity care models undertaken in Australia and internationally (see p. 91 for previous studies). However, a unique feature of the current study was the addition of variables that enabled measurement of Commonwealth-subsidised services and pharmaceuticals after discharge from state hospital-funded services as described above.

Table 3-10 Variables of Interest by Category: Prospective Study Arm (2010–2012)

Clinical variables	• Age • Gravida/Parity • Spontaneous Vaginal Birth • Instrumental Birth • Elective Caesarean Section • Emergency Caesarean Section • Episiotomy • Intact Perineum • 1st Degree Perineal Tear • 2nd Degree Perineal Tear • 3rd Degree Perineal Tear • 4th Degree Perineal Tear • Baby's Weight • Baby's Gender	**Statistical Analysis** • Descriptive (chi-square test for categories; independent sample t test for continuous data) • Negative binomial regression model • Adjusted IRR for clinical predictors of MBS use
Resource variables (at birth)	• Frequency of Baby Direct Room In at Birth • Frequency of Baby Admissions to Special Care Baby Nursery (Acuity Levels 1, 2, 3)	• Descriptive (chi-square test for categories)
Resource variables (in 4 months after birth)	• Number of Medicare Benefits Schedule (MBS) Visits • Number and Type of Pharmaceutical Benefits Scheme (PBS) Prescriptions	• Negative binomial regression model • Descriptive (chi-square test for categories of claim items)
Cost variables	• Cost of Medicare Benefits Schedule (MBS) Visits included: o Provider Charge o Schedule Fee o Benefit Paid o Patient out-of-Pocket Cost o Cost of Pharmaceutical Benefits Scheme (PBS) Prescriptions	• Multivariate generalised linear models [Gaussian family] Log Link Function; mean; SD

Key. IRR = incidence rate ratio; SD = standard deviation

Data collection and storage

In this arm of the study, individual written consents were required. Requests for MBS and/or pharmaceutical benefit information are subject to secrecy provisions including those under section 130 of the Health Insurance Act 1973; section 135A of the National Health Act 1953; and the provisions of the

Privacy Act 1988. Accordingly, the unique participant identifier number was allocated and used to collect and link the clinical data for each woman.

Commonwealth data on MBS and pharmaceutical benefits use and costs were provided for each woman according to the approved data parameters (Appendices 3.10a and 3.10b). Each extraction request covered an approved modified four-month period after giving birth (Appendix 3.19). The parameters detailed Medicare history for each woman for Medicare Benefit Schedule Item Numbers 1–74991 and Pharmaceutical Benefits Scheme Items 1–330, including date of service, type of service or prescription, benefit paid, schedule fee and patient out-of-pocket costs. As with the retrospective arm, the data collected were collated both in electronic (password-coded) and paper format and securely stored in locked filing cabinets on-site at the hospital and University. The researcher was the only person with access.

Statistical analyses

The analysis of data in the prospective arm was undertaken using statistical software STATA – version 13 (StataCorp 2013). This section of the analyses examined the relationship between population characteristics, clinical outcomes and patterns of Commonwealth Medicare benefit and pharmaceutical benefit use and cost generated by women in MGP and SHC in the first four months after giving birth. Definitions for statistical models and tests used in the analyses have been provided in Appendix 3.22.

The prospective study arm used descriptive statistics and negative binomial regression modelling to analyse adjusted incidence rate ratio for predictors of Medicare benefit use (Hilbe 2011). Costs for provider charge, scheduled fee, benefit paid and patient out-of-pocket cost between the two groups of women was analysed using generalised linear models (Gaussian family) with log link function. Simple descriptive statistics (percentages) were used to analyse pharmaceutical benefits use between the groups due to very small numbers of women with recorded pharmaceutical claims in both groups n = 14 (MGP) and n = 43 (SHC). The demographic and clinical characteristics that may have confounded patterns of use and cost between groups were considered by using an independent sample t test to compare the ages of women and the weights of babies between 2 groups (McCrum-Gardner 2007) and the chi-square statistic to examine all categorical clinical variables of interest (Plichta & Garzon 2009). Negative binomial regression modelling with adjusted incident rate ratio indicated variables associated with patterns of MBS use between groups (Hilbe 2011) (Table 3.10).

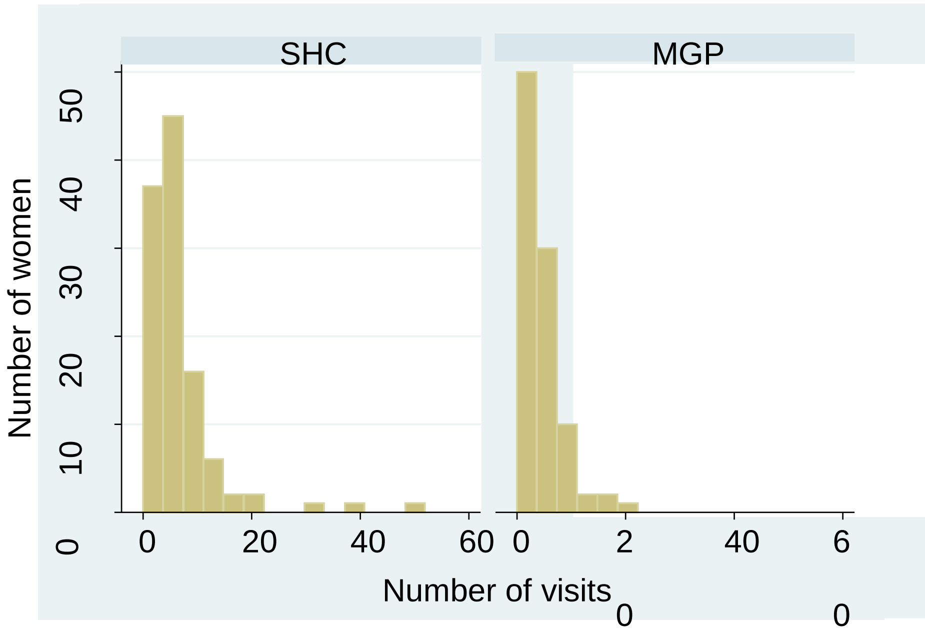
Descriptive statistics

Descriptive statistics were used to provide a profile of the population of women in the dataset of the prospective arm. This included an overview of comparative clinical outcomes for both groups, MGP and SHC (Table 3.10). The independent sample t test was used for continuous data (ages of women and weights of babies)(McCrum-Gardner 2007), and the chi-square statistical test was used for categories (clinical and resource variables listed in Table 3.10) (Maltby, Day & Williams 2007). Demographic and clinical characteristics of women and babies in MGP and SHC were analysed with significance levels set at 0.05.

Negative binomial regression model

Analyses in the prospective arm examined count data, that is, the distribution of MBS and pharmaceutical benefit items between MGP and SHC groups. Initially, a Poisson regression model was considered as this is regarded as the benchmark for analyses of count data (Hilbe 2007; Lord 2006); however, Poisson regression was limited. The model assumed equidispersion – that the variance of the dependent variable is equal to its mean (Hilbe 2011). In reality, the variance of count data usually exceeds the mean, a characteristic known as over-dispersion (Hutchinson & Holtman 2005). In datasets with over-dispersion, Poisson regression incorrectly conflates levels of significance (Katz 2006).

Where count data is over-dispersed use of the negative binomial regression model is considered a better fit (Hilbe 2011; Ullah, Finch & Day 2010). Because the distribution of MBS visits was highly skewed in both MGP and SHC groups (Figure 3.3) a negative binomial distribution therefore was used to remodel the number of visits across women's demographic and clinical characteristics (Ullah, Finch & Day 2010).



Key. SHC = Standard Hospital Care; MGP = Midwifery Group Practice

Figure 3-3 Distribution of Commonwealth MBS Visits Post-Birth in the SHC and MGP Groups 2010–2012

Incident rate ratio

The relationship of MBS visits to women's demographic and clinical characteristics were reported using adjusted incidence rate ratios. An incidence rate ratio is an epidemiologic measure used to compare the incidence rates of events (in this case uptake of MBS visit/items) based on an association between a certain risk factor and an outcome (Hoffman et al. 2008). Adjusted incident rate ratios showed the range of demographic and clinical predictors of use that were considered in this study (Table 3.10).

Generalised linear model with Gaussian family and Log Link Function

To determine if any statistically significant differences occurred in comparative costs for Provider Charges, Schedule Fees, Benefits Paid, and patient out-of-pocket (OOP) costs for MGP and SHC groups in relation to Medicare benefits items and visits (Table 3.10), a generalised linear model with Gaussian family with log link function was used. The distribution of these cost data was significantly skewed and was not normally distributed. Log transformation is an appropriate way to analyse these skewed cost data (Baum 2013; Tabachnick & Fidell 2013).

Limitations of statistical analyses

Meaningful statistical analysis in the prospective arm was hampered by the limited pharmaceutical benefit data available for analysis. Moreover, post-analyses audit of all outliers with high MBS and PBS use identified inclusion of six women with moderate-risk pregnancy classification from rural residential postcodes. Given the small sample and data available, rather than excluding these women's data, descriptive analyses of potential confounding demographic and clinical influences that may have contributed to their outlier status has been provided in Chapter 6.

Rigour in the prospective study arm

Rigour in research methodology has been defined as

> the extent to which the researcher has actively sought to carry out the study to a high standard. This includes identifying possible pitfalls in the design of the study and reducing their effect as much as possible. (Rees 2011, p. 250)

Reliability and validity were strengthened in the prospective arm of this study through the supply of de-identified individual data collected in robust federal datasets, the Medicare Benefits Schedule (MBS) and Pharmaceutical Benefit Scheme (PBS). These electronic datasets are administered by federal legislation and maintained by the Commonwealth of Australia. This includes strict codes governing data collection quality and confidentiality (see Appendix 3.10a, p. 298 and 3.10b, p. 304 for a full description of data collected, collection instruments, data quality and protocols governing access). However, inclusion of data for six women who had a residential postcode outside the metropolitan catchment defined for this study, placed some limitations on interpretation of the results with respect to patterns of postnatal PBS use by women in each model of maternity care.

Evaluation framework used to interpret study results

The aims of this study were to:

- compare and contrast obstetric outcomes between MGP model and Standard Hospital Care (SHC) model for women whose pregnancy was classified as moderate risk
- examine resource use and cost-effectiveness between MGP and mainstream obstetric care
- evaluate inequity in access among women with different socioeconomic characteristics

The Donabedian framework

The results of statistical analysis require interpretation in order to outline the findings and their meaning to the Health Care system. In this study an evaluation framework was used to interpret the results and is explained in the section that follows. This included the relevance of the framework to current health policy objectives in South Australia.

The model that was used to interpret the results of the study was the Donabedian SPO model (Donabedian 1966, 2003, 2005). The Donabedian SPO model is a validated health evaluation framework informed by the seven pillars of quality in health care (Donabedian 1990, 2003). When assessed the pillars of quality featured in this model were found to align closely with the currently cited objectives of health policy and service transformation in South Australia (Government of South Australia 2015).

Donabedian (SPO) model – structure/process/outcome

The structure, process, outcome model (SPO) and 'seven pillars' of quality in health care (Donabedian 1990) have been widely used in health service research and are internationally recognised as a robust framework for assessing quality assurance (Donabedian 1982, 1983, 1985; Glickman et al. 2007). In a seminal paper titled 'Evaluating the quality of medical care', Donabedian described the predominant methods and approaches that had been used to evaluate quality in health care (Donabedian 1966, 2005). Of many issues identified, the lack of comprehensive and integrated consideration of the system as a whole was significant. This included the absence of a range of diverse quality measures and their dynamic, interactive effect on health outcomes. For Donabedian, ‘quality’ in health care was considered to be an attribute of a system (**structure**) which resulted from a set of organised activities (**process**) that produced an **outcome/s**. He considered outcome/s (the dominant evaluation measures used in health care) to be significantly influenced by both structure and process (Donabedian 2003). Furthermore, he proposed the model and quality measures included in each of the three components to underpin comprehensive health care evaluation (Figure 3.4).

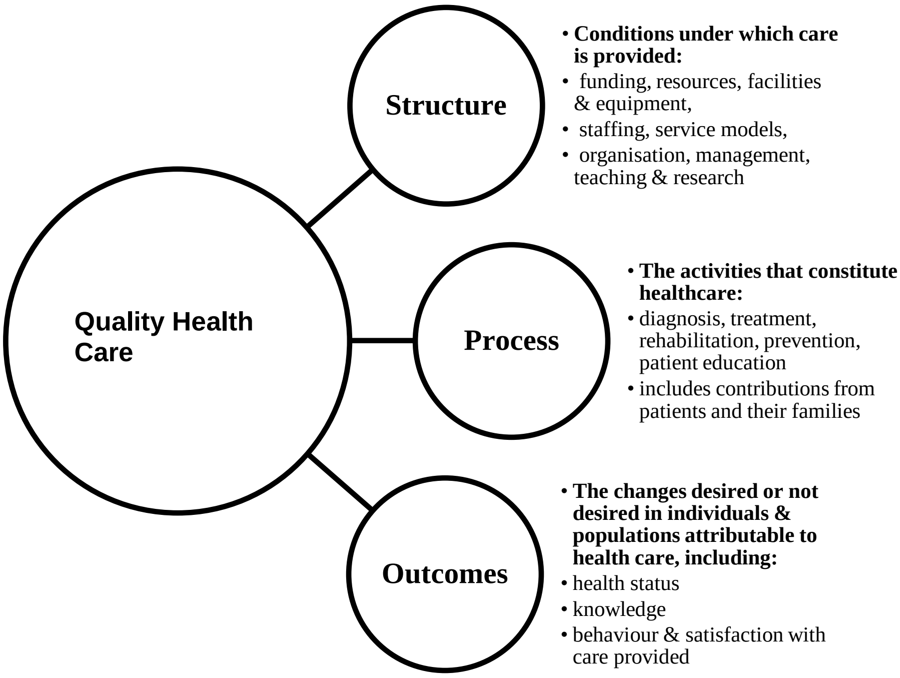


Diagram as interpreted by researcher, Conceptual Source (Donabedian 2003, 2005 p.712)

Figure 3-4 Donabedian SPO Model – Three core components of quality health care

While each of the three components in the Donabedian SPO model contributed to cause and effect in quality health care, the Donabedian perspective is that each component, if considered in isolation, excludes consideration of the others. This can have the effect of significantly narrowing the application of suitable quality measures in research. As well as limiting the results of a study, this also can limit its interpretation and capacity to effect improvement within the context of concern. This then skews a comprehensive understanding of what constitutes quality including how different components of the system and their relationships intersect to significantly influence health care and outcomes under specific conditions (Donabedian 1980, 1982, 1985, 2003, 2005).

Seven pillars of quality

Within the SPO Framework 'seven pillars' or 'essential attributes of quality' in public health care have been described (Donabedian 2005) (Figure 3.5).

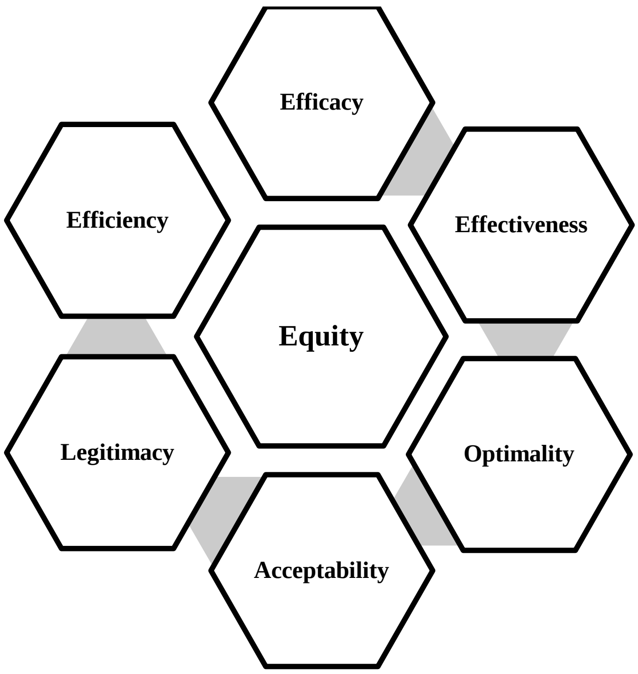


Diagram as interpreted by researcher, Conceptual Source (Donabedian 1990, p. 1115)

Figure 3-5 Donabedian's 'seven pillars' of Quality in Health Care

Each of the seven pillars comprises a facet or component of what determines quality within the health system. The pillars align with the current SA

Government Transforming Health values and quality care principles, which have been expressed as: patient-centred, safe, effective, accessible, efficient, and equitable. Definitions for each of the pillars as translated and applied to maternity care/services have been provided in Figure 3.6 below. The Donabedian SPO model exemplifies how the emphasis placed on each of the pillars, including the quality indicators selected within them to evaluate health care, can operate to either narrow or broaden interpretation and understanding of what constitutes quality in health care services and systems. In the maternity system, structure (the conditions and service models under which maternity care is provided) and processes (the activities and relationships of maternity care, including safety and quality) fundamentally influence outcomes (individual and population maternal and infant health status) (Donabedian 2003).

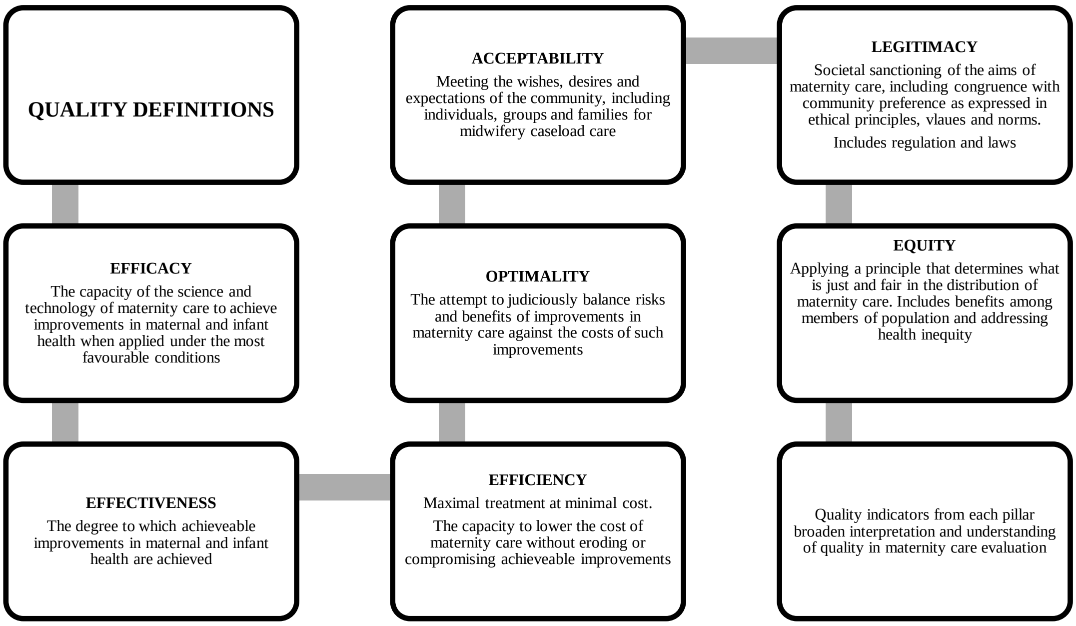


Diagram as interpreted by researcher, Conceptual source (Donabedian 1990, pp. 1115-8)

Figure 3-6 Seven pillars of quality in health care – quality definitions

Applying an integrated SPO Model to maternity services evaluation

Determining priorities in monitoring and selecting approaches to assessing system performance in maternity services, therefore was critical, as described in the National Maternity Services Plan (Commonwealth of Australia 2011) and earlier proposals for change (Boxall & Flitcroft 2007; Maternity Coalition 2002). Structure, Process and Outcome measures, when considered separately, provide a limited assessment of quality health care in the Australian maternity services and system, compared to combined measures that can provide a comprehensive evaluation picture. When all components were considered as part of an integrated framework they provide a useful tool to inform interpretation of the data in two public models of maternity care, Midwifery Group Practice and Standard Hospital Care, at one metropolitan hospital. This includes assessing the comparative clinical outcomes, resource use and cost performance of the models, and how structural and process components of these services currently impact maternity outcomes for mothers and babies in South Australia.

Outcome components that measured quality in relation to clinical effectiveness, cost and resource use were addressed in the SA database analysis. The seven quality attributes of effectiveness, efficacy, efficiency, acceptability, optimality, legitimacy and equity were incorporated into interpretation of the data for comparative outcomes of MGP and SHC in South Australia. Results from both arms of the study were integrated to evaluate how the maternity service models measure up to each of the three core components of the integrated Donabedian SPO model for quality care as shown in Figure 3.7 below.

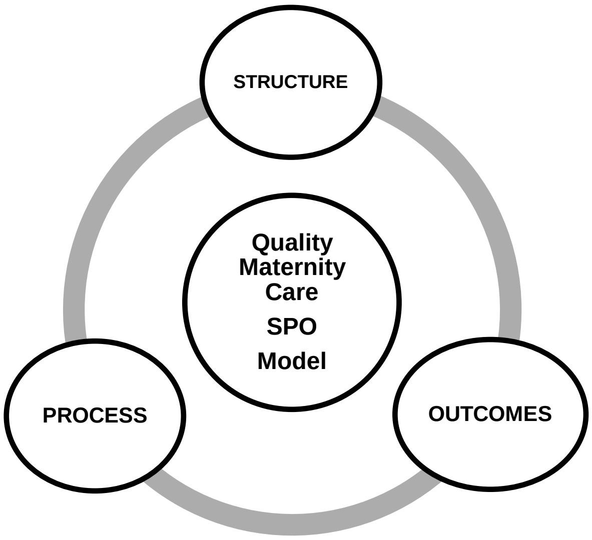


Diagram as interpreted by researcher, Conceptual source (Donabedian 2003)

Figure 3-7 Integrated SPO model for evaluating quality in maternity services

The model of evaluation described above framed and influenced the interpretation of the results of this study and was used in guiding their interpretation and discussion in the chapters which follow. In terms of priority setting, the Donabedian SPO model provides an integrated lens for decision makers to evaluate current and future resource allocation in relation to cost and quality in Australian maternity services.

Summary

Chapter 3 has described the key elements of the research design and methods that were used in the database analyses in this study. The database analyses entailed a two-armed quantitative, non-experimental comparison of outcomes between two public health maternity models in South Australia, MGP and SHC. The retrospective arm (2004–2010) and prospective arm

(2010–2012) analyses linked state and Commonwealth clinical, resource and cost information to compare outcomes between two groups of women who experienced pregnancies that were classified as ‘moderate obstetric risk’.

The study location, maternity service models, units of analyses (i.e. case records and linked datasets), risk-screening criteria, inclusion and exclusion criteria, sample size and time frames for collection of data were addressed. The selection of a priori clinical outcome, resource and cost variables used in both arms of the study were justified and described with reference to supporting national and international evidence. Key ethical considerations were also outlined.

Explanation of the statistical methods, models and tests used in each arm of the study were provided, including justification for why these were the appropriate choice. These included descriptive statistics, logistic regression, negative binomial regression, and multivariate GLMs (Gaussian family) with log link function (unadjusted and adjusted to address confounders). The assumptions on which the study was based, and the issues of reliability, validity, and rigour, also were considered. Process and methods that were used to address these issues have been described and discussed, as has the evaluation framework that was used to interpret the results of the study. The following chapter reports the results from the database analysis undertaken in the retrospective arm of the study.

CHAPTER 4 RESULTS CLINICAL EFFECTIVENESS, RESOURCE USE AND COST OF STATE-FUNDED HEALTH SERVICES BETWEEN STANDARD HOSPITAL CARE AND MIDWIFERY GROUP PRACTICE: RETROSPECTIVE STUDY ARM 2004–2010

Introduction

In Australia, resource allocation and cost of birthing services, including admission of public patients, are drawn from the acute care budget of hospitals managed by the state. While public hospitals receive a quantum of funding from the Commonwealth government they remain the responsibility and financial management of state governments. This chapter reports the results from the retrospective arm of the case record database analyses undertaken at one hospital in South Australia during the period 2004–2010. The purpose of the analyses was to compare clinical outcomes, resource use, and costs in Standard Hospital Care and Midwifery Group Practice models for women with moderately complex pregnancies and their babies.

Structure for Reporting Results–Retrospective Arm 2004–2010

Results are reported under two principal headings ‘Population Characteristics’, and ‘Clinical Effectiveness and Cost Results’. Population Characteristics included analysis of maternal and neonatal variables. Maternal characteristics included age, gravida, parity, and number of previous caesarean sections. Maternal race, country/region of birth, marital status, residential postcode (socioeconomic index for area classification), occupational status, body mass index, and smoking status were also considered. The neonatal characteristics that were examined included plurality (i.e. singleton or twin), clinical gestation, birth weight of baby, presence or absence of congenital abnormality, and outcome for the baby (e.g. discharged home, fetal death or stillbirth, neonatal death within 28 days, or hospitalised at 28 days). Clinical effectiveness and cost results were further subdivided under three headings:

1. Clinical Effectiveness Outcomes: hospital childbirth interventions and complications associated with care type
2. Resource Use: maternal hospital admissions, bed stay, and neonatal admissions to Special Care Baby Unit (SCBU)
3. Cost and Revenue Results: maternal admissions and route of birth costing: Standard Hospital Care and Midwifery Group Practice, Australian Refined Diagnostic Related Group Separations 2004–2010.

Population Characteristics Variables: Moderate-Risk Pregnancy Classification

One of the objectives of the study was to analyse the population characteristics of women accessing the Standard Hospital Care and Midwifery Group Practice model so that any variations in population profile for women of moderate-risk pregnancy classification between the groups could be determined. The broad range of demographic and socioeconomic characteristics of women and babies outlined were examined.

Maternal age, gravida, parity, number of previous caesarean sections

When the normality of the data was examined, it was found that both groups were significantly skewed. Therefore, the Mann-Whitney U test was used to compare the Standard Hospital Care and Midwifery Groups (Green & Salkind 2008) (Appendix 4.22). Table 4.1 summarises the median and interquartile range of maternal characteristics for age, gravida, parity and number of previous caesarean sections between groups.

Table 4-1 Median (IQR) of womens' characteristics SHC and MGP groups

Characteristics/Potential Confounders	Care type		P value
	SHC (n = 9,442)	MGP (n = 2,964)	
Age, y,	29.0 (24.0–34.0)	31.0 (27.0–35.0)	<0.001
Gravida	2.0 (1.0–3.0)	2.0 (1.0–3.0)	0.06
Parity	1.0 (0–2.0)	1.0 (0–1.0)	<0.01
Number of previous caesareans	0 (0–1.0)	0 (0–0)	<0.001
Nulliparous	n %	n %	
Not nulliparous	5,575 (59.0)	1,762 (59.5)	0.71
Nulliparous	3,867 (41.0)	1,202 (40.5)	0.71

Key: SHC = Standard Hospital Care; MGP = Midwifery Group Practice; IQR = Interquartile range; p values are based on the Mann-Whitney U test; yellow highlight indicates significant results

Women who received services from Standard Hospital Care were younger (median age = 29 years) than women who undertook care with the Midwifery Group Practice (median age = 31 years). This difference was consistent across all years examined in the study.

There were significant differences between the two groups of women in terms of their gravid and parity status. Women in the SHC group had significantly more pregnancies and babies than those in the MGP group. In addition, women in the SHC group were more likely than those in the MGP group to have had a caesarean section. There was no significant difference between groups for nulliparous women (Table 4.1).

Maternal Race, Country of Birth, Marital Status, Postcode, Occupation, Body Mass Index, Smoking Status

Specific population characteristics of women in both groups have been summarised in Table 4.2. An association with care type was found to be statistically significant for race, country of origin, marital status, residential postcode, occupation, body mass index, and smoking status. Significance levels for subanalyses of characteristics have been indicated on tables that follow.

Table 4-2 Women's characteristics between SHC and MGP groups 2004–2010

Characteristics/Potential Confounders	Care type SHC (n = 9,442)	Care type MGP (n = 2,964)	P value*
	n %	n %	
Race			<0.001
Caucasian	5,995 (63.5)	2,450 (82.7)	
Aboriginal, Torres Strait Island	386 (4.1)	52 (1.8)	
Asian	1,832 (19.4)	323 (10.9)	
Other (include Mid-East/Africa)	1,229 (13.0)	139 (4.7)	
Country of Birth			<0.001
Oceania & Antarctica	5,861 (62.1)	2,243 (75.7)	
Europe & USSR	567 (6.0)	246 (8.3)	
Middle East & Nth Africa	587 (6.2)	48 (1.6)	
South-East Asia	795 (8.4)	121 (4.1)	
North-East Asia	356 (3.8)	92 (3.1)	
Southern Asia	763 (8.1)	112 (3.8)	
Northern America	43 (0.5)	21 (0.7)	
South/Central America/Carribn	74 (0.8)	21 (0.7)	
Africa (excluding Nth Africa)	396 (4.2)	60 (2.0)	
Marital Status			<0.001
Married / De facto	7,077 (75.0)	2,493 (84.1)	
Widowed, divorced, separated	268 (2.8)	64 (2.2)	
Never married	2,065 (22.0)	400 (13.5)	
Unknown	32 (0.3)	7 (0.2)	
Postcode / SEIFA category#			<0.001
CBD/Nth Adelaide (SEIFA1)	123 (1.3)	73 (2.5)	
Nth/N East suburbs (SEIFA 6)	5,014 (53.1)	1,121 (37.8)	
West / Beach suburb (SEIFA 4)	2,702 (28.6)	946 (32.0)	
Southern suburbs (SEIFA 5)	920 (9.7)	384 (13.0)	
Eastern suburbs (SEIFA 2)	581 (6.2)	390 (13.2)	

Characteristics/Potential Confounders	Care type SHC (n = 9,442)	MGP (n = 2,964)	P value*
	n %	n %	
Adelaide hill suburbs (SEIFA 3)	102 (1.1)	50 (1.7)	
Maternal Occupation			**<0.001**
Managers and Administrators	363 (3.8)	204 (7.0)	
Professionals	590 (6.3)	472 (16.0)	
Associate professionals	516 (5.5)	325 (11.0)	
Tradespersons/related wkrs	334 (3.5)	106 (3.6)	
Advanced clerical / service wkr	529 (5.6)	220 (7.4)	
Clerical, sales, service workers	1,344 (14.2)	480 (16.2)	
Production/transport workers	64 (0.7)	11 (0.4)	
Elementary clerical/sale/servc	237 (2.5)	42 (1.4)	
Labourers and related workers	5,465 (58.0)	1,104 (37.3)	
Body Mass Index^			**<0.01**
Normal (18–25)	4,206 (54.5)	1,606 (57.6)	
Low <18	127 (1.7)	32 (1.2)	
Overweight (26–35)	2,707 (35.1)	946 (33.9)	
Obese II (36–40)	429 (5.6)	142 (5.1)	
Obese III (≥ 41)	246 (3.2)	60 (2.2)	
Smoking Status			**<0.001**
Nonsmoker	7,269 (77.0)	2,474 (83.5)	
Smoker	1,768 (18.7)	377 (12.7)	
Quit before first pregnancy visit	342 (3.6)	110 (3.7)	
Unknown	62 (0.7)	3 (0.1)	

Key: SHC = Standard Hospital Care; MGP = Midwifery Group Practice; **Bold p =** overall Chi-square; #SEIFA = Socioeconomic Index for Area where SEIFA 1 highest advantage and SEIFA 6 lowest advantage; ^ International Body Mass Index Categories (2015); BMI missing for n = 1905 records; p values based on Chi-square test; yellow highlight indicates significant results

Maternal race and country of birth

The majority of case records in this study were from women of Caucasian background (n = 8445) with migrant women comprising 36.4% of the total number of case records examined (n = 4901) (see Appendix 4.1 for a comprehensive listing for women's country of birth). A higher percentage of women who were Caucasian experienced services provided through Midwifery Group Practice (82.7% vs 63.5%; p<0.001), while significantly more women of Aboriginal, Torres Strait Islander, Asian, Middle Eastern and

African women were represented in Standard Hospital Care group than in MGP (Table 4.3).

Table 4-3 Women's race and country of birth SHC and MGP groups 2004–2010

Characteristics/Potential Confounders	Care type SHC (n = 9,442) n %	MGP (n = 2,964) n %	P value*
Race			**<0.001**
Caucasian	5,995 (63.5)	2,450 (82.7)	<0.001
Aboriginal, Torres Strait Island	386 (4.1)	52 (1.8)	<0.001
Asian	1,832 (19.4)	323 (10.9)	<0.001
Other (include Mid-East/Africa)	1,229 (13.0)	139 (4.7)	<0.001
Country of Birth			**<0.001**
Oceania & Antarctica	5,861 (62.1)	2,243 (75.7)	<0.001
Europe & USSR	567 (6.0)	246 (8.3)	<0.001
Middle East & Nth Africa	587 (6.2)	48 (1.6)	<0.001
South-East Asia	795 (8.4)	121 (4.1)	<0.001
North-East Asia	356 (3.8)	92 (3.1)	0.10
Southern Asia	763 (8.1)	112 (3.8)	<0.001
Northern America	43 (0.5)	21 (0.7)	0.13
South/Central America/Carribn	74 (0.8)	21 (0.7)	0.77
Africa (excluding Nth Africa)	396 (4.2)	60 (2.0)	<0.001

Key: SHC, Standard Hospital Care; MGP, Midwifery Group Practice; **Bold p =** overall Chi-square, rest = subanalyses; yellow highlight indicates significant results

Marital status

As seen in Table 4.4 the majority of women in both groups were either married or living in a de facto relationship. A significantly higher percentage of women who were single mothers received Standard Hospital Care services.

Table 4-4 Marital status of women in each service group 2004–2010

Characteristics/Potential Confounders	Care type: SHC (n = 9,442) n %	Care type: MGP (n = 2,964) n %	P value
Marital Status	7,077 (75.0)	2,493 (84.1)	**<0.001**
Married/De facto	268 (2.8)	64 (2.2)	<0.001
Widowed, divorced, separated	2,065 (22.0)	400 (13.5)	0.05
Never married	32 (0.3)	7 (0.2)	<0.001
Unknown			0.49

Key: SHC, Standard Hospital Care; MGP, Midwifery Group Practice; **Bold p =** overall Chi-square, rest = subanalyses; yellow highlight indicates significant results

Residential postcode

A total of 128 residential postcodes in the geographical range 5000–5174 (Adelaide metropolitan and surrounds) were recorded for women in the retrospective arm of the study (Appendix 3.6). For the analysis, the postcodes were grouped into six subregional clusters using statistical local areas and socioeconomic index for advantage (SEIFA; see methods, p. 90). Appendix 3.7 presents the six postcode cluster subregions and SEIFA categories in full.

It was found that women who lived in regions of higher economic status (e.g. SEIFA 1 and 2) were significantly more likely to receive MGP services than those living in lower economic status regions (e.g. SEIFA 6), who were more likely to receive Standard Hospital Care (Table 4.5).

Table 4-5 SEIFA status of women receiving either SHC or MGP 2004–2010

Characteristics/Potential Confounders	Care type		P value
	SHC (n = 9,442)	MGP (n = 2,964)	
	n %	n %	
Postcode/SEIFA category*			**<0.001**
CBD/Nth Adelaide (SEIFA1)	123 (1.3)	73 (2.5)	<0.001
Nth/N East suburbs (SEIFA 6)	5,014 (53.1)	1,121 (37.8)	<0.001
West / Beach suburb (SEIFA 4)	2,702 (28.6)	946 (32.0)	<0.001
Southern suburbs (SEIFA 5)	920 (9.7)	384 (13.0)	<0.001
Eastern suburbs (SEIFA 2)	581 (6.2)	390 (13.2)	<0.001
Adelaide hill suburbs (SEIFA 3)	102 (1.1)	50 (1.7)	0.01

Key*:* SHC = Standard Hospital Care; MGP = Midwifery Group Practice; **Bold p** = overall Chi-square, rest = subanalyses; yellow highlight indicates significant results; SEIFA = Socioeconomic index for advantage; *SEIFA 1= highest advantage, SEIFA6 = lowest advantage

Maternal occupation

As observed with SEIFA categories, those women who indicated having an occupation listed in the top three Australian Standard Classification for Occupation (ASCO), categories (i.e. managers, administrators, professionals, and associate professionals) were more likely to receive MGP services (Table 4.6). Conversely, women who indicated occupations listed in the lowest two ASCO categories (i.e. elementary clerical, sales and service workers and labourers and related workers) were more likely to receive SHC (Table 4.6).

Table 4-6 Occupational status between SHC and MGP groups 2004–2010

Characteristics/Potential Confounders	Care type		P value
	SHC (n = 9,442)	MGP (n = 2,964)	
	n %	n %	
Maternal Occupation			**<0.001**
Managers and Administrators	363 (3.8)	204 (7.0)	<0.001
Professionals	590 (6.3)	472 (16.0)	<0.001
Associate professionals	516 (5.5)	325 (11.0)	<0.001
Tradespersons / related wkrs	334 (3.5)	106 (3.6)	0.97
Advanced clerical / service wkr	529 (5.6)	220 (7.4)	<0.001
Clerical, sales, service workers	1,344 (14.2)	480 (16.2)	<0.01
Production / transport workers	64 (0.7)	11 (0.4)	0.08
Elementary clerical/sale/servc	237 (2.5)	42 (1.4)	<0.001
Labourers and related workers	5,465 (58.0)	1,104 (37.3)	<0.001

Key: SHC = Standard Hospital Care; MGP = Midwifery Group Practice; **Bold p** = overall Chi-square, rest = subanalyses; yellow highlight indicates significant results

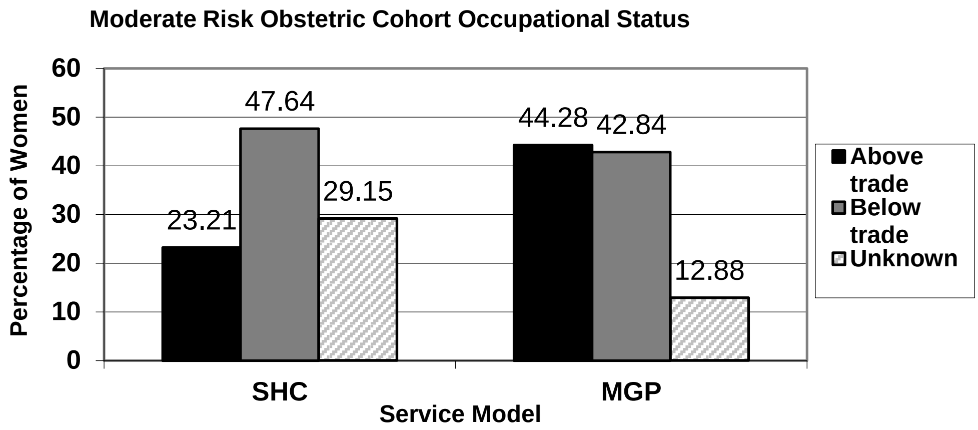
When the nine occupational classification codes were benchmarked against the five Australian Standard Classification Occupation codes for skill level (see Table 4.7) and aggregated into three categories, ‘above trade’, ‘below trade’, or ‘unknown’, there was still a significantly higher proportion of women represented in ‘below trade’ occupations in Standard Hospital Care group compared to Midwifery Group Practice (Figure 4.1).

Table 4-7 Australian Standard Classifications: Occupation & Skill Level

ASCO Code	ASCO Occupational Group	Skill Level*	Aggregate Codes used in Figure 5.1
1	Managers and Administrators	1	Above Trade
2	Professionals	1	
3	Associate Professionals	2	
4	Tradespersons and Related Workers	3	
5	Advanced Clerical and Service Workers	3	
6	Intermediate Clerical, Sales & Service Workers	4	Below Trade
7	Intermediate Production & Transport Workers	4	
8	Elementary Clerical, Sales and Service Workers	5	
9	Labourers and Related Workers	5	
	Students, Pensioners, Women: 'home duties', unemployed		Unknown

Note. *Defined by Australian Qualifications Framework (AQF) Levels, ASCO Second Edition (ABS 1997)

1 = Bachelor Degree, or higher, or at least 5 years of experience; 2 = Diploma or Advanced Diploma, or at least 3 years of experience; 3 = Skill commensurate with AQF Certificate III or IV, or at least 3 years of experience; 4 = Skill commensurate with AQF Certificate II or at least 1 year relevant experience; 5 = Skill level commensurate with completion of compulsory secondary education or AQF Certificate 1 qualification.



Key: SHC = Standard Hospital Care; MGP = Midwifery Group Practice

Figure 4-1 Maternal occupation: Aggregated for Skill Level Moderate-Risk Pregnancy Classification SHC and MGP 2004–2010

The 'unknown' group included those recorded on the Supplementary Birth Record as students, pensioners, women undertaking 'home duties', and the unemployed. However, even when the unknown group were excluded and frequencies were recalculated there was still a significantly higher proportion of women represented in ‘below trade’ occupations in Standard Hospital Care group compared to Midwifery Group Practice (67.2% vs 49.2%; ($\chi 2$ = 289.18), $p<0.001$).

Appendices 4.2 and 4.3 show frequency and percentage tables for both maternal and paternal occupations. These were coded from State Supplementary Birth Record data and included all nine Australian Standard Classification Occupation codes. As shown paternal occupations mirrored maternal occupations.

Body mass index

As there is an increased burden of disease and adverse outcomes where pregnancy BMI lies outside the normal range (18.5–24.9), (World Health Organization 2014; Yao et al. 2014), the BMI of women participating in this study was examined. It was found that women who received MGP were more likely to have a BMI in the normal range than those in the SHC group. In addition, significantly more women classified as Obese III received standard hospital care (Table 4.8).

Table 4-8 Body Mass Index of women in SHC and MGP groups 2004–2010

Characteristics/Potential Confounders	Care type		P value
	SHC (n = 9,442)	MGP (n = 2,964)	
	n %	n %	
Body Mass Index#			**<0.01**
Normal (18–25)	4,206 (54.5)	1,606 (57.6)	<0.01
Low <18	127 (1.7)	32 (1.2)	0.08
Overweight (26–35)	2,707 (35.1)	946 (33.9)	0.29
Obese II 36–40	429 (5.6)	142 (5.1)	0.38
Obese III ≥ 41	246 (3.2)	60 (2.2)	<0.01

Key: SHC = Standard Hospital Care; MGP = Midwifery Group Practice; **Bold p** = overall Chi-square, rest = subanalyses; yellow highlight indicates significant results; # = International Body Mass Index Categories (2015); BMI missing for n = 1905 records

Smoking status

Short and longer term complications for mother and babies have been associated with maternal tobacco use in pregnancy (Cancer Council Australia 2014). It was significant that a greater percentage of women who were recorded as smokers received services in Standard Hospital Care as compared with Midwifery Group Practice (18.7% vs 12.7%; p<0.001) (Table 4.9).

Table 4-9 Smoking status of women in SHC and MGP groups 2004–2010

Characteristics/Potential Confounders	Care type		P value
	SHC (n=9,442)	MGP (n = 2,964)	
	n %	n %	
Smoking Status	7,269 (77.0)	2,474 (83.5)	**<0.001**
Nonsmoker	1,768 (18.7)	377 (12.7)	<0.001
Smoker	342 (3.6)	110 (3.7)	<0.001
Quit before first pregnancy visit	62 (0.7)	3 (0.1)	0.87
Unknown			–

Key: SHC, Standard Hospital Care; MGP, Midwifery Group Practice; **Bold p =** overall Chi-square, rest = subanalyses; yellow highlight indicates significant results; – p value could not be calculated due to small cell frequencies

Population characteristics of babies of women with moderate risk, plurality, clinical gestation, birth weight, congenital abnormality, outcome for baby

As there were significant differences in the demographic characteristics of women who used either the SHC or MGP services it was decided to examine the characteristics of babies born to mothers under Standard Hospital Care and Midwifery Group Practice (Table 4.10).

Table 4-10 Babies' characteristics between SHC and MGP groups 2004–2010

Characteristics/Potential Confounders	Care type		P value
	SHC (n = 9,442)	MGP (n = 2,964)	
	n %	n %	
Plurality			**<0.02**
Singleton	9,308 (98.6)	2,939 (99.2)	0.02
Twin	134 (1.4)	25 (0.8)	0.02
Clinical Gestation of Baby			**<0.003**
37–43 weeks	9,015 (95.5)	2,872 (96.9)	<0.001
28–36 weeks	404 (4.3)	88 (3.0)	<0.01
20–27 weeks	23 (0.2)	4 (0.1)	0.38
Birth Weight of Baby			**<0.001**
3000 grams +	7,378 (78.1)	2,515 (85.0)	<0.001
<3000 grams	1,961 (20.8)	431 (14.5)	<0.001
<2000 grams	103 (1.1)	18 (0.6)	0.03
Congenital Abnormality			**0.64**
No congenital abnormality	9,168 (97.7)	2,881 (97.6)	0.7
Congenital abnormality present	215 (2.3)	72 (2.4)	0.7
Outcome for Baby			**0.07**
Discharged < 28 days of birth	9,343 (99.0)	2,944 (99.4)	0.09
Fetal death or stillbirth	32 (0.3)	10 (0.3)	0.99
Neonatal death (within 28 days)	46 (0.5)	7 (0.2)	0.1
In hospital @ 28 days or transfer	18 (0.2)	1 (0.03)	–

Key: SHC = Standard Hospital Care; MGP = Midwifery Group Practice**; Bold p** = overall Chi-square, rest = subanalyses; yellow highlight indicates significant results; – p value could not be calculated due to small cell frequencies; Congenital Abnormality n = 70 missing records

A significant association with care type was found for clinical gestation of baby and birth weight of baby. More women receiving Standard Hospital

Care gave birth to pre-term babies than those receiving MGP, and were more likely to give birth to babies weighing less than 3000 grams. While it should be noted that pre-term birth may be correlated with low birth weight, this is not always the case. Babies born to women in the MGP group, on the other hand, were more likely to be full term (>37 weeks) (Table 4.10). No significant association with care type was found for plurality, babies with a congenital abnormality or outcomes for the baby (Table 4.10).

Summary: Population characteristics of women and babies

In summary, the population characteristics for the moderate pregnancy risk classification dataset indicated that women undertaking care in the Midwifery Group Practice model were older (Table 4.1), more likely to be Caucasian and partnered (Table 4.2). These women also had a greater likelihood of English as their first language and significantly more of the MGP group were born in Australia, United Kingdom, Ireland, New Zealand, Europe and North America (Appendix 4.1). The analysis further showed that women receiving Midwifery Group Practice had higher levels of representation in 'above trade' occupations represented by ASCO skill classifications of managers/administrators, professionals and paraprofessionals (Figure 4.1, p. 134), as did their partners (Appendix 4.3).

A lower percentage of women who received services in Midwifery Group Practice were from areas of economic disadvantage; for example, North and North-Eastern suburbs, SEIFA area 6. SEIFA 6 was ranked among the five most disadvantaged statistical local areas for the greater Adelaide region (Glover et al. 2006 p. 499) (see Table 4.2, p. 128). There were greater numbers of women who received care in Midwifery Group Practice represented in Eastern suburbs, SEIFA area 2, which was ranked among the most advantaged statistical local areas for the greater Adelaide region, as based on the national Index of Relative Socioeconomic Disadvantage (Australian Bureau of Statistics 2008) (Table 4.2). Moreover, there was less variation in the parity and number of previous recorded caesarean sections for women receiving Midwifery Group Practice (Table 4.1, p.127). The women in the MGP group also were more likely to have a body mass index in the normal range ($p<0.01$) and less likely to smoke ($p<0.001$) (Table 4.2).

The babies of women who received services through Midwifery Group Practice also demonstrated significantly different characteristics to those who received Standard Hospital Care services. MGP babies were more likely to have a clinical gestation greater than 37 weeks ($p<0.001$) and a birth weight greater than 3000 grams ($p<0.001$)(Table 4.10, p. 137). These population characteristics, including their influence and potential confounding effect on other outcomes, namely resource use and cost, were taken into account in the multivariate regression cost model results described later in this chapter.

Clinical Effectiveness and Cost – Results Clinical Effectiveness Outcomes

Hospital childbirth interventions and complications associated with care type

The aim of this section was to determine if there was any significant difference in common childbirth interventions, mode of birth, or morbidity for women with complex pregnancies who received care in Standard Hospital Care as compared with those who received care in Midwifery Group Practice. Clinical variables known to affect resource consumption, length of stay and the costs of care for women and babies were extracted from the hospital High Risk Patient Service dataset (methods chapter Table 3.4, p. 93) (Commonwealth Department of Health and Ageing 2010).

Logistic regression was undertaken for the clinical variables described in Table 3.4. It was used to examine the strength of association between clinical outcomes of interest for women with moderate-risk pregnancy classification and care type. Outcomes that demonstrated a strong association with care type have been highlighted (Table 4.11).

Table 4.11 showed that medical intervention in childbirth was associated with the group care type. Women who received Standard Hospital Care had an increased likelihood of medical intervention in childbirth and decreased likelihood of spontaneous vaginal birth. Moreover, women who received Standard Care experienced the effect of additional serious childbirth-related morbidity associated with several of these interventions after birth across a number of core indicators. This constituted an additional burden for women who experienced complex pregnancy. Childbirth interventions interfered with important short-term health outcomes for mothers and babies; for example, bonding, breastfeeding, and rooming-in with mother at time of birth. Moreover, associated longer term morbidities, such as haemorrhage, infection, and wound breakdown resulted in extended hospital stay or readmission for treatment, increased resource use and increased costs for services.

Table 4-11 Birth Intervention Morbidity for Women with moderate-risk pregnancy receiving either SHC or MGP 2004–2010

Outcomes: Birth Intervention Morbidity Reference Group: Standard Hospital Care	Unadjusted Odds Ratio^	95% CI	p value	SHC (n = 10,077) n %	MGP (n = 3,385) n %
Epidural analgesia	0.70	0.64–0.76	<0.001	3,694 (36.7)	971 (28.7)
Induction of labour (caesarean excluded)	0.69	0.65–0.75	<0.001	3,143 (36.3)	844 (26.9)
(caesarean not excluded)			<0.001	3, 143 (31.2)	844 (24.9)
Episiotomy received	0.75	0.66–0.86	<0.001	1,227 (12.2)	320 (9.5)
Intact perineum (caesareans excluded)	1.13	1.03–1.24	0.008	2,589 (36.1)	1,037 (39.0)
1 Degree Tear	1.53	1.36–1.72	<0.001	971 (9.6)	474 (14.0)
2 Degree Tear	1.03	0.94–1.13	0.53	2,323 (23.1)	798 (23.6)
3 Degree Tear	1.01	0.81–1.27	0.92	303 (3.01)	103 (3.04)
4 Degree Tear	-	-	-	23 (0.23)	8 (0.24)
Spontaneous vaginal birth	1.52	1.40–1.65	<0.001	5,783 (57.4)	2,272 (67.1)
Instrumental birth	0.80	0.71–0.91	<0.001	1,365 (13.6)	378 (11.2)
Elective caesarean	0.45	0.39–0.52	<0.001	1,305 (13.0)	213 (6.3)
Emergency caesarean	0.95	0.85–1.06	0.34	1,590 (15.8)	511 (15.1)
PPH ≥ 500 ml	0.83	0.75–0.92	<0.001	2,292 (32.0)	687 (28.2)
PPH ≥ 1500 ml	0.93	0.69–1.25	0.63	186 (2.6)	59 (2.4)
Postnatal infection prior to discharge ᴥ	0.64	0.40–1.02	0.060	98 (0.97)	21 (0.62)

Key: ^ = Logistic regression; p values used Pearson Chi-square; yellow highlight indicates significant results; – sample size too small for regression analysis; ᴥ = Postnatal infection included maternal infections of urinary tract, breast, wound and systemic infection

Logistic regression analysis showed women with pregnancies classified as moderate risk were 30% less likely to utilise epidural analgesia in labour when receiving care through the Midwifery Group Practice than were women in Standard Hospital Care group. There were also fewer women in MGP induced when compared to SHC (24.9% vs 31.2%). Moreover, when the elective caesarean cases were excluded from the sample, enabling accurate comparison of induced birth with spontaneous onset of labour only, the proportion of women in Midwifery Group Practice (26.9%) who were induced was again lower than the proportion in Standard Hospital Care (36.3%; p<0.001) (see Table 4.11).

As shown in Table 4.11, women who received care in the Midwifery Group Practice were significantly more likely to have a spontaneous vaginal birth and 55% less likely to experience elective caesarean surgery than women in SHC. There were, however, no differences found between groups when only emergency caesarean sections were considered (Table 4.11).

Perineal status is an important clinical indicator that has been shown to be associated with short- and longer term morbidity outcomes for women (Baghurst 2013). While regression analysis showed women in Midwifery Group Practice were 25% (95% CI 0.66–0.86) less likely to experience surgical incision of their perineum during childbirth (episiotomy), the likelihood of having a first-degree perineal tear was actually greater for women in this group compared to women in Standard Hospital Care (OR 1.53; 95% CI 1.36–1.72) (see Table 4.11). First-degree perineal tears, however, constituted the least severe classification of perineal injury, involving the skin layer only. When all caesarean cases were excluded (to minimise the confounding effect of increased rates of elective caesarean section for women receiving Standard Hospital Care), the likelihood of maintaining an intact perineum remained greater for women in Midwifery Group Practice, compared with women who received Standard Hospital Care (OR 1.13; 95% CI 1.03–1.24).

Primary postpartum haemorrhage was another important clinical indicator that has been shown to be associated with short- and longer term morbidity outcomes for women (Knight, Callaghan & Berg 2009). Rates for primary postpartum haemorrhage ≥ 500 ml at birth, therefore, were compared for women in both groups. In this study PPH ≥ 500 ml was also found to be significantly associated with model of care as women in Midwifery Group Practice were 17% (95% CI 0.75–0.92) less likely to have a primary postpartum haemorrhage (PPH) ≥ 500 ml following birth than women in Standard Hospital Care (Table 4.11). No differences between groups were noted when considering catastrophic postpartum haemorrhage (PPH ≥ 1500 ml).

No effect for care type across several key indicators was found (Table 4.11). These included the likelihood of severe perineal injury (i.e. second- and third-degree tears); the odds of emergency caesarean section and catastrophic postpartum haemorrhage PPH ≥ 1500 ml; and the odds of postnatal maternal infections such as urinary tract, breast, wound, and systemic infections prior to discharge from hospital (Table 4.11).

Resource Use Maternal Hospital Admissions, Bed Stay, and Admissions to Special Care Baby Unit in Standard Hospital Care and Midwifery Group Practice

A further objective of this study was to analyse patterns of variation in hospital resource use for mothers with a moderate-risk pregnancy classification and their babies. Therefore, resource variables from the National Hospital Cost Data Report were linked to public hospital expenditure and staffing in the care of childbearing women and their infants (Commonwealth Department of Health and Ageing 2010) (Table 3.4, p. 93). A non-parametric Mann-Whitney U test was used to compare Standard

Hospital Care and Midwifery Group Practice (Green & Salkind 2008). Median and interquartile range were reported as count data were skewed. Table 4.12 summarises the use of resources, hospital admissions and bed stay for women and babies in both groups. The analyses in this study considered: number of antenatal visits, number of antenatal hospital admissions (including the range of days admitted for each service group), number of women's hospital emergency presentations for short-term assessment, postnatal maternal bed stay, babies' bed stay (whole days) in Special Care Baby Unit (Levels 2 and 3). The proportion of Special Care Baby Unit admissions overall (Levels 1, 2 and 3) was contrasted with the proportion of neonates who directly 'roomed in' with their mothers at time of birth (Chi-square test).

Table 4-12 Resource Use, Hospital Admissions, Bed Stay: Women with moderate-risk pregnancy SHC and MGP 2004–2010

Resource/facility use & hospitalisation	Standard Hospital Care	Midwifery Group Practice	p value
Antenatal Visits			
median (IQR)	9 (3–23) visits	10 (3–29) visits	p<0.001*
Antenatal Admissions to Hospital %			
1 visit	13.10%	9.50%	
>1 visit	3.40%	1.40%	p<0.001**
(Range of hospital stay for Antenatal Admissions)	(0–40 days)	(0–12 days)	p<0.001**
Number of Women's Emergency Presentations/Short Assessment Services			
median (IQR)	1 (0–2) presentations	0 (0–1) presentations	p<0.001*
Postnatal Maternal Stay (whole days)			
median (IQR)	3 (0–2) days	3 (0–2) days	p=0.06
Babies Bed Stay SCBU[ő] median (IQR)			
Level 2 Baby Unit	2 (0–6)	2 (0–5)	p<0.001*
Level 3 NICU	1 (0–4)	1 (1–4)	p<0.001*
Babies Admitted to SCBU			
Levels 1 2 3 Combined (%)	35.3% (n = 3, 556)	24.8% (n = 839)	p<0.001**
Babies direct rooming-in with mother Combined (%)	64.7% (n = 6, 518)	75.2% (n = 2, 545)	p<0.001**

Key: *Mann-Whitney U test; **Chi-square test (proportions); SCBU = Special Care Baby Unit; NICU = Neonatal intensive care unit; [ő] = Level 1 SCBU admissions not included as not in whole days; yellow highlight indicates significant results

Emergency Presentations, Antenatal Admissions, Hospital Bed Stay, Use of Special Care Baby Unit

Resource use by women in SHC and MGP 2004–2010

While women in Standard Hospital Care had fewer antenatal visits (9 antenatal visits) compared with Midwifery Group Practice (10), lower proportions of resources were used overall in MGP service (Table 4.12). Women receiving SHC service were more likely to be admitted to hospital during the antenatal period, and require more than one hospital antenatal admission than women receiving the MGP service. They also had greater emergency presentations / short assessment services than women in the

MGP group. No difference was found between groups in the median for overall length of maternal postnatal stay in whole days (Table 4.12).

Resource use by neonates in SHC and MGP 2004–2010

When the resource use by neonates was examined, it was noted that a larger proportion of babies born to women receiving Standard Hospital Care with moderate-risk pregnancy classification were admitted to the Special Care Baby Unit across all levels of acuity (Levels 1, 2, 3, combined %), (35.3% SHC vs 24.8% MGP; $p<0.001$). This result also was mirrored in the proportion of babies who were able to ‘direct room in’ with their mothers immediately after birth as fewer Standard Hospital Care babies directly roomed in as compared with those from Midwifery Group Practice (64.7% vs 75.2%; $p<0.001$)(Table 4.12).

In addition to comparing the clinical effectiveness and resource use associated with each of the two study groups, database analyses of cost and revenue for maternal hospital admissions and route of birth based on women’s hospital separation data was undertaken. This included analyses of Australian Refined Diagnostic Related Group cost data for the period 2004–2010. These results are presented below.

Cost and Revenue Results Maternal Admissions and Route of Birth Costing: SHC and MGP Australian Refined Diagnostic Related Group Separations 2004–2010

Australian Refined Diagnostic Related Groups comprise a classification system based on specific diagnostic categories. Australian Refined Diagnostic Related Group codes are generated with hospital separation data to inform activity-based funding in both the public and private sectors of the

Australian health system. They provide a national framework for benchmarking, funding and planning hospital-based services, and for reporting in the National Hospital Cost Data Collection (Commonwealth Department of Health and Ageing 2010; Independent Hospital Pricing Authority [IHPA] 2013; Women's Healthcare Australasia 2015).

In this study, Australian Refined Diagnostic Related Group hospital separation data for mode of birth, same-day antenatal admissions, antenatal and obstetric admissions, and postnatal admissions was provided by Health Informatics South Australia for years 2004–2010 (fiscal years June 2003–June 2011). This section of the analyses sought to answer the question: Did Standard Hospital Care and Midwifery Group Practice services differ in the public cost and revenue generated for Australian Refined Diagnostic Related Group separations for mode of birth and hospital admissions during this period?

For this section of the study, separation data were extracted from the Integrated South Australian Activity Collection (ISAAC) for 26 codes, including cost and revenue streams for Standard Hospital Care and Midwifery Group Practice. Appendices 3.8 and 3.9 contain the summary of Australian Refined Diagnostic Related Group obstetric code descriptions for Versions 5.1, 5.2, and Version 6. The appendices include the date ranges and coding changes that were relevant to this arm of the study. Prior to analyses, the 26 codes were reduced to 15 to enable meaningful statistical analysis (see Methods, p. 91). This included retention of 13 original codes; combining two codes (O66A and O66Z for the same category into one:

Antenatal and Other Obstetric Admissions); and combining a further 11 infrequent or ceased codes into a single collapsed category, ‘Other’. Other showed a cumulative total of only seven matched separation episodes after inclusion of all 11 category codes (Appendix 3.9).

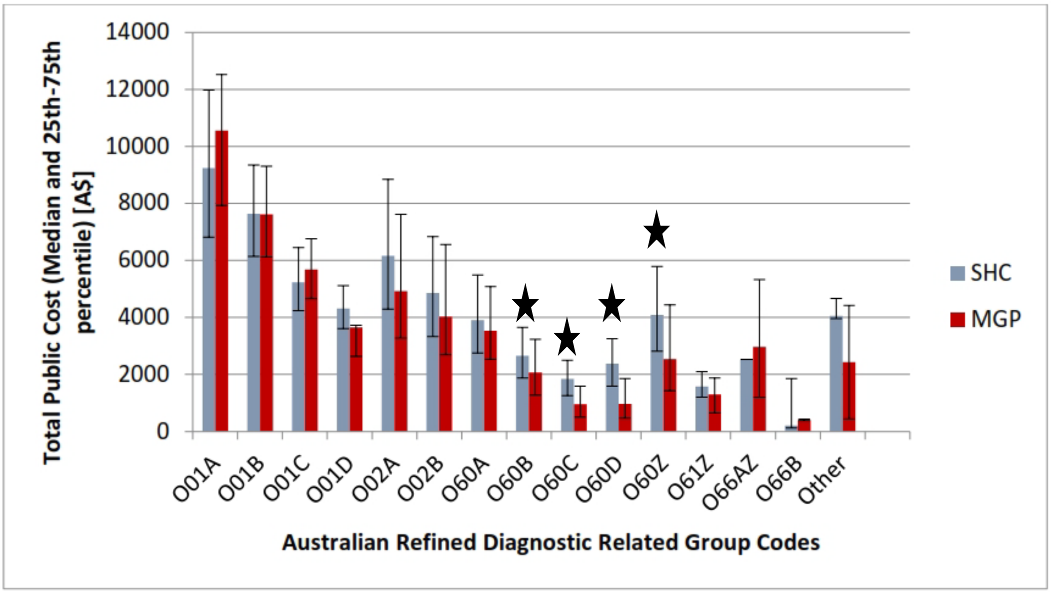
Missing data

As described in methods (p. 90), cost data for 253 women (1.9% of the total retrospective sample) was ‘missing’ from the ISAAC dataset provided by Health Informatics. The ISAAC cost and revenue data for these 253 case records remained ‘unavailable’ after the researcher requested a hospital audit for 216 records from MGP service (6.4% of MGP records) and 37 records from SHC service (0.37% of SHC records). No separation data, cost or revenue stream data were coded, recorded, or available for these records in the ISAAC database. The most significant cluster of missing data occurred in the Midwifery Group Practice sample for February–June of the 2006 calendar year (n = 193). While the percentage of missing data was small, it constituted a limitation of the findings in relation to cumulative costing, particularly for the 2006 year.

The multivariate analysis results for hospital cost and revenue trends reported against national Australian Refined Diagnostic Related Group codes for obstetric and neonatal separation data for the period 2004–2010 follows. Generalised linear models were used to examine the effect of confounders on state hospital costs and revenue for both groups of women in the study. A summary subanalyses of AR–DRG code costs for the combined hospital (ISAAC dataset), was also completed (Appendix 4.4). This provided a hospital benchmark for comparisons between the groups for 13 high volume and/or high cost hospital AR DRGs. These included: antenatal and other obstetric admissions, vaginal birth (with and without complications), caesarean surgery (with and without complications), and postpartum admissions without an operating room procedure (Appendix 4.4).

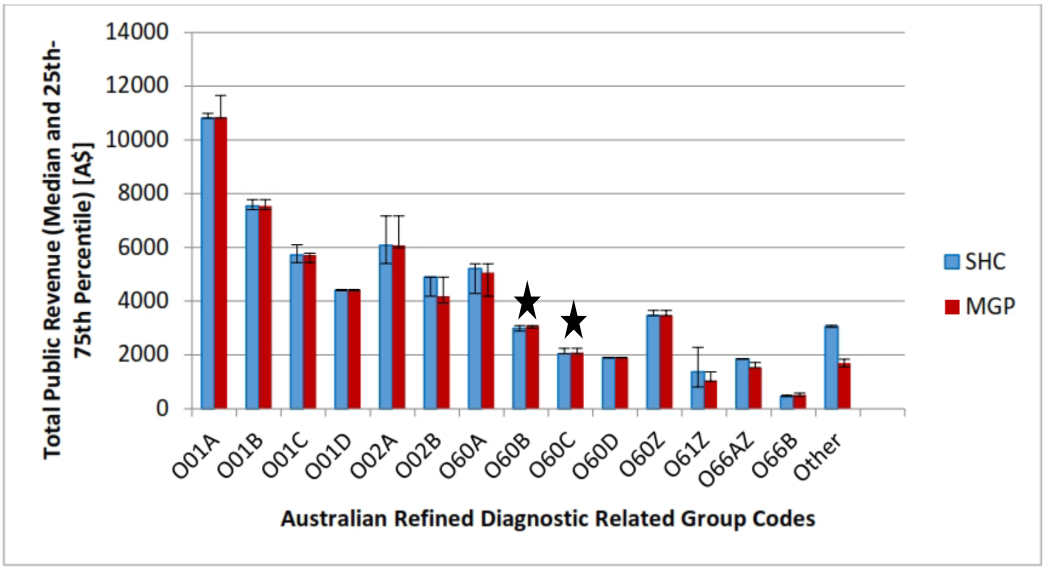
Total Public Hospital Cost and Revenue for SHC and MGP Diagnostic Related Group Separations 2004–2010

The total median public hospital costs and revenues for each of the study groups are summarised in Figures 4.2 and 4.3 (corresponding Appendices 4.5 and 4.6).



Key: See Appendices 3.8 and 3.9 for DRG separation codes (Legend included on next page); black bars show interquartile range; ★ indicates significant results

Figure 4-2 Total public cost DRG Separation Codes SHC vs MGP 2003/04–2010/11



Key: See Appendices 3.8 and 3.9 for DRG separation codes (Legend included below); black bars show interquartile range; ★indicates significant results

Figure 4-3 Total public revenue DRG Separation Codes SHC vs MGP 2003/04–2010/11

Legend for AR–DRG Separation Codes–Figures 4.2 and 4.3

DRG Code	Diagnostic Related Group Code Descriptions
O01A	Lower segment caesarean section, catastrophic complication
O01B	Lower segment caesarean section, severe complex
O01C	Lower segment caesarean section, moderate complex
O01D	Lower segment caesarean section, no complications
O02A	Vaginal birth, catastrophic complication
O02B	Vaginal birth, complex, operating room
O60A	Vaginal birth, multiple complications
O60B	Vaginal birth, some complexity
O60C	Vaginal birth, complicated
O60D	Vaginal birth, no complexity
O60Z	Vaginal birth, uncomplicated
O61Z	Postnatal admission, no operating theatre
O66AZ	Same-day antenatal admission
O66B	Antenatal or obstetric admission
Other	Included 11 codes–see Appendix 3.8 and 3.9 for full listing

As can be seen, a significant association between care type and public hospital cost was found only for four codes (O60B; O60C; O60D; O60Z). These codes were related to categories of uncomplicated and complicated vaginal birth with varying levels of complexity. In each case the median cost was higher in Standard Hospital Care as compared to Midwifery Group Practice ($p<0.001$). By contrast, associations between care type and public hospital revenue were shown across only two codes (Figure 4.3; Appendix 4.6). Median revenue generated was lower in two categories of complicated vaginal birth in Standard Hospital Care as compared to Midwifery Group Practice (O60B, $p=0.03$; O60C, $p=0.01$).

Factors Contributing to Total Cost and Revenue for SHC and MGP Services

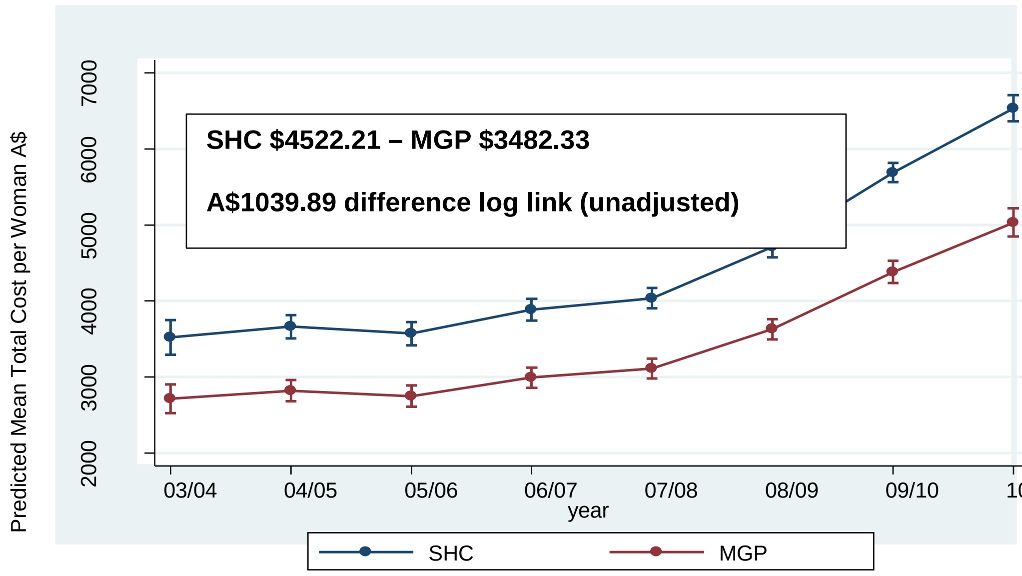
As one of the aims of this study was to identify the total public cost and revenue differences generated between groups over time, and, to identify those confounders that had a statistically significant influence on cost and revenue differences between groups, including measurement of the cost influence, unadjusted and adjusted multivariate generalised linear model with log link function were used to examine the data.

Figures 4.4 and 4.5 provide a snapshot of outcomes for total cost, and Figures 4.6 and 4.7 of outcomes for total revenue that compared Standard Hospital Care and Midwifery Group Practice during the period examined. The models shown are unadjusted (i.e. confounders not accounted for in the model), and adjusted (i.e. 18 confounders accounted for in the model).

Appendices 4.7 and 4.8 show the corresponding referents, coefficient (β) values, 95% CI, and p values calculated for each fiscal year in both unadjusted and adjusted cost and revenue generalised linear models, respectively, for the fiscal years 2003/04–2010/11. Coefficient values for the 18 confounders and their subcategories (adjusted models) were important to interpret the percentage effects (measured in Australian dollars A$) that each confounder may have had on the cost and revenue results shown in the models (Tabachnick & Fidell 2013, p. 920). Appendix 4.7 also shows the predicted mean cost total across years 2003/04–2010/11 for SHC and MGP services in Australian dollars for the cost (adjusted) multivariate generalised linear model (Figure 4.5). Similarly, Appendix 4.8 shows the predicted mean revenue total across years 2003/04–2010/11 for SHC and MGP services in Australian dollars for the revenue (adjusted) multivariate GLM model (Figure 4.7)

Variables contributing to increased total public hospital cost

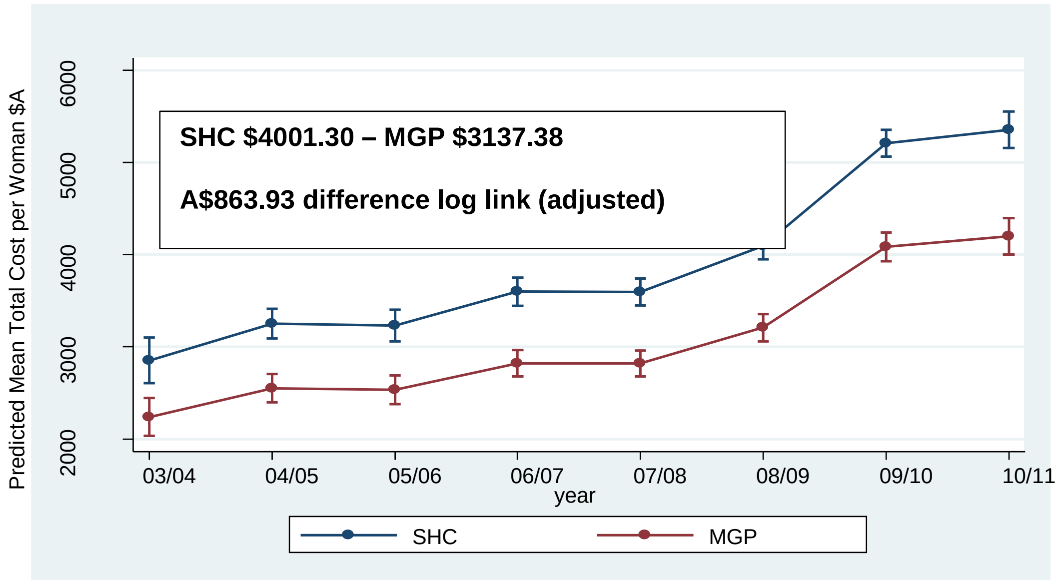
Figures 4.4 and 4.5 indicate that cost per year per woman increased in both Standard Hospital Care service and Midwifery Group Practice for the period 2003/04–2010/11, in both unadjusted and adjusted models. When the unadjusted model (Figure 4.4) is examined, it was noted that total mean hospital costs were greater for separations in Standard Hospital Care by $1039.89 per woman for fiscal years 2003/04–2010/11. When confounders (Figure 4.5) were accounted for, the total average costs for separations were still higher in SHC than MGP by $863.93.



Key. SHC = Standard Hospital Care; MGP = Midwifery Group Practice; Vertical Bars = 95% CI; A$ = Australian Dollars

Figure 4-4 Public Hospital Cost by Year and Care Type (unadjusted) Standard Hospital Care vs Midwifery Group Practice 2003/04–2010/11

(Generalised linear model [Gaussian family] with log link function) p<0.001



Key. SHC = Standard Hospital Care; MGP = Midwifery Group Practice; Vertical Bars = 95% CI; A$ = Australian Dollars

Figure 4-5 Public Hospital Cost by Year and Care Type (confounders adjusted) Standard Hospital Care vs Midwifery Group Practice 2003/04–2010/11

(Generalised linear model [Gaussian family] with log link function) p<0.001

Maternal variables significantly associated with total cost

The maternal variables that were significantly associated with total cost in the generalised linear model have been highlighted in Appendix 4.7. As shown by the β coefficients (weights) assigned to the predictor variables, β overall cost was 0.77; 95% CI 0.75–0.79 (unadjusted model), and 0.79; 95% CI 0.76–0.82 (adjusted model) for MGP service, as compared with the referent SHC, p<0.001.Maternal age (β = 1.01; 95% CI 0.01–1.02) and parity (β = 0.89; 95% CI 0.87–0.91) significantly increased cost, as did the number of previous caesarean sections (β = 1.39; 95% CI 0.37–1.42), p<0.001 (Appendix 4.7). Women from the Middle East and North Africa, Southern Asia, South/Central America/Caribbean, and Africa (excluding North Africa) subcategories also were all associated with cost increases (Ranges of β: 1.16; 95% CI 1.05–1.28, p<0.003; 1.17; 95% CI 1.06–1.31, p<0.003; 1.19; 95% CI 1.04–1.37, p<0.01; 1.18; 95% CI 1.07–1.30, p<0.001, respectively) (Appendix 4.7). Other maternal variables that increased cost included, body mass index (Overweight β = 1.13; 95% CI 1.10–1.16), and Obese II β = 1.23; 95% CI 1.16–1.30), and Obese III category β = 1.33; 95% CI 1.24–1.41), the 'unknown' category for smoking status (β = 3.16; 95% CI 2.73–3.65), and nulliparity (β = 1.44; 95% CI 1.36–1.52), p<0.001 (Appendix 4.7).

Infant variables significantly associated with total cost

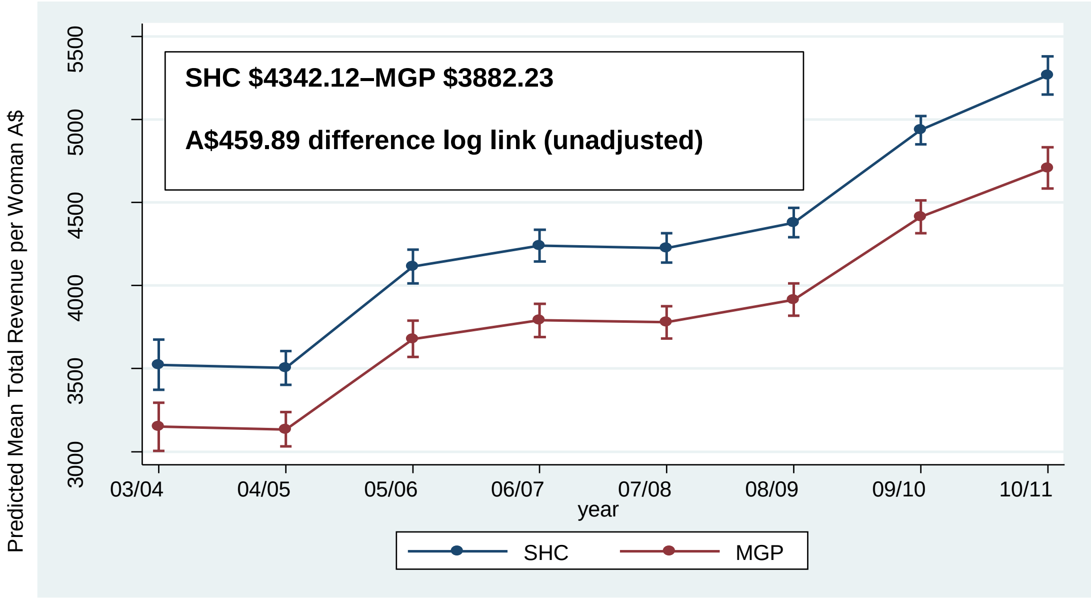
As measured against the referent, the infant variables that were identified as significantly associated with total cost included: plurality (i.e. where baby had a twin, β = 1.49; 95% CI 1.36–1.62, p<0.001); clinical gestation of babies (in the 28–36 week category β = 1.25; 95% CI 1.17–1.34, and in the 20–27 week category β = 0.37; 95% CI 0.24–0.57, p<0.001); weight of babies (those weighing < 2000 grams β = 1.20; 95% CI 1.05–1.38, $p<0.01$); infants with a congenital abnormality (β = 1.25; 95% CI 1.16–1.36), and those babies who remained hospitalised at 28 days or who were transferred to another health facility (β = 3.23; 95% CI 2.86–3.66), $p<0.001$ (Appendix 4.7).

Moreover, the β coefficients in the GLM for the fiscal years shown in Appendix 4.7 demonstrated incremental cost increases for the period 2004/05–2010/11 for predictive mean total cost between SHC and MGP services (Range of β = 1.14; 95% CI 1.04–1.26 to β = 1.89; 95% CI 1.72–2.07, respectively).This was statistically significant for each fiscal year from the referent period 2003/04 up to 2010/11, $p<0.001$ (Appendix 4.7). The mean cost totals for SHC and MGP in Australian dollars for each year, including standard error and 95% CI are shown on the table in Appendix 4.7. These ranged from SHC A$2853.24 (A$125.92) vs MGP A$2237.19 (A$105.00) for the 2003/04 fiscal year, increasing to SHC A$5355.17 (A$101.04) vs MGP A$4198.93 (A$101.24) for the 2010/11 fiscal year (Appendix 4.7).

Variables influencing total public hospital revenue

Public hospital revenue that compared Diagnostic Related Group separation data between Standard Hospital Care and Midwifery Group Practice 2003/04–2010/11 were also calculated and analysed using multivariate modelling. Revenue was calculated post costs and the results are shown in Figures 4.6 and 4.7. The figures show predicted mean total revenue per year per woman by care type, unadjusted (Figure 4.6) and adjusted (Figure 4.7). Figures 4.6, 4.7 and Appendix 4.8 show that revenue has increased in both

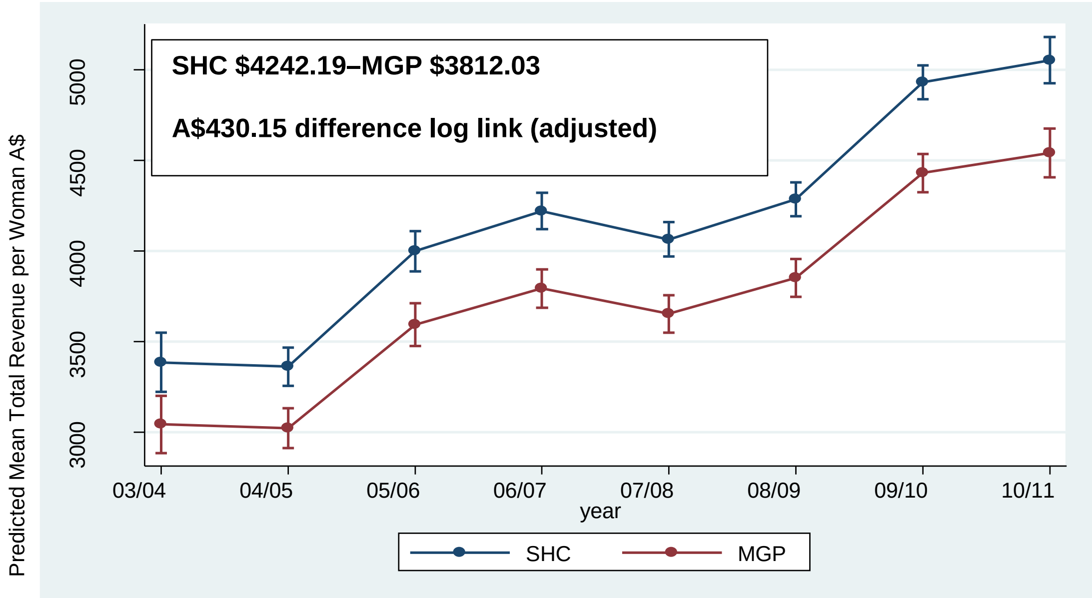
Standard Hospital Care and Midwifery Group Practice over the period examined.



Key. SHC = Standard Hospital Care; MGP = Midwifery Group Practice; Vertical Bars = 95% CI; A$ = Australian Dollars

Figure 4-6 Public Hospital Revenue by Year and Care Type (unadjusted) Standard Hospital Care vs Midwifery Group Practice 2003/04–2010/11

(Generalised linear model [Gaussian family] with log link function) $p<0.001$



Key. SHC = Standard Hospital Care; MGP = Midwifery Group Practice; Vertical Bars = 95% CI; A$ = Australian Dollars

Figure 4-7 Public Hospital Revenue by Year and Care Type (adjusted) Standard Hospital Care vs Midwifery Group Practice 2003/04–2010/11

(Generalised linear model [Gaussian family] with log link function) $p<0.001$

As shown in Figure 4.6, total mean predictive revenue was greater for separations in Standard Hospital Care by $459.89 per woman (excluding confounders) (Figure 4.6). When the model was adjusted to account for confounders, total mean predictive revenue remained greater for separations in Standard Hospital Care by $430.15 per woman (Figure 4.7).

Tables in Appendix 4.8 show the predictive mean revenue totals across fiscal years 2003–2011. Appendix 4.8 highlights the maternal and infant variables that were found to be significantly associated with public revenue across combined (all) Diagnostic Related Group codes in the multivariate model when measured against the referent. The results indicate that the predictive mean revenue totals across fiscal years 2003–2011 were statistically significant in each year from 2005 onward, with Standard Hospital Care model showing higher revenue when the model was adjusted for 18 confounders (p<0.001).

Maternal variables significantly associated with total revenue

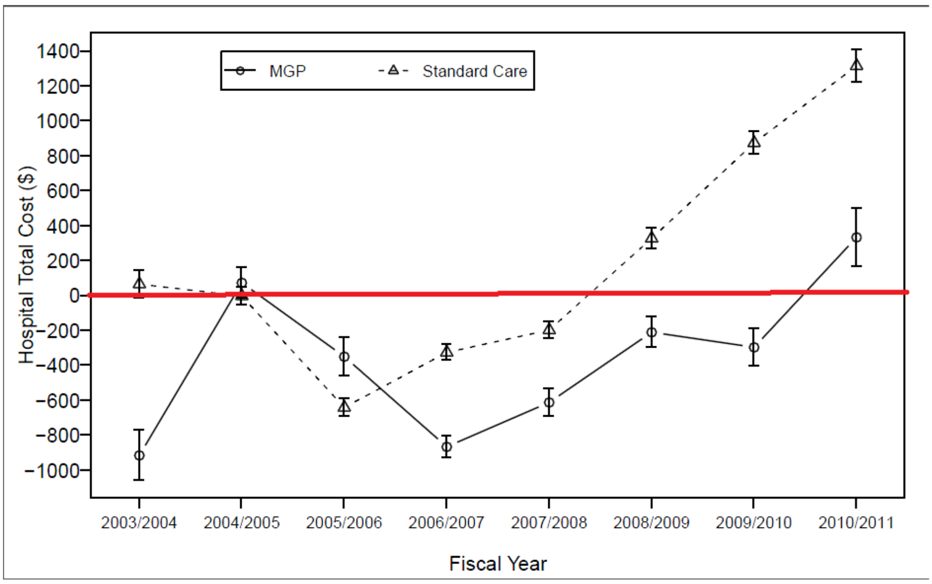
Those variables that were significantly associated with revenue included, the parity of women (β = 0.91; 95% CI 0.90–0.92) including nulliparity (β = 1.13; 95% CI 1.09–1.17), and number of previous caesarean sections (β = 1.38; 95% CI 1.37–1.40), p<0.001. Aboriginal and Torres Strait Islander women were shown to have a significant association with public revenues attracted into the hospital budget (β = 1.29; 95% CI 1.23–1.35, p<0.001), as did women who were from the Middle East and North Africa (β = 1.09; 95% CI 1.02–1.16), Southern Asia (β = 1.09; 95% CI 1.02–1.17), South/Central America/Caribbean (β = 1.12; 95% CI 1.02–1.23), p<0.01, and Africa (excluding North Africa) (β = 1.13; 95% CI 1.06–1.21, p<0.001) (Appendix 4.8). Other maternal variables that were significantly associated with revenue included body mass index (Overweight β = 1.04; 95% CI 1.02–1/06, and Obese II β = 1.09; 95% CI 1.05–1.13, and Obese III β = 1.17; 95% CI 1.12–1.22 category), and the 'unknown' category for smoking status (β = 1.90; 95% CI 1.67–2.17), p<0.001.

Infant variables significantly associated with total revenue

The infant variables that demonstrated significant association with increased public revenue generated for the hospital as measured against the referent included: plurality (i.e. where baby had a twin) (β = 1.63; 95% CI 1.55–1.71), babies within the clinical gestation categories of 28–36 weeks (β = 1.07; 95% CI 1.02–1.12, p<0.004) and 20–27 weeks (β = 0.35; 95% CI 0.25–0.49), babies with a birth weight <2000 grams (β = 1.35; 95% CI 1.24–1.47) p<0.001, and babies with a congenital abnormality (β = 1.07; 96% CI 1.01–1.13. Hospital revenue also increased where fetal death or stillbirth occurred (β = 0.52; 95% CI 0.38–0.70, p<0.001), when neonatal death occurred within 28 days (β = 1.14; 95% CI 1.00–1.30, p<0.05), and when the baby remained in hospital at 28 days or was transferred to another hospital (β = 2.34; 95% CI 2.09–2.62, p<0.001) (Appendix 4.8).

Summary of total public cost and revenue deficit trend results/care type

A summary comparing the public cost and revenue deficit trend result for Standard Hospital Care and Midwifery Group Practice based on the Diagnostic Related Group codes examined in this study for the period 2003/04–2010/11 is shown in Figure 4.8. Comparative deficit calculations in Figure 4.8 reflected fiscal year totals; that is, deficits were not carried forward cumulatively.



Key: SHC = Standard Hospital Care; MGP = Midwifery Group Practice

Figure 4-8 Cost and revenue deficit by care type–public deficit trend Standard Hospital Care vs Midwifery Group Practice 2003/04–2010/11

Figure 4.8 shows that after initial set-up/establishment costs for the Midwifery Group Practice in 2003/2004 (not shown in figure), the Midwifery Group Practice did not generate a deficit in public funds in the care of pregnant women with moderate risk until the 2010 fiscal year. In contrast, Standard Hospital Care service began to generate a deficit trend line from 2008, where it continued to increase in 2009 and 2010.

Based on the analyses undertaken in this study and the time period examined, the results shown in Figure 4.8 suggest public cost savings were generated in the Midwifery Group Practice service up to and including the 2010 fiscal year. In contrast, the trend in Standard Hospital Care showed increasing deficit since 2008. These results have been discussed in Chapter 6 in relation to resource allocation, workforce and service access demands from and for women with moderate complex pregnancy classification.

Influence of individual DRG categories to cost and revenue of SHC and MGP services

In order to examine the influence of individual DRG categories on cost and revenue of SHC and MGP services, Australian Refined Diagnostic Related Groups that were found to be significantly associated with care type for total cost (see Appendix 4.5) were examined using multivariate GLM models adjusted for confounders. Those AR DRGs that contributed to increased cost (adjusted model) included: Vaginal Birth Some Complexity (O60B), $p<0.001$; Vaginal Birth Complicated (O60C), $p<0.001$; Vaginal Delivery Without Complicating Diagnosis (O60D), $p<0.001$; and Vaginal Birth Uncomplicated (O60Z), $p<0.001$ (Appendix 4.9). However, none of the AR DRGs were found to significantly contribute to increased total revenue for either SHC or MGP services (Appendix 4.10).

A subanalysis of high volume and/or high cost Australian Refined Diagnostic Related Group separations for cost and revenue stream for combined hospital for the years 2003/04–2010/11 also was completed for 13 maternal AR–DRG codes and three neonatal AR–DRG codes. The purpose of the subanalysis was to provide institutional comparators from the site where the study was conducted, including a benchmark for costs in the maternity models compared in the study. Aggregate cumulative yearly averages based on cost minus revenue with standard deviation were reported (Appendix 4.4). Cost deficits for specific DRGs in the subanalysis were relevant to patterns of clinical outcomes and resource use reported in this study. For example, the four highest volume DRGs for hospital cost deficit (all maternity models) included, antenatal and other obstetric admissions, same-day admissions, caesarean delivery without severe or catastrophic complications, and postpartum admissions without an operating room procedure (Appendix 4.4, Table 4.3). Conversely, obstetric codes that generated hospital revenue were high volume uncomplicated vaginal birth, and babies discharged without problems or medical procedures (Appendix 4.4, Table 4.4). Equivalent comparators from the National Hospital Cost Data Report therefore were also summarised as these identified high volume/high cost obstetric DRGs for public sector hospitals across Australia and were important to the discussion of results from this study (Commonwealth Department of Health and Ageing 2010) (Appendix 4.4).

Summary

This chapter has reported the demographic, clinical, resource, and cost results in the retrospective arm of a data linkage study conducted at one tertiary referral maternity hospital in South Australia. This arm of the study compared outcomes for 13 462 women with pregnancies classified as moderate obstetric risk who received care through either Midwifery Group Practice or Standard Hospital Care during the period 2004–2010. Descriptive statistics, logistic regression, and multivariate generalised linear cost models (unadjusted and adjusted for confounding variables) for 12 406 women and their babies matched across three datasets identified significant differences between the two groups.

The results showed significant differences in group demographics, clinical outcomes, and resource consumption in two maternity service models in the public sector. Women in Midwifery Group Practice were older (29.0 [24.0–34.0] vs 31.0 [27.0–35.0] years), more likely to be Caucasian, to be partnered, and to have English as their first language (p<0.001) (Tables 4.1 and 4.2, pp. 127-128). Women in this group also identified higher rates of employment in professional and para-professional roles (p<0.001) (Table 4.6, Figure 4.1, pp. 133-134). They were less likely to reside in a statistical local area that was disadvantaged (p<0.001) (Table 4.5, p. 132; Appendix 3.7), to have a Body Mass Index in the Obese III category (p<0.01) (Table 4.8, p. 136), or to smoke (p<0.001) (Table 4.9, p. 136). Moreover, babies born to women in this group were more likely to have a clinical gestation greater than 37 weeks (p<0.001), and to weigh more than 3000 grams at birth (p<0.001) (Table 4.10, p. 137).

Rates of hospitalisation and frequency of some birth interventions and complications that are known to result in increased morbidity for childbearing women and their babies also differed significantly between groups (Table 4.11, p. 140). While the results of regression analysis showed no significant difference between groups in the rate of emergency caesarean section, catastrophic postpartum haemorrhage ≥ 1500 ml, or odds of severe perineal injury (second- and third- degree tears), women with complex pregnancy in the Midwifery Group Practice were one and a half times more likely to experience a spontaneous vaginal birth (95% CI 1.40–1.65).

Alongside the significantly higher odds for achieving spontaneous vaginal birth, women in Midwifery Group Practice also had higher odds for maintaining an intact perineum (OR 1.13; 95% CI 1.03–1.24), but also a greater chance of sustaining a first-degree perineal injury (OR 1.53; 95% CI 1.36–1.72). Significantly, however, the odds for utilisation of epidural analgesia, for postpartum haemorrhage ≥ 500 ml, and for elective caesarean section were all less for women who received care through Midwifery Group Practice (Table 4.11, p.140). Moreover, the babies of the women in MGP with complex pregnancies were more likely to room in with their mother at the time of birth rather than require admission to Special Care Baby Nursery ($p<0.001$) (Table 4.12, p. 145).

Other important areas of resource consumption that differed significantly between groups were the rate of emergency presentations and antenatal hospital admissions. The median for both was higher for women in Standard Hospital Care. While women in Standard Hospital Care had one less antenatal visit than women in the Midwifery Group Practice, postnatal length of stay was equivalent in both groups of women (Table 4.12).

Cost and revenue results modelled with hospital Diagnostic Related Group separation data and adjusted for confounders showed increased mean cost overall for the health system in both groups (Figure 4.5, p. 153, Appendix 4.7; Figure 4.7, p. 157, Appendix 4.8). However, the multivariate generalised linear models for total cost and revenue show public cost savings were generated in the Midwifery Group Practice service up to and including the 2010 fiscal year (Figure 4.8, p. 159). Moreover, the analysis demonstrated that total mean costs remained greater for separations for women with complex pregnancy in Standard Hospital Care by A$863.93 (95% CI) per separation across the 8-year fiscal period examined (Figure 4.5). Similarly, total mean revenue received from separations also remained greater for women with complex pregnancy in Standard Hospital Care by $430.15 (AUS$) (95% CI) per separation (Figure 4.7).

Maternal confounders that were identified in the multivariate models as significantly influencing cost between groups included: increasing maternal age and parity; the number of previous caesarean sections; women from the Middle East and North Africa, Southern Asia, South/Central America/Caribbean, and Africa (excluding North Africa); in addition to increasing body mass index, namely Overweight, Obese II and Obese III categories; smoking status; and nulliparity (Appendix 4.7). Infant confounders associated with increased cost included: clinical gestation of babies (28–36 week category and 20–27 week category), babies that weighed < 2000 grams, those who had a twin or a congenital abnormality, and those babies who remained hospitalised at 28 days or who were transferred to another health facility (Appendix 4.7).

The chapter following reports results from the prospective arm of the study. The prospective arm examined a separate, smaller sample of women with pregnancies classified as moderate-risk pregnancy classification. Whereas the retrospective arm examined variables and costs relevant to the antenatal period and birth episodes, results from the prospective arm examined women's patterns of Commonwealth Medicare Benefits Schedule and Pharmaceutical Benefits Schedule use in the four months after giving birth. These included costs following discharge from hospital.

CHAPTER 5 : RESULTS USE AND COST OF COMMONWEALTH-FUNDED HEALTH SERVICES BETWEEN STANDARD HOSPITAL CARE VERSUS MIDWIFERY GROUP PRACTICE: PROSPECTIVE STUDY ARM 2010–2012

Introduction

The previous chapter discussed the results of the retrospective arm of the study in which hospital resource/cost variables and clinical outcomes for women who used either a midwifery-led service or standard hospital service in a state-funded public hospital during pregnancy and childbirth were examined. In this chapter the results of the prospective arm of the study will be discussed. The prospective arm measured and compared the use and cost of Commonwealth-funded health services and pharmaceuticals by women after discharge from hospital.

While birthing services for public patients are funded under the auspice of state governments in state government hospitals, after hospital discharge costs for public patients shift to the Commonwealth. The Commonwealth government bears the cost of universal health services funded through the Medicare Benefits Schedule and Pharmaceutical Benefits Scheme (Australian Government Department of Human Services 2014; Duckett & Willcox 2011; Willis, Reynolds & Keleher 2012).

The measurement and effect on clinical outcomes, patterns of service use, resource consumption and public cost for groups of women who have experienced different models of pregnancy and childbirth care is an important consideration for allocation of both state and Commonwealth public health resources in maternity care (Australian Government 2009). As previously discussed in the methods chapter (p. 93) the clinical, resource and cost variables outlined in Tables 3.4, p. 93 and 3.10, p. 112 have been recognised internationally as standardised benchmarks for measuring rates of clinical effectiveness, morbidity and cost ratios to monitor quality outcomes for childbearing women and their infants (Devane et al. 2010; Gibbons et al. 2010; Sandall et al. 2015; Tracy 2011).

The National Hospital Cost Data Collection (refer supporting Appendix 4.4, Tables 4.5a; 4.5b; 4.5c) showed that women with complex pregnancies generated higher levels of medical intervention and cost for public hospitals managed by the state (Commonwealth Department of Health and Ageing 2010). This has also been confirmed in recent analysis by the NHPA (National Health Performance Authority 2013, 2014, 2015). However, there are few indicators currently used to measure maternity-related resource and cost-shifting effects to the Commonwealth health budget after women have been discharged from hospital. The comparative measurement and analyses of Medicare Benefits Schedule and Pharmaceutical Benefits Scheme postnatal use and costs for women who received care in different public health models undertaken in this study provided further information in this area. This arm of the study examined differences in the clinical outcomes, including Medicare Benefits Schedule and Pharmaceutical Benefits Scheme cost and resource use in the four months after giving birth, for those women and their babies who received care in either Standard Hospital Care model or Midwifery Group Practice at the same hospital setting as those women in the retrospective arm.

Medicare and Pharmaceutical Benefits Use by Women Receiving Either SHC or MGP Services

The results from this section are based on case records of an additional sample of 206 women, who gave birth during the period of June 2010–June 2012. Initially, a total of 211 women, whose pregnancies were classified as moderate obstetric risk, were recruited during the study consenting period, June 2010–June 2012. After audit and matching processes were undertaken by Commonwealth Medicare Statistical Services Division, 206 women were assessed with valid consent forms (SHC = 111; MGP = 95).

While all women in the MGP sample had postcodes in the metropolitan range (5000–5074), a post-analysis audit of outliers identified that six of the women who were recruited to SHC actually resided in regional and rural locations of South Australia. These included Murray Bridge, Wallaroo, Peterborough, Port Lincoln, Port Augusta and Renmark (see Appendix 5.1). Due to the small amount of data collected in the prospective arm, rather than excluding data for these women post-analyses, they were retained.

Modelling of Medicare benefit count and cost data

The Medicare Benefits Schedule items examined are identified in Table 3.8 (p. 109). As the distribution of Medicare Benefits Schedule visits and items in each group was treated as count and assessed as highly skewed (the majority of women used few Medicare items and made few visits, e.g. 1–5 items/visits), a Poisson regression model was considered to analyse these count data (Lord 2006; Ullah, Finch & Day 2010). However, as the data were over dispersed (the variance of count data usually exceeds the mean), the negative binomial regression model was used and considered a better fit (Hilbe 2011).

The negative binomial regression analyses modelled the number of visits according to the participants' demographic and clinical characteristics as described in the methods (Table 3.10, p.112). The model analysed the pattern and incidence of Commonwealth Medicare Benefit items used by women in the first four months after they had given birth. Models were adjusted for a number of confounders. These included age, gravida, parity, birth type, perineal status, plurality, baby's gender, baby's weight, and whether the baby roomed in with the mother, or required admission to the Special Care Baby Unit.

The cost data were modelled using a generalised linear model with Gaussian family and log link function that compared costs for the variables of Provider Charge, Schedule Fee, Benefit Paid, and Patient out-of-pocket cost for women in SHC and MGP services. The comparative cost of these variables was important as they affected both the public purse and out-of-pocket costs for families.

Reporting pharmaceutical benefits use

In contrast to the 206 women who used Medicare benefits, only 57 participants were recorded using pharmaceutical benefits (SHC: n = 43 vs MGP: n = 14). Due to the small amount of data available for analyses the Pharmaceutical Benefits Scheme dataset and associated clinical outcomes were examined using percentages. The complete list of Pharmaceutical Benefits Scheme medications, including the eight major categories of prescription items relevant to this study, are provided in Appendix 3.21. Relevant clinical and demographic findings related to patterns of use for outliers in both the Medicare Benefits Schedule and Pharmaceutical Benefits Scheme datasets have been described in Appendices 5.2; 5.3, and Tables 5.4, p. 180; 5.5, p. 187; 5.6, p. 189).

Use and cost of Commonwealth-funded health services for SHC and MGP 2010–2012

The aim of this section was to analyse the Commonwealth cost incurred after birth by claims to the Medicare Benefit Schedule (MBS) and Pharmaceutical Benefit Scheme (PBS) when women were discharged from a state hospital. The MBS and PBS claims were analysed to determine variation in patterns of use and cost between groups. The results have been reported under the following subsections: Demographic and clinical characteristics of women; Medicare Benefits Schedule use; Medicare benefits costing; Pharmaceutical benefits use. Other areas examined included: distribution of Medicare Benefits Schedule and Pharmaceutical Benefits Scheme items, number of visits, costs for women in each group, and effects of outliers on results.

Demographic and clinical characteristics

Age and parity of women

Participants' demographics and clinical characteristics were examined using descriptive statistics. An independent sample t test was used to compare the ages of women and the weights of babies between two groups (McCrum-Gardner 2007). The chi-square test statistic was used for all categorical clinical variables of interest (Maltby, Day & Williams 2007; Plichta & Garzon 2009, p.408)

Table 5.1 summarises the demographic features of the sample, including the clinical characteristics of women and babies who were participants in the prospective arm of this study.

Table 5-1 Participant demographics and clinical characteristics

Characteristics	SHC (n = 111)	MGP (n = 95)	p value
Age Year–Mean(SD)	**29.5 (5.1)**	**31.3 (5.4)**	**p<0.02**
Gravida (%)			
1	45.1	43.2	p=0.77
2	27.0	33.7	p=0.28
3	10.8	14.7	p=0.39
4+	17.1	8.4	p<0.05
Parity (%)			
1	56.8	55.8	p=0.89
2	23.4	32.6	p=0.11
3	8.1	8.4	p=0.99
4+	11.7	3.2	p<0.02
Birth type (%)			
Normal vaginal birth (NVB)	51.4	62.1	p=0.11
Instrumental	14.4	15.8	p=0.69
Elective LSCS	14.4	8.4	p=0.17
Emergency LSCS	19.8	13.7	p=0.26
Perineum status (%)			
Intact (includes LSCS)	53.2	43.1	p=0.15
First-degree tear	7.2	17.9	p<0.02
Episiotomy/second degree tear	32.4	31.6	p=0.99
Third-degree tear	7.2	7.4	p=0.99
Twin (%)*			
No	99.1	98.9	p=0.99
Yes	0.9	1.1	p=0.94
Baby's gender (%)			
Female	47.8	62.1	p=0.04
Male	52.2	37.9	p=0.04
Baby's weight (g) (Mean(SD)	3330.1 (577.9)	3406.6 (486.1)	p=0.31
Baby's Direct Room In (%)			
DRI	77.5	81.0	p=0.60
SCBU/NICU	20.7	19.0	p=0.72

Key*:* MGP = Midwifery group practice; SHC = Standard hospital care; LSCS = Lower segment caesarean section; SCBU = Special care baby unit; NICU = Neonatal intensive care unit; * Only 2 sets of twin babies found and excluded from the study. p values are based on independent sample t test for continuous data and chi-square test for categories. Groups differ significantly if p < 0.05. Significant results are highlighted in yellow.

As highlighted in Table 5.1 there were statistically significant age differences between the two groups. Women in the Standard Hospital Care group were younger than women in the Midwifery Group Practice (SHC Mean=29.5, SD=5.1; MGP Mean=31.3, SD=5.4). Despite the small sample size, the age ranges in this arm mirrored those identified in the retrospective sample.

Significant differences also were found between the two groups in relation to gravida and parity, with significantly more women having experienced four or more pregnancies and births in the SHC group than the MGP group.

Clinical outcomes

Overall, the clinical outcomes for women receiving either type of care service were similar. The only exception found was in the rates of first-degree tears of the perineum where significantly more women in the MGP group experienced this type of care when compared to women in the SHC group (Table 5.1).

Medicare Benefits Schedule use by women with moderate-risk pregnancy in the first four months post-birth

The Commonwealth Medicare Benefit Schedule dataset indicated a total of 1123 claim items for all participants whose pregnancies were classified as moderate obstetric risk during the four months period after birth. These claims included 127 separate Medicare Benefits Schedule Item descriptions/numbers which were collapsed into six clustered codes to enable meaningful analyses (see methods, p. 109). A complete description of all MBS item numbers, including the distribution of items claimed by women in each group has been provided in Appendix 5.4.

Medicare benefits claims for women in SHC and MGP

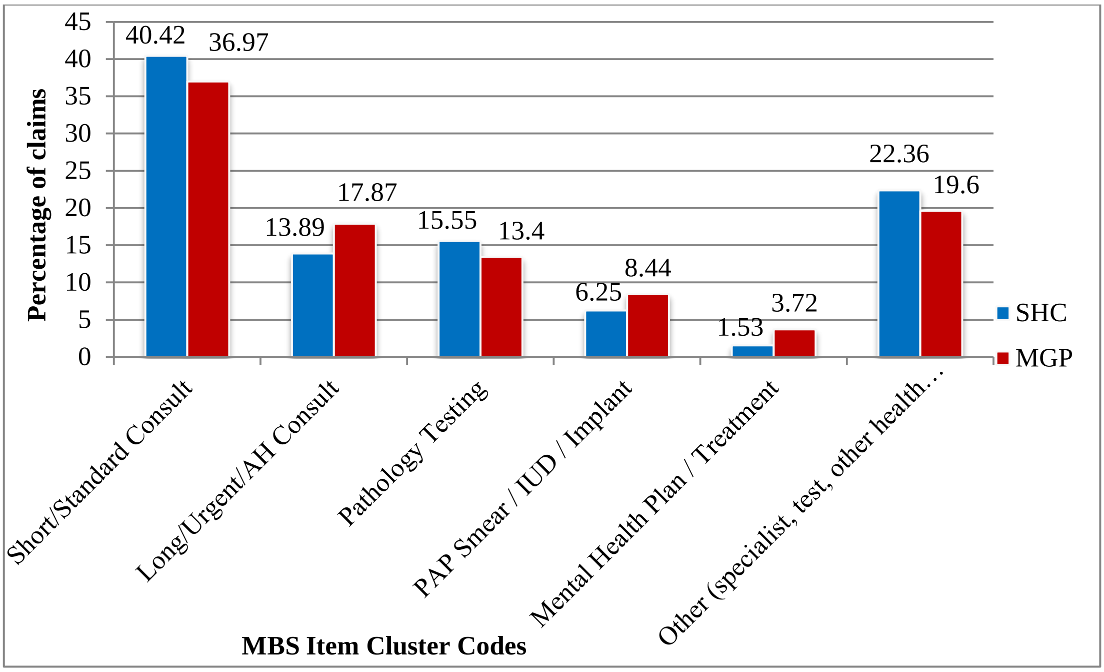
Claims included a total of 720 MBS Items matched to 111 women in SHC (6.48 items/woman). In contrast, a total of 403 MBS Items were recorded for

95 women in MGP (4.24 items/woman). There were four women in the SHC group without any MBS claims in the four-month period after birth, as compared with six women in MGP without any claims for the same period.

The highest number of MBS claims in SHC for a single postpartum woman was 52 (MBS Items 3; 23; 53; and multiple claims for item 65120, prothrombin/INR screening) (Appendix 5.4). In contrast, the highest number for an individual in MGP was 19 (MBS Items 3; 23; 53; 296; 5020; 5040; 73053; 69333; and multiple claims for item 2717, psychological assessments). The median and IQR for use of MBS items and visits during the four-month postpartum period was 5 (3–8) for women who received SHC as compared to 3 (2–5) for women in MGP.

MBS patterns of use

When the proportion of MBS claim items were compared between the two groups no significant differences were found except for Mental Health Plan and Treatment, where use was greater for women in the MGP (p=0.03, chi-square test) (Figure 5.1).



Key: SHC = Standard hospital care; MGP = Midwifery group practice; p<0.05 (chi – square test)

Figure 5-1 Medicare Benefits Schedule Claim Items after Birth: Pattern of Use (%) by MBS Category in SHC vs MGP 2010—2012

Collectively, most MBS claims were for Cluster Code One—Short or Standard Consultations with Medical Practitioners (440 claims). There were 240 claims for ‘Other’ consultations with a variety of specialist medical or allied health professionals and 172 claims for long/urgent/ or at home consultations with medical practitioners. Pathology and diagnostic tests encompassed 166 claims. MBS claims for cervical screening and contraception (79 claims) and Mental Health Plans and treatment (26 claims) were the items where the fewest claims were incurred.

Distribution of Commonwealth MBS visits post-birth

A negative binomial regression model was used to analyse the number of MBS visits by participant demographic and clinical characteristics (methods Figure 3.3, p. 115). This was important to determine variation in the distribution of Commonwealth claims after birth for women who experienced complications or co-morbidity as a result of childbirth. These women required additional medical assessment, follow up and/or treatment, for example, pharmaceuticals, or readmission to hospital. Consequently, resource use and cost for the health system was increased and shifted between state and Commonwealth funding.

Table 5.2 shows the adjusted incidence rate ratio using the negative binomial regression model of number of visits by participant demographic and clinical characteristics.

Groups were found to be a significant influence with a 41% lower rate of MBS visits for women in MGP than SHC (Table 5.2). While participants' age showed some influence on MBS use, (i.e. for every year increase in age there was a 2% increment in risk of visits to health professionals/doctors and MBS use), the strength of association was weak and 95% CI included 1.00, which suggested no effect. Other predictors for increased MBS use included women with gravida 2 status (Table 5.2) and those women who experienced elective caesarean section surgery (Table 5.2).

Table 5-2 Number of visits by participant demographic and clinical characteristics

Characteristics	IRR	95% CI	p value
Group			
SHC	1.00	-	p<0.001
MGP	0.59	0.46–0.76	
Age	1.02	1.00–1.05	p=0.03
Gravida			
1	1.00	-	-
2	0.63	0.43–0.91	p=0.02
3	0.70	0.43–1.12	p=0.13
4+	0.58	0.29–1.16	p=0.12
Parity (%)			
1	1.00	-	-
2	1.14	0.78–1.68	p=0.50
3	1.55	0.76–3.17	p=0.23
4+	1.57	0.71–3.49	p=0.27
Birth type			
Normal vaginal birth (NVB)	1.00	-	-
Instrumental	1.19	0.79–1.78	p=0.42
Elective LSCS	0.54	0.31–0.91	p=0.02
Emergency LSCS	0.72	0.51–1.04	p=0.08
Perineum status			
Intact (Includes LSCS)	1.00	-	-
First-degree tear	1.08	0.69–1.67	p=0.74
Episiotomy/second degree tear	0.91	0.66–1.26	p=0.56
Third-degree tear	0.97	0.59–1.60	p=0.90
Baby's weight (g) Mean(SD)	1.00	1.00–1.00	p=0.10
Baby's Direct Room In (%)			
DRI	1.00	-	-
SCBU/NICU	0.81	0.50–3.80	p=0.53

Key. MGP = Midwifery group practice; SHC = Standard hospital care; LSCS = Lower segment caesarean section; SCBU = Special care baby unit; NICU = Neonatal intensive care unit; IRR = Adjusted incident rate ratio * Only 2 sets of twin babies found and excluded from the study due to potential confounding effect; p values are based on negative binomial regression model; significant results are highlighted in yellow

Medicare Benefits Schedule costs for women in the first four months after giving birth

While Medicare provides universal coverage for those without private health insurance, costs incurred for medical care after birth can be a significant burden for families if additional payments are required. This burden may be greater for women who experience complexities. Many providers of health services have charges that exceed the fees rebated by the Medicare schedule. This practice can leave significant out-of-pocket costs for recipients of services. Cost acts as a deterrent to health services access for specific population groups. The rationale for this section of the analyses was to examine any variation in cost burden between women in each group.

A generalised linear model with Gaussian family and log link function was used to compare costs for Provider Charge, Schedule Fee, Benefit Paid, and Patient out-of-pocket cost for women between MGP and SHC groups in relation to Medicare Benefit Schedule items and visits.

Table 5-3 Comparative Medicare Benefits Schedule Costs for Women

MBS Charges/Costing	SHC (n = 720)	MGP (n = 403)	p value
Provider Charge (Mean(SD))	\$41.04 (33.21)	\$48.24 (36.69)	p<0.001
Schedule Fee (Mean(SD))	\$39.11 (29.80)	\$41.60 (33.28)	p=0.20
Benefit Paid (Mean(SD))	\$37.12 (27.91)	\$39.86 (31.61)	p=0.13
Patient Out-of-Pocket (Mean(SD))	\$4.09 (13.77)	\$8.38 (13.86)	p<0.001

Key*:* SHC = Standard hospital care; MGP = Midwifery group practice; A generalised linear model with Gaussian family and log link function was used to compare MBS cost between groups; $ Australian; significant results are highlighted in yellow

As shown in Table 5.3 mean Provider Charges were higher for women in MGP service, (p<0.001) and they experienced higher MBS out-of-pocket costs overall in the four-months postpartum as compared to women from SHC group (p<0.001). Despite less MBS use by women in the MGP in the four months after giving birth, the cost gap between the increased provider charges for the MBS Items and visits and the cost reimbursed by Medicare left women in MGP group out-of-pocket at a rate that was significantly higher than that of women in SHC group.

Patterns of Medicare benefits use: outliers in MGP and SHC

Following statistical analysis of count data for SHC and MGP using negative binomial regression model the records of individuals who used 10 or more MBS items and/or visits in the first four months after birth were examined. As the majority of women in both groups had fewer than 10 visits, records for those women who exceeded this threshold ('outliers') were audited to identify possible demographic and or clinical characteristics that may have influenced increased patterns of MBS use.

Results for the MBS outliers in SHC and MGP have been recorded and described in Appendices 5.2 and 5.3 respectively. The analyses included a breakdown of MBS item descriptions and visits to health providers, age and residential postcode/SEIFA status of the woman (Appendix 3.7), gravida and parity, birth type (including perineal status), and the sex and weight of the baby, including whether the baby roomed in at the time of birth or required a special care baby nursery admission.

There were 22 outliers identified in SHC group who used 10 or more MBS items and or visits (Appendix 5.2), and nine outliers identified in MGP who used 10 or more MBS items and or visits (Appendix 5.3). Of these outliers, a post-analyses audit identified that there were five women in SHC group who had residential postcodes outside the metropolitan area and resided in rural or regional South Australia (see Appendix 5.1). These five women recorded MBS items ranging from 11 to 52 items/visits per woman (Appendix 5.2). When the five postpartum rural outliers were excluded, the average SHC group MBS use reduced to five MBS items/visits in the four-month postpartum period, one more than women in MGP. Table 5.4 summarises the characteristics of outliers with 10 or more Medicare benefits items and visits between the two groups, with rural outliers identified separately.

Table 5-4 Characteristics of Outliers with 10 or > Medicare Benefit Schedule Items / Visits Between Groups—SHC vs MGP 2010—2012

Group	No of MBS Items	No of MBS Visits	Age ≥ 35	Primi	Multi	Total n of babies birthed previously	Birth	Peri	Baby Sex	Baby Weight ≥3000 (grams)	DRI Or SCBU	PC / SEIFA* = n
SHC (n = 17)	240	145	4	12	5	30	SVB = 11 INST= 2 LSCS= 4	intact = 8 episi = 2 1 tear = 3 2tear = 1 3tear = 3	F = 9 M = 8	14	DRI = 13 SCBU = 4	SEIFA1 = 0 SEIFA 2 = 2 SEIFA 3 = 1 SEIFA 4 = 5 SEIFA 5 = 3 SEIFA 6 = 6
MGP (n = 9)	120	70	6	7	3	11	SVB = 7 INST= 2 LSCS= 0	Intact = 2 episi = 0 1 tear = 2 2tear = 3 3tear = 2	F = 8 M = 1	7	DRI = 8 SCBU = 1	SEIFA1 = 1 SEIFA 2 = 2 SEIFA 3 = 0 SEIFA 4 = 3 SEIFA 5 = 1 SEIFA 6 = 2
Rural Outliers (n = 5) n = 5 SHC n = 0 MGP	122	60	1	2	3	12	SVB = 4 INST= 1 LSCS= 0	intact = 3 episi = 1 1 tear = 0 2tear = 1 3tear = 0	F = 2 M = 3	3	DRI = 3 SCBU = 2	Rural/Regional (Appendix 6.1)

Key. SHC = Standard hospital care; MGP = Midwifery group practice; Primi = primiparous; Multi = multiparous; SVB = spontaneous vaginal birth; INST = instrumental; LSCS = lower segment caesarean section; Peri = perineal status—first, second, third-degree tear; episi = episiotomy; F = female; M = male; DRI = direct room in of baby with mother after birth; SCBU = special care baby unit; PC = postcode; SEIFA = socioeconomic index for area*See SEIFA Legend Appendix 5.2 and Appendix 3.7

Few women from either group were regarded as outliers and, therefore, only descriptive statistics (frequency and %) were presented to examine the clinical and demographic characteristics that may have influenced the Medicare benefits use of outliers from each service model.

Characteristics of Standard Hospital Care MBS outliers

Excluding the women who were rural outliers, Table 5.4 showed that more women (n = 5) in Standard Hospital Care MBS outlier group had experienced previous pregnancies as compared to women in Midwifery Group Practice MBS outlier group (n = 3). The women in the SHC group also had given birth to greater numbers of babies (n = 30) as compared to MGP (n = 11). Of the 17 women who were SHC outliers, the greater numbers were from low socioeconomic areas (northern suburbs SEIFA 6 (six women), western suburbs SEIFA 4 (five women), and southern suburbs SEIFA 5 (three women). Only three women were identified from high socioeconomic areas, two from the eastern suburbs (SEIFA 2) and one from the hills area (SEIFA 3) (Table 5.4).

Four women in the SHC outlier group were aged 35 or older (Appendix 5.2 and Table 5.4). Four women had a caesarean section. Of the 11 women in this group who experienced a spontaneous vaginal birth, over half had sustained perineal injury. Three of the perineal injuries involved third-degree tears and there were two women who had episiotomies. Four babies in this group were identified as having admissions to special care baby nursery at the time of birth (compared to one special care baby nursery admission in MGP outliers) (Table 5.4, p. 180). Two women in SHC group outliers were also identified as having had psychological assessment attendances or mental health treatment plans following discharge from hospital (Appendix 5.2).

Midwifery Group Practice MBS outliers

In contrast to SHC group, seven of the nine women (77.8%) identified as MBS outliers in MGP had given birth to their first baby, as compared to 12 of 17 women (70.6%) in SHC outliers (Appendix 5.3 and Table 5.4). The nine women who were MGP outliers came from a range of SEIFA areas, (i.e. two women were from northern suburbs SEIFA 6, three women were from western suburbs SEIFA 4, one woman from southern area SEIFA 5, one from the central business district SEIFA 1, and two others identified as eastern suburbs SEIFA 2) (Table 5.4).

Six women in the MGP outliers group were aged 35 or older (Appendix 5.3 and Table 5.4). No women in this group were recorded as having had a caesarean section. All experienced vaginal birth, although two of the nine women were assisted with instruments (Appendix 5.3). Seven women in the MGP outliers sustained perineal injury; two of these involved third-degree tears; there were no recorded episiotomies (Appendix 5.3). All babies direct roomed in with their mothers and only one of nine babies (11.1%) recorded an admission to the special care baby nursery (Table 5.4). Three women in the MGP outlier group were recorded as having mental health treatment plans and/or referral for specialist psychiatric consultation after they had given birth and were discharged from hospital (Appendix 5.3).

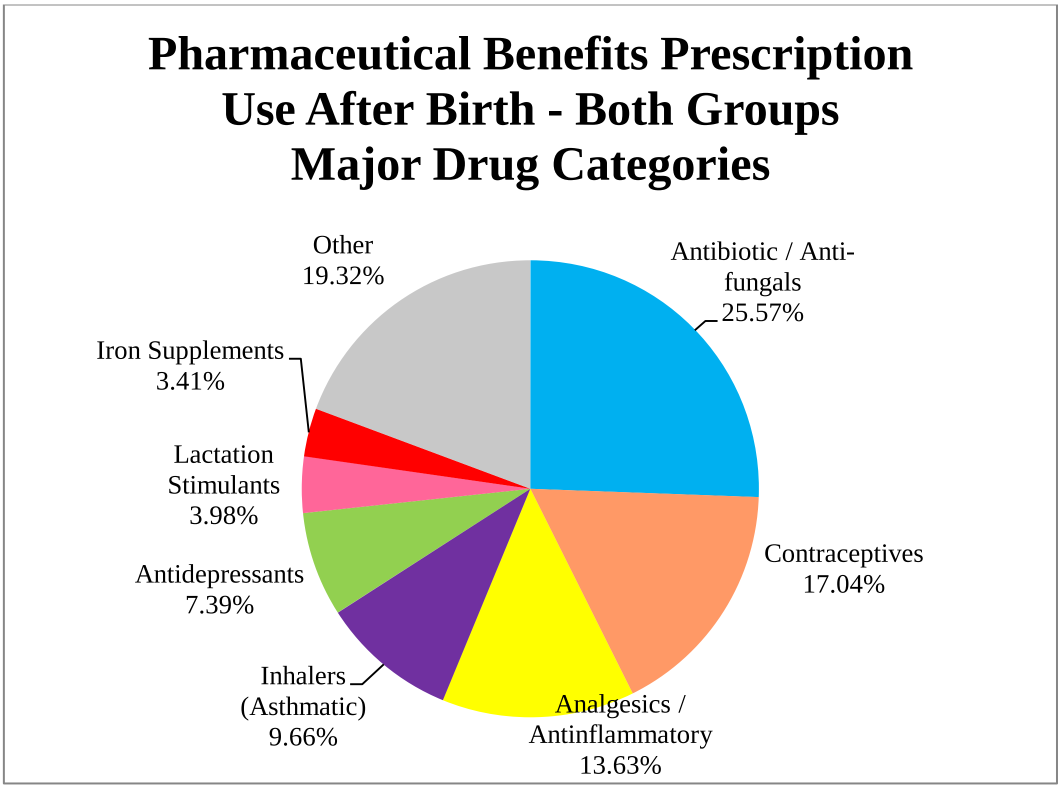
Pharmaceutical Benefits Scheme use by women with moderate-risk pregnancy in the first four months post-birth

The Pharmaceutical Benefit Scheme dataset included a total of 176 prescriptions/claim items for all participants during the four-month period after birth (Appendix 5.5). As described in the methods chapter (p. 110), 72 separate pharmaceutical benefits drug item codes were collapsed and re-coded into 8 drug groups to enable meaningful analysis (Appendix 3.21).

In the SHC a total of 152 (86.36%) prescription/claim items were matched to 43 of the 111 women. This contrasted with a total of 24 (13.64%) PBS items recorded for 14 of the 95 women in the MGP. Therefore, 61.26% (n = 68) women in SHC did not make any PBS prescription claims in the four-month period after birth, as compared with 85.26% (n = 81) women in the MGP.

Analyses of Pharmaceutical Benefit Scheme patterns of use

Due to the small number of data available for analyses, Pharmaceutical Benefits Scheme patterns of use were examined descriptively. Figure 5.2 shows the percentage of pharmaceutical benefit items that were used and claimed by both groups of women across the eight major drug categories.



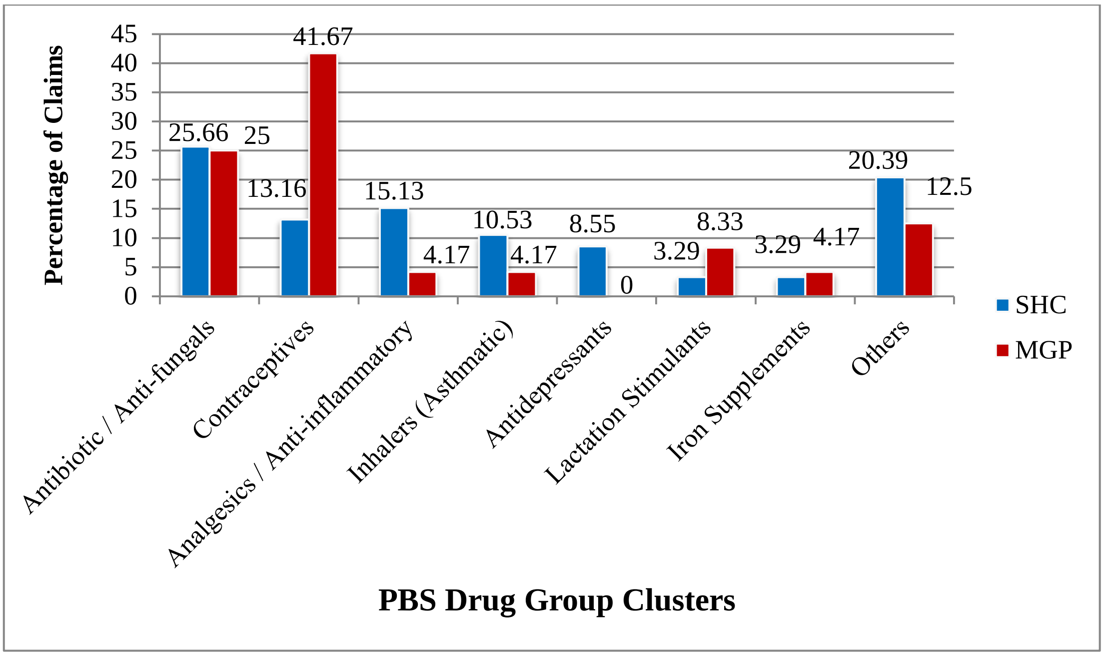
Note. Others include one-off scripts for: antihypertensive, anticoagulant, oral hypoglycaemic, epilepsy, antimalarial, milk suppressant, thyroid, and reflux medications (Appendix 5.5)

Figure 5-2 Pharmaceutical Benefits Scheme Items Use after Birth by SHC and MGP 2010–2012

As shown in Figure 5.2, antibiotic and antifungal medication comprised the greatest percentage category of pharmaceuticals prescribed for both groups of postpartum women after they were discharged from hospital (25.57%; n = 45). While the ‘Other’ category was the second largest, (19.32%; n = 34), it was comprised of single item scripts for a diverse range of medical conditions. Contraceptives/contraceptive devices (17.04%; n = 30) and analgesics/anti-inflammatory drugs (13.63%; n = 24) were the third and fourth major categories of drug groups represented. Prescriptions for asthma, antidepressant medication, lactation stimulants and iron supplements each comprised less than ten per cent of the claims for all women (Figure 5.2).

Comparative Pharmaceutical Benefit Scheme use by groups

While the Commonwealth government subsidises the cost of prescription medicine listed on the PBS, there are still out-of-pocket costs for pharmaceuticals prescribed after childbirth. These costs may pose a significant burden for families, especially for women who experience complexity or who have pre-existing co-morbidity. The rationale for this section of analyses was to examine variation in prescription claims for women between each group. Figure 5.3 shows the comparative percentage of PBS items used by women in each service group for each of the major drug groups in the four-month postnatal period after discharge from hospital.



Key: *SHC = Standard hospital care; MGP = Midwifery group practice;*Numbers in drug group categories show% of Pharmaceutical Benefit Scheme scripts issued—SHC and MGP

Figure 5-3 Pharmaceutical Benefits Use after Birth: Pattern of Use (%) by PBS Drug Group in SHC vs MGP 2010—2012*

The highest threshold for number of PBS prescription claims in SHC for a single postpartum woman was 10.53% (n = 16). The results indicate that

30.26% (n = 46) of the total PBS prescription claims in SHC group were shared among five women. These women had upward of seven prescription item claims each (Table 5.5, p.187).

It was noted that all PBS prescription claims for antidepressant medication (7.39%; n = 13) were from the SHC group (Figure 5.3). In addition, women who received SHC made the majority of prescription claims for both analgesic (95.83%; n = 24), asthmatic inhalant medication (94.12%; n = 17), and all PBS prescriptions listed as ‘Other’ (91.18%; n = 34) (Figure 5.3; Appendix 5.5).

Table 5-5 Women with > 7 Pharmaceutical Benefit Scheme Prescriptions in Four-Month Period after Giving Birth (All SHC group)

Unique identifier	No of PBS Scripts	Pattern of Pharmaceutical Benefits Use	Age	G: P	Birth type	Perineal status	Baby sex	Baby weight (grams)	DRI or SCBU	Postcode SEIFA
22002	14	Analgesic Iron Hypoglycaemic Other—topical	35	2: 2	Spontaneous Vaginal	intact	Female	4070	No—SCBU	5014 SEIFA4
22004	15	Analgesic Antibiotic Contraception Antidepressant Other-suppress lactation, epilepsy	36	6: 4	Spontaneous Vaginal	intact	Female	3380	Yes—DRI	5422 Rural
22015	9	Analgesic Antibiotic Antidepressant	29	6: 5	Spontaneous Vaginal	intact	Male	3790	Yes—DRI	5042 SEIFA5
22044	16	Analgesic Antibiotic Thyroxine Inhalant	32	3: 3	Elective LSCS	-	Male	3770	Yes—DRI	5073 SEIFA2
22046	12	Inhalants (asthmatic)	24	2: 2	Spontaneous Vaginal	2 degree tear	Male	3660	No—SCBU	5341 Rural

Key. SHC = Standard hospital care; SEIFA = Socioeconomic index for area; G:P = gravida: parity; SCBU = Special Care Baby Unit; DRI = Direct Room In; LSCS = Lower Segment Caesarean Section; Socioeconomic index for area—see Legend, Appendix 5.2

In contrast to the results for women in SHC, the highest threshold in MGP for an individual PBS prescription claim was 29.17%; n = 7. All women with PBS claims from the MGP (apart from three women) had single claims for either contraceptive (41.67%; n = 10) or antibiotic (25.00%; n = 6) prescriptions (Figure 5.3; Appendix 5.5). Contraception comprised the largest percentage of prescription items for women in the MGP overall. The other three women had claims of combined prescriptions for analgesia, antihypertensive medication, iron supplementation, lactation stimulation and inhalant therapy (33.34%; n = 8)(Figure 5.3, p. 185; Appendix 5.5).

Pharmaceutical Benefit Scheme outliers

The majority of women in both groups who made PBS in the four-month period after they were discharged from hospital had less than seven prescription claims. Individual women who had more than seven PBS item claims during this period were therefore identified as outliers. Five women only were identified as PBS outliers with more than seven prescription claims. All of these women had received SHC with two women having rural postcodes. The claims for these women, including demographic and clinical characteristics are shown in Tables 5.5, p. 187 and 5.6, p. 189.

Table 5-6 Summary Characteristics of Outliers with > 7 Pharmaceutical Benefit Scheme Claims—SHC vs MGP 2010–2012

Group	No of PBS script caims	PBS Drug Groups associated with increased use	Age ≥ 35	Primi	Multi	Total n of babies birthed previously	Birth	Peri	Baby sex	Baby Weight ≥3000 (grams)	DRI Or SCBU	PC/SEIFA*
SHC (n = 3)	39	Analgesic Antibiotic Asthma Inhaler Antidepressants Other – hypoglycaemic thyroxine	1	0	3	10	SVB 2 INST 0 LSCS 1	intact = 3 episi = 0 1 tear = 0 2 tear = 0 3 tear = 0	F = 1 M = 1	3	DRI = 2 SCBU = 1	SEIFA1 = 0 SEIFA 2 = 1 SEIFA 3 = 0 SEIFA 4 = 1 SEIFA 5 = 1 SEIFA 6 = 0
MGP (n = 0)	0		0	0	0	0	SVB 0 INST 0 LSCS 0	Intact = 0 episi = 0 1 tear = 0 2 tear = 0 3 tear = 0	F = 0 M = 0	0	DRI = 0 SCBU = 0	SEIFA1 = 0 SEIFA 2 = 0 SEIFA 3 = 0 SEIFA 4 = 0 SEIFA 5 = 0 SEIFA 6 = 0
Rural Outliers (n = 2) all SHC	27	Analgesic Antibiotic Asthma Inhaler Antidepressants Other—epilepsy	1	0	2	6	SVB 2 INST 0 LSCS 0	intact = 1 episi = 0 1 tear = 0 2 tear = 1 3 tear = 0	F = 1 M = 1	2	DRI = 1 SCBU = 1	Rural / Regional (Appendix 6.1) Far North Riverland

Key. SHC = Standard hospital care; MGP = Midwifery group practice; Primi = primiparous; Multi = multiparous; SVB = spontaneous vaginal birth; INST =instrumental; LSCS = lower segment caesarean section; Peri = perineal status—first, second, third-degree tear; episi = episiotomy; F = female; M = male; DRI = direct room in of baby with mother after birth; SCBU = special care baby unit; PC = postcode; SEIFA = socioeconomic index for area*See SEIFA Legend Appendix 5.2 and Appendix 3.7

As shown in Table 5.5 the most frequent categories of prescription items for the group of women identified as outliers included analgesics and antibiotics. One woman identified as asthmatic had multiple prescriptions for inhalant medication, and two women had multiple prescription items for antidepressant medications.

Table 5.6 shows the summary characteristics of women who were outliers with more than seven pharmaceutical benefit claims. All women in the PBS outlier group had given birth previously, with two women having had six pregnancies each. Four women experienced spontaneous vaginal birth and one woman had an elective caesarean section. The woman who experienced an elective caesarean section was the only outlier from a higher socioeconomic index (SEIFA 2). Two women were aged 35 or older and all babies were of normal birth weight.

One of the rural PBS outliers was also identified as a Medicare Benefit Schedule outlier with 17 medical visits, including specialist physician and consultant psychiatric review with a mental health treatment plan in place (Appendix 5.2—Unique Identifier 22004). This woman also had multiple PBS prescription items for antidepressant medication (Table 5.5, p. 187).

Summary

This chapter has reported the demographic and clinical characteristics of women in the prospective arm of a data linkage study. The prospective arm examined patterns of use of Commonwealth Medicare Benefits Schedule and Pharmaceutical Benefits Scheme items by women in the four months after they had given birth during 2010–2012. All women experienced pregnancies classified as moderate obstetric risk. Women received care through either Midwifery Group Practice or Standard Hospital service in the same setting as women who participated in the retrospective arm of the study.

The analyses identified significant differences in demographics and clinical characteristics of women between the two groups (Table 5.1, p. 171). Women receiving MGP care were on average older than women receiving SHC care (MGP M = 31.3, SD=5.4; SHC M = 29.5, SD = 5.1). However, there was a higher percentage of women in SHC who had pregnancies in the gravida 4+ category (17.1% vs 8.4%; p = 0.05) and also a higher percentage of women in SHC who had birthed more babies in the parity 4+ category (11.7% vs 3.2%; p = 0.02). In contrast, the percentage of first-degree perineal tearing was higher for women in MGP (7.2% vs 17.9%, p = 0.02).

The analyses of MBS data identified significant differences in demographic characteristics and specific clinical predictors for patterns of resource consumption and cost (Table 5.2, p. 175). There was a 41% lower rate of MBS visits for women in MGP than in SHC (95% CI 0.46–0.76). While women's age showed some influence on Medicare benefits use (i.e. there was a 2% increment in risk of visits to health professionals for every year increase in age), the strength of association was weak and the 95% CI included 1.00, which suggested no effect. Other predictors for increased use of Medicare benefits items and visits across groups included the increased gravid status of women (gravida 2 category; 95% CI 0.43–0.91) and those women who gave birth by elective caesarean section (95% CI 0.31–0.91).

Moreover, significant difference was found between groups for Provider Charges and patient out-of-pocket cost. The analyses identified that women in MGP experienced higher mean provider charges (\$41.04(33.21) vs \$48.24(36.69); $p < 0.001$) and higher mean out-of-pocket costs (\$4.09(13.77) vs \$8.38(13.86); $p<0.001$) for their Medicare benefit use (Table 5.3, p. 177).

Patterns of Pharmaceutical Benefits Scheme use and cost were examined using percentages due to the limited data available for analyses. Compared to MGP, there were six times as many PBS claims recorded for SHC women. The major categories of medications prescribed included analgesics, antibiotics, contraceptives, inhalants, and antidepressants. Detailed analysis of records identified that half the PBS prescription items in SHC group could be attributed to five outliers, two of whom resided in rural locations. Importantly, several women whom were outliers for both MBS and PBS use were identified as having mental health assessment, mental health treatment plans and prescriptions for antidepressant medication.

Post-analyses audit of six women recruited to SHC group identified them as regional/rural outliers (Appendix 5.1). All six women used more Medicare benefits or pharmaceutical benefits than women with moderate-risk pregnancy classification of either group who resided in metropolitan postcodes.

Factors that may account for the variations in clinical, resource and cost findings for women whose pregnancies were classified as moderate obstetric risk and their babies when undertaking care in different maternity services models have been discussed in the following chapter. Specifically, how the results of this study when interpreted through the lens of the Donabedian quality evaluation framework can be used to inform and improve public sector maternity services for women experiencing complex pregnancies have been examined. This includes policy and practice recommendations for decision makers.

CHAPTER 6 : DISCUSSION AND CONCLUSION

Introduction

This chapter interprets and discusses data from the study using the Donabedian evaluation framework described in Chapter 3 (Figures 3.4, p. 119 and 3.7, p. 123, respectively). In this chapter the results of the database analysis have been interpreted through the lens of the Donabedian health evaluation framework (Donabedian 2003, 2005) (Chapter 3, Fig 3.7, p. 123). The model and seven pillars of quality health care provided a focused lens through which results from both arms of the study were interpreted in relation to health services research in maternity care (Donabedian 1990, 1980, 1982, 1985, 2003, 2005) (Figures 3.5, 3.6, 3.7, pp. 120–123). Use of the Donabedian evaluation framework enabled robust critique of the South Australian maternity system and the models of care considered in this study.

The research in this study analysed the clinical, resource and cost outcomes for women with complex pregnancies in two maternity models in South Australia, MGP and SHC. The strength of this study is that it is the first of its kind in the Australian context that has investigated comparative outcomes in public health maternity models where the focus has been specifically on pregnant women with 'moderate obstetric risk' classification. The inclusion of two study arms, a retrospective arm 2004–2010 (state-based), and a prospective arm 2010–2012 (Commonwealth-based), meant the research was unique in both its focus and its methods. Net benefit principles specifically enabled a consideration of comparative cost and resource use in relation to clinical outcomes for women and their babies in two maternity models in one state of Australia (methods, pp. 70-1, and Appendix 3.2 respectively).

This study has therefore generated new knowledge by providing evidence for the clinical and cost-effectiveness of a midwifery model of care (MGP) for women with pregnancies specifically classified as 'moderate obstetric risk' when compared to standard hospital services (SHC) in South Australia. In demonstrating improved clinical outcomes for women with moderate complex pregnancies and improved cost and resource use in the MGP model in the public system, the results of this study make an incremental contribution to the body of knowledge that establishes the quality of midwife-led care compared to standard maternity models for childbearing women in Australia. This chapter will discuss how the results from both arms of this study have important implications for state and federal health decision-makers in relation to allocation of scarce public health resources.

Four important issues were identified in the results of the database analysis in the retrospective and prospective arms of this study. They included: inequitable access to public health MGP midwifery models for women who experienced complex pregnancy; improved clinical effectiveness of the MGP midwifery model for women whose pregnancy was classified as 'moderate obstetric risk' compared to standard hospital services (SHC); enhanced cost and efficiency of resource use in the MGP midwifery model measured against standard public health services (SHC), and the combined impact of state and federal funding on midwifery models and maternity services, including maternity care choices for women. The impact of state and federal funding included the effects of cost shifting on the implementation and expansion of models of maternity care, and the quality of care available to women in South Australia when their pregnancy risk classification level was elevated.

Addressing these four issues in policy and practice is critical to quality improvement in the maternity system, including the structure, process, and outcomes of maternity services in South Australia.

The seven pillars of quality health care described in the Donabedian evaluation framework, namely, efficacy, effectiveness, efficiency, optimality, acceptability, legitimacy and equity, in addition to the structure, process and outcomes of the maternity models (Donabedian 1990, 2003, 2005) were used to frame the interpretation of the findings of this study. The discussion of the findings also factors in the models of care currently available (and not available) to all women with complex pregnancy in South Australia, and the implications for women and the health system if this remains the status quo. This chapter concludes with a consideration of the strengths and limitations of the study, provides suggestions for future research, and makes policy and practice recommendations for health decision-makers.

Critical issues for the maternity system and services in South Australia

Inequitable access to public health midwifery models

Equitable access to health services is an important principle of the universal health system in Australia (Armstrong et al. 2007; Duckett & Willcox 2011; McAuley & Lyons 2015). Equitable access to maternity services for women with the same health needs is also a key determinant of quality improvement within the Donabedian SPO evaluation framework, applied to the structure, process and outcomes of maternity service models available within the public health system (Donabedian 1985, 1990, 2003). Of the 20,000 women giving birth in South Australia each year, only 3000 have access to a state public health midwifery model (Scheil et al. 2014). Of the 1000 women per year who accessed the MGP in this study, there was a waiting list of approximately 50 women per month who were not able to access the midwifery maternity model (Buttery 2015, Daw 2013). While almost 60% of women receiving care at the hospital where this study was conducted were classified as having a pregnancy of ‘moderate obstetric risk’ (Chapter 3, p. 87), results from both arms of this study showed there was inequitable access to the MGP model for the women with elevated pregnancy risk factors.

In this study, there were significant differences in the demographic profile of women who self-selected for each service model. Women with the greatest social disadvantage had the least access to the midwifery model. These results were consistent with the findings of recent population-based studies conducted in two Australian states, Victoria and South Australia (Sutherland, Yelland & Brown 2012; Yelland et al. 2015). Sutherland, Yelland & Brown (2012, p. 291) showed clear links between the model of care attended in pregnancy and individual level indicators of social disadvantage, concluding "Across all social and economic indicators, women at greatest risk of disadvantage were significantly less likely to receive primary midwife care than public clinic care."

Notably, women who received SHC in this study experienced greater socioeconomic disadvantage, poorer health outcomes, and generated higher costs for obstetric services in the health system than women in the MGP model. These differences were mirrored in both the retrospective and prospective arms of the study. For example, greater numbers of women who accessed the SHC model were culturally and linguistically diverse, born in countries outside Australia, and English was not their first language. These women, unlike those in MGP, also were less likely to be employed in professional and para-professional roles and more likely to reside in a statistically disadvantaged local area. The women in SHC were also more likely to experience severe health morbidity; for example, to have a body mass index classification of Obese III, to smoke; or to have experienced greater number of pregnancies (four or more), and to have given birth to more babies. Women who received SHC care also experienced higher rates of medical intervention in childbirth, including previous birth by caesarean, repeat caesarean surgery, and 'elective' caesarean surgery. The women who received MGP care however, were older, more likely to be Caucasian and English-speaking, to be employed or to have a spouse employed in a professional or para-professional role, of normal BMI, and less likely to smoke or reside in a statistically disadvantaged social area.

During the period covered by the study the majority of statistical local areas in the metropolitan region were not considered to be high risk for adverse perinatal outcomes because women in these areas were considered to be of higher socioeconomic advantage according to the Social Health Atlas of South Australia (Glover et al. 2006). In this study, however, women from the low socioeconomic area, SEIFA 6 (Appendix 3.7), were substantially over-represented in SHC as compared to MGP. Women from SEIFA 6 were identified as having the highest possible perinatal risk factor score with rates in 17 risk factors, (including sole-parent households, jobless families, smoking during pregnancy, high rates of admission to public hospitals, and increased linkage with Child Adolescent Mental Health Services and the South Australian Housing Trust), and demonstrated poorer perinatal outcomes in comparison with the South Australian average (Glover et al. 2006, p. 23). These results aligned with a strong inverse correlation with the Index of Relative Socio-Economic Disadvantage that showed an association at the statistical local area level between high risk factors for adverse perinatal outcomes and significant socioeconomic disadvantage (Glover et al. 2006, p. 194).

The differing profile of women with complex pregnancies in each service showed how women in South Australia experienced inequitable access to maternity models at the hospital where this study was conducted. These results confirmed the findings of previous studies that showed how discrimination in perinatal care based on maternal social characteristics, including lack of access to midwifery models for vulnerable and disadvantaged women, remains a critical issue that decision-makers in Australian maternity services have not adequately addressed (Brown et al. 2011; Jongen et al. 2014; Yelland, Sutherland & Brown 2012). Discrimination in service access and treatment is an important social determinant of health (Baum 2008; Keleher & McDougall 2015; Tulchinsky & Varavikova 2014). In Victoria and South Australia, it has been found that proportionately more pregnant women from a lower socio-economic demographic received fragmented care in the medical maternity model and that these women were less likely to be satisfied with their care. Of the Victorian and South Australian women surveyed who received midwifery-led care, most rated their care as very good (odds ratio three times higher), as compared to the standard medical model (Sutherland, Yelland & Brown 2012, p. 291).

In this study of women with complex pregnancies in South Australia, two aspects of equity were considered in relation to maternity services, equity of access and equity of outcomes (Duckett & Willcox 2011, pp. 300–2). Applying the Donabedian evaluation lens (Donabedian 1982, 1990, 2003), equity of access (to the structures and process of the service models offered), and equity of outcomes have both been demonstrated as critical in reducing short and longer term maternal and infant population health disparities (Bertilone & McEvoy 2015; Commission on Social Determinants of Health 2007; Jongen et al. 2014; Rayment-Jones, Murrells & Sandall 2015).

In this study, equity involved applying a principle that determined what is just and fair in the distribution of public health care for women and their babies. The most accepted egalitarian perspective is that services be horizontally equitable. This included the principle that two individuals who experienced the same health need should be able to receive the same treatment and services (Wagstaff & van Doorslaer 2001). At the hospital where this study was conducted women with the same health needs were unable to access the same services.

While women self-selected for model of maternity care, SHC was the only default 'choice' for women excluded from the MGP service due to lack of adequate MGP resource and service availability. Furthermore, results from both arms of this study demonstrated inequities in the extent to which many disadvantaged and marginalised women, in particular, have the power and resources to apply individual agency to decisions relating to their reproductive health, including access to choice of maternity model.

Access to the MGP was dependent on limited resources for a restricted number of midwifery caseload places, available to women within a defined geographic catchment. In this system, women who presented early in their pregnancy for antenatal care, who were informed about their options for maternity care, or who spoke English, gained an access advantage, as compared to women who did not. Women who lived outside the geographical catchment also experienced service exclusion. Moreover, while the MGP at the hospital where the study was conducted offered an “all risk” midwifery model for pregnant women, many public health MGPs, including some in SA, do not. Furthermore, when women engage with public health services that do not offer them the same ‘choices’ that are available to other women, there is evidence that woman with elevated pregnancy risk in SA and Australia may avoid care altogether and opt for other ‘choices’, for example, unattended childbirth, or care with unregulated providers (Dahlen et al. 2011; Dahlen, Jackson & Stevens 2011; Davison et al. 2015). This has been an alarming new development in the Australian and South Australian context that has been linked with the marginalisation and exclusion of pregnant women with identified risk factors from mainstream midwifery models (Deputy State Coroner Anthony Ernest Schapel 2012; Rigg et al. 2015).

While the Australian government review of maternity services acknowledged inequalities in access to services for individuals and population subgroups related to “socioeconomic status, risk factors and existing service arrangements” these were “not part of its detailed considerations” (Australian Government 2009, p. 22). This current study has demonstrated that equitable access to midwifery maternity models remains a critical issue. Very few women in South Australia and other parts of Australia currently have access to midwifery caseload services outside the metropolitan area (Brown, M & Dietsch 2013; Dawson et al. 2015; Dietsch et al. 2008; Kildea et al. 2015; Kildea & Van Wagner 2012). To date, monitoring and evaluation of maternity services in South Australia have not included considerations of equity, or the Donabedian quality pillars of legitimacy, acceptability, and optimality, or the capacity of different maternity service models to address health inequities. Nor has broader monitoring and evaluation of public health maternity models considered what the orientation and long-term underlying objectives of the Australian maternity system and its outcomes should be (Tracy 2011, p. 37). Applying quality measures from the Donabedian framework highlights the need to address equitable access to maternity models by all population groups, especially those with elevated risk and social disadvantage (Menadue 2011; Morell et al. 2014; Wilson et al. 2009).

In Australia only 8% of women can access publicly funded maternity models with a midwife as lead carer (Dawson et al. 2015), as compared to 81% of women in New Zealand (Bartholomew et al. 2015). While the health systems of both countries differ, they also share strong similarities and structures, including a commitment to the principles of universality and equity. Critically, the generalist overview of Australia as a safe country in which to give birth has obscured the disparity in the health inequalities, and the choices available to different population groups (Bar-Zeev et al. 2013; Buist et al. 2008; Dahlen et al. 2012; Kildea et al. 2015; Monk et al. 2014; Morell et al.

2014; Yelland et al. 2015). The results of this study affirm that reality for disadvantaged women with moderately complex pregnancy in South Australia. The second critical issue identified in this study was the significantly improved clinical effectiveness outcomes for women in the midwifery model. These are examined in the section below.

Improved clinical effectiveness in MGP maternity model

Clinical effectiveness and efficacy (the capacity of health services to optimise outcomes within available resources), are two key pillars of the Donabedian framework that contribute to quality in public healthcare (Donabedian 1980, 1982, 1985) (Fig 3.6, p. 122). Results in the retrospective and prospective arms of this study demonstrated significantly improved clinical effectiveness outcomes across a range of variables for women and their babies that were associated with receiving care in the MGP model. These results were important as they related specifically to women with a defined moderate pregnancy risk classification and to their care across the childbearing continuum, in contrast to samples of 'low risk' women (Begley et al. 2011; Flint, Poulengeris & Grant 1989; Harvey et al. 1996; MacVicar et al. 1993; McLachlan et al. 2012; Sutcliffe et al. 2012; Waldenstrom & Turnbull 1998; Young, Lees & Twaddle 1997), or to 'mixed risk' samples (Biro, Waldenstrom & Pannifex 2000; Homer et al. 2001; Kenny et al. 1994; North Staffordshire Changing Childbirth Research Team 2000; Rowley et al. 1995; Tracy et al. 2013).

The retrospective arm in this study showed that women who received care in the MGP model significantly increased their odds of a spontaneous vaginal birth (OR 1.52, 95% CI, 1.40–1.65) and an intact perineum (OR 1.13, 95% CI, 1.03–1.24). In addition to achieving higher rates of physiological birth, the women in MGP also experienced fewer complications and morbidities associated with routine medical intervention in childbirth. These were critical findings, as women with complex pregnancies (and their babies) commonly experience higher rates of routine intervention and medicalisation of their care that result in decreased satisfaction with health services and higher morbidity and higher costs for the health system (Davis-Floyd et al. 2009; Homer et al. 2014; Renfrew et al. 2014).

Not all morbidity and medical intervention in childbirth was increased in women who received SHC in this study. While there was no significant difference in outcomes for women between MGP and SHC in the emergency caesarean rate, severe perineal injury (second- and third- degree tears), catastrophic PPH ≥ 1500 ml, or infection, there also were significantly reduced odds for induction of labour (OR 0.69, 95% CI, 0.65–0.75), use of epidural analgesia (OR 0.70, 95% CI 0.64–0.76), episiotomy (OR 0.75, 95% CI, 0.66–0.86), instrumental birth (OR 0.80, 95% CI, 0.71–0.91), elective caesarean (OR 0.45, 95%CI, 0.39–0.52), and PPH ≥ 500 ml (OR 0.83, 95% CI, 0.75–0.92), for women who received MGP care compared to women who received SHC ($p<0.001$). The increased rate of vaginal birth may also have accounted for women’s higher chance of sustaining a first-degree perineal tear (one and half times) as compared to women in SHC.

The proportion of babies who directly roomed in with their mother at the time of birth was also significantly higher in the MGP model (MGP 75.2% vs SHC 64.7%, $p<0.001$). Rooming in was shown, in other studies, to optimise maternal–infant attachment and early initiation of breastfeeding, contributing to successful breastfeeding in the longer term (Bartic & Reinhold 2010; Dyson, McCormack & Renfrew 2005; Moore et al. 2012; Renfrew et al. 2012). Improved rates of breastfeeding are a significant feature of the national health strategy to optimise long-term health outcomes for the Australian population (AHMAC 2009; House of Representatives Standing Committee on Health & Ageing 2007). In the Donabedian framework, developing and expanding models of health care (i.e. a ‘process’ component within the Donabedian SPO model) that optimises the risks and benefits of improvements in clinical outcomes for mothers and babies is an important public health goal (Donabedian 1980, 1982, 1985).

The absence of non-experimental studies in the literature that specifically examined quality outcomes for clinical variables for women with defined moderate risk pregnancy and their babies in MGP models was a critical gap that was addressed by this study. In this study, while quality outcomes for women and babies who received MGP care showed results that were mirrored in some published ‘mixed risk’ studies, other results differed. For example, six randomised controlled trials of women of ‘mixed pregnancy risk’ were included in Sandall et al.’s (2015) review of outcomes in midwife-led models versus other models of care for childbearing women (Biro, Waldenstrom & Pannifex

2000; Homer et al. 2001b; Kenny et al. 1994; North Staffordshire Changing Childbirth Research Team 2000; Rowley et al. 1995; Tracy et al. 2013). Five of the six ‘mixed pregnancy risk’ studies cited were conducted in only two states of Australia (Victoria and New South Wales). All demonstrated higher rates of spontaneous vaginal birth (RR 1.05, 95% CI, 1.03–1.07) for women in the midwifery-led model (Sandall et al. 2015, p. 2). While there was no difference between groups for caesarean births or intact perineum (unlike results from this study), women who were cared for in midwife-led models also were less likely to experience regional analgesia (epidural/spinal) for labour or birth (RR 0.85, 95% CI, 0.78–0.92), instrumental birth (RR 0.90, 95% CI, 0.83–0.97), preterm birth (<37 weeks) (RR 0.76, 95% CI, 0.64–0.91), and overall fetal loss and neonatal death (RR 0.84, 95% CI, 0.71–0.99) (Sandall et al. 2015, pp. 1–2). While the current study comprised a non-experimental database analysis, unlike these studies, it did show higher rates of intact perineum and reduced elective surgical birth for women with moderate complex pregnancy who received the midwifery model. These results were significant.

This study extended the knowledge base for the clinical effectiveness of the MGP model in South Australia by providing new evidence of quality across a range of variables for women with a moderately complex pregnancy, and their babies. New evidence provided by this study included the significantly different results for rates of elective caesarean section in women between MGP and SHC. While no difference was found in the emergency caesarean rate between models of care in the retrospective arm of this study, women who received the MGP model were 55% less likely to experience elective caesarean surgery than women in SHC (OR 0.45, 95% CI, 0.39–0.52). Whether these results were influenced by the self-selection bias of women themselves in their choice of maternity model (Bryant et al. 2007; Campo-Englestein et al. 2015), or whether it related to the demographic characteristics of the women or the practice of the health professionals within the models is an area that requires further research. This is important because evidence shows that higher morbidity for women and babies in the short and longer term is associated with surgical birth (Cardwell et al. 2008; Hyde et al. 2012; Schlinzig et al. 2009; Tracy, Sullivan & Tracy 2007; Victora & Barros 2006).

The organisation of maternity models and pregnancy care also is recognised as an opportunity for early intervention to promote a ‘healthy start to life’ for babies that can reduce their risk for chronic disease later in life (Brinkman, McDermott & Lynch 2010; Kildea et al. 2010; Raisler & Kennedy 2005; ten Hoope-Bender et al. 2014). Previous research has demonstrated how maternity services in Australia are not meeting the needs of immigrant women and others who experience significant social disadvantage, including the ongoing implications of long-term poorer health outcomes for both them and their babies (Brown, S et al. 2011; Yelland et al. 2015). In the retrospective and prospective arms of this study, the outcomes for babies of women who received care in the different maternity models also were significantly different. The babies born to women who received care in MGP model were more likely to have a clinical gestation greater than 37 weeks and a birth weight greater than 3000 grams, optimising their early start to life, unlike babies whose mothers received SHC (Moster, Lie & Markestad 2008; Risnes et al. 2011; Shah 2010). These disparate health outcomes coupled with lack of equal access to service models did not meet the components of quality health care essential to the Donabedian framework, namely acceptability, optimality and legitimacy (Donabedian 2003). Furthermore, they violated principles of equity in a universally funded public health care system as further demonstrated by the unmet demand for choice of maternity model by women (McAuley & Lyons 2015).

The challenges of providing clinically effective care for women with elevated pregnancy risk classification remain critical for the maternity system. In Australia, It has been shown that these women and their babies experience multiple comorbidities and poorer social determinants of health (Australian Government 2015; Bar-Zeev et al. 2013; Brown et al. 2011; Hilder et al. 2014). Their families also carry the additional burdens of unnecessary medical intervention, cost, and increased childbirth and perinatal mental health morbidity (Australian Government 2015; Buist et al. 2008; Cardwell et al. 2008; Hyde et al. 2012; Tracy 2011).

In this study, the outcome components of the Donabedian quality assurance SPO model that enhanced maternal and infant health states and behaviour were measured by accepted national and international benchmarks for quality childbirth care (ten Hoope-Bender et al. 2014; United Nations 2010; United Nations Population Fund 2014; World Health Organization 2000). These benchmarks were recognised by the National Hospital Cost Data Collection (Commonwealth Department of Health and Ageing 2010), IHPA (Independent Hospital Pricing Authority [IHPA] 2013), and NHPA (National Health Performance Authority 2015). They included 'optimisation of normal processes of reproduction and early life and strengthening of women's capabilities to care for themselves and their families' (Renfrew et al. 2014, p. 1130). Of the 72 effective practices within midwifery scope that were studied by Renfrew and colleagues, 62% showed the benefits of optimising physiological vaginal birth for women and babies (Renfrew et al. 2014, pp. 1134–1135). In this study, the increased spontaneous onset of labour and increased rate of physiological vaginal birth for women in MGP was significant, as was the increased numbers of babies who reached term gestation, who roomed in with their mother, and who had birth weights greater than 3000 grams. The reduction in other routine interventions and childbirth morbidity for women with pregnancy complexities also was significant for women in MGP, as compared with SHC. Reductions in elective surgical birth, induction of labour, use of epidural analgesia, episiotomy and instrumental birth, and PPH ≥ 500 ml contributed further to optimisation of clinical outcomes for the women who received care in MGP.

Results in the prospective arm of this study that measured comparative claims for Commonwealth Medicare benefits and prescriptions from the PBS also showed that both were used less by women who received MGP. This suggests that particular clinical effectiveness outcomes of childbearing experienced by women cared for in the MGP model may have continued following discharge from hospital. The extended benefits of higher rates of vaginal birth and reduced elective surgical birth, and the associated reduced morbidity for mothers and babies further supported the optimisation of maternal and infant health outcomes in the early postnatal period for women who received MGP care.

Process components of quality maternity care for women with elevated pregnancy risk were critical in contributing to the improved clinical effectiveness outcomes shown in the MGP model in this study. Within the Donabedian framework, process components are the activities that constitute health care, including assessment, education, and contributions from patients and their families (Donabedian 2003) (Figure 3.4, pp. 119). Previous research has shown that safety, maternal satisfaction, and risk management via early detection of complications was enhanced within continuity maternity models where there is a known care provider and an ongoing relationship of trust established with women (Bryers & van Teijlingen 2010; Kotaska 2011;

Reiger & Morton 2012). Within the MGP model in this study maternity care was individualised and tailored to meet the needs of women. Relationships with care providers in midwifery models focused on partnership, participation, and active contributions from each woman and her family that included integrated care between the hospital and community (Government of South Australia: Children Youth and Women's Health Service 2006; Turnbull et al. 2009). Previous studies demonstrated these processes and relationships provided high-level satisfaction for women and families (Cornwell, Donnellan-Fernandez & Nixon 2008; Fereday et al. 2009). A named MGP midwife and a secondary MGP midwife delivered personalised services and care across the childbearing continuum. On call cover by other midwives from the MGP was provided when either the primary or secondary midwife was unavailable. In contrast, women in SHC received rostered care from a series of different health professionals (upward of 30 over the continuum of a pregnancy, birth and the postnatal period), resulting in fragmented relationships and service provision. Strong relationships with midwives who provide continuity of care demonstrate improved efficacy via early identification of problems, better engagement with health services, and improved coordination of care for women with complexities and social disadvantage (Homer et al. 2008; Rayment-Jones, Murrell & Sandall 2015).

The clinical results in this study contribute to a developing evidence base that establishes the quality of clinical effectiveness outcomes in midwifery maternity models in Australia for women with a ‘moderate pregnancy risk' classification. The third critical issue identified was the cost and resource efficiency of the MGP model.

Cost and efficient resource use in the MGP model

Sustainable health systems depend on cost-effectiveness and efficient use of resources to optimise health outcomes (Baumgartner & Quass 2010; Duckett et al. 2015). In this evaluation study of two maternity models in SA, consideration of the combined effect of cost, efficient use of public health resources, and clinical outcomes that optimised physiological birth for mothers and babies were a requirement to satisfy both net benefit analysis (Eckermann 2007; 2009a; 2009b), and the quality healthcare pillars in the Donabedian SPO model (Donabedian 1983, 1990, 2003). The Donabedian framework applies integrative evaluation in selecting optimal models for health care, in which the relationships among health status, quality of care, and resource expenditure (measured as improvements in health status attributable to care), are all considered (Donabedian, Wheeler & Wyszewianski 1982). A robust feature of this study was that it included both clinical outcomes and internationally validated cost ratios for mode of birth (Petrou, Henderson & Glazener 2001; Tracy & Tracy 2003; Twaddle & Young 1999; Young, Lees & Twaddle 1997). The ratios determined in the earlier studies demonstrated consistent incremental cost increase associated with higher rates of medical intervention applied to mode of birth. While physiological vaginal birth was associated with reduced cost, assisted instrumental birth and caesarean section (including increased resource use associated with induction of labour, use of epidural analgesia and increased complications and morbidity such as perineal trauma and PPH), demonstrated higher costs, respectively (Tracy & Tracy 2003).

Results in both arms of this study demonstrated significant cost savings in the care of women with moderate pregnancy risk classification who received services in the MGP model across the continuum of antenatal, intrapartum and postpartum care. While two other Australian studies have used Australian Refined – Diagnostic Related Group (AR-DRG) separation data to calculate intrapartum care cost for women of ‘mixed risk’ classification in midwifery models (Rowley et al. 1995; Tracy et al. 2013), no Australian studies have measured comparative Medicare Benefit Schedule and PBS costs for postnatal women who received care in different maternity models. In both arms of this study significant differences between MGP and SHC groups were found that included reduced cost and resource use for women who received MGP care across the antenatal, intrapartum and postpartum childbearing continuum in both arms of the study.

In the retrospective study arm, the cost and revenue results modelled using AR-DRG separation data showed increased mean cost overall for the health system in both MGP and SHC over time (Figure 4.8, p. 159). Multivariate GLM models for total cost and revenue (adjusted for 18 confounders), however, showed public cost savings were generated in the MGP model. Significantly, total mean costs remained greater for hospital separations for women with complex pregnancy in

SHC by A$863.93 (β = 0.79; 95% CI 0.76–0.82) per separation across the eight-year fiscal period examined (see Figure 4.5, p. 153, and Appendix 4.7). Women in SHC used more resources, as measured by their increased admissions to hospital during the antenatal period, and had greater likelihood of requiring more than one hospital admission. The SHC group also incurred greater hospital emergency presentations and short-term assessment services, and a higher proportion of their babies were admitted to the Special Care Baby Unit (SBCU), unlike those who received MGP care. These were significant findings, as increased hospital admissions and use of SCBU incurred greater staffing requirements and greater costs for the hospital and the funder/s of state hospital care, as shown in the subanalyses of combined hospital AR-DRG separations in Appendix 4.4 (including summary Tables 4.5a; 4.5b and 4.5c, pp. 368–369, that show high volume, high cost AR-DRGs for public hospitals in SA) (National Hospital Cost Data Report 2010).

While abundant evidence was found in the international literature for the clinical and cost benefits of midwifery models for women with 'low risk' pregnancy (Begley et al. 2011; Birthplace in England Collaborative Group 2011; McLachlan et al. 2012; Ryan et al. 2013; Schroeder et al. 2012), robust evidence of the clinical and cost benefits of midwifery models for women who experienced complex pregnancy is scarce, including in the Australian context (Biro, Waldenstrom & Pannifex 2000; Homer et al. 2001; Kenny et al. 1994; Rowley et al. 1995; Tracy et al. 2013). Furthermore, the majority of

Australian studies are now dated, having been conducted over a decade ago. As discussed in the literature review in this study, there also was a lack of consistency in the economic evaluation of models of maternity care. Variations in measurement, modelling, variables selected, and episode of the childbearing continuum analysed (i.e. antenatal, intrapartum, postnatal), made cross-country and within-country cost comparisons challenging. In the review of midwifery-led maternity models undertaken by Sandall et al. (2015), only six studies out of the fifteen selected for inclusion in their review included an economic analysis (Flint, Poulengeris & Grant 1989; Homer et al. 2001; Kenny et al. 1994; Rowley et al. 1995; Tracy et al. 2013; Young, Lees & Twaddle 1997). Additionally, the midwifery models in Sandall et al.'s review of studies with an economic analysis comprised 'team midwife care', (as distinguished from MGP/caseload midwifery models), with the exception of one study (Tracy et al. 2013). Moreover, each of these studies presented cost data using different economic evaluation methods, and included combinations of 'low risk' and 'mixed risk' samples of pregnant women.

Nevertheless, in respect of antenatal and intrapartum resource use for women, midwifery-led models consistently demonstrated reduced cost, dependent on caseload volume within the midwifery model (Ryan et al. 2013; Villar et al. 2007). The lack of costing studies for women with specifically defined elevated pregnancy risk, however, remains a critical gap. In this study (retrospective arm 2004–2010) AR-DRG code hospital costs per separation per woman with moderate risk pregnancy classification, show a significant saving for women in MGP (A$863.93) (GLM adjusted model) over a sustained time period. These cost savings are supported by the findings from two Australian studies of mixed risk samples of pregnant women which also used AR-DRG codes to determine comparative intrapartum costs between models of care (Rowley et al. 1995; Tracy et al. 2013). The first study, which did not include antenatal or postnatal care costs, showed mean intrapartum savings were A$151 in the team midwifery model (Rowley et al. 1995). The latter study (in which the full episode of maternity care was recalculated from services provided to the woman for duration of hospital stay, but did not include neonatal costs) showed median intrapartum cost savings were A$566.74 in the midwifery-led caseload model (95% CI 106.17–1027.30, p=0.02) (Tracy et al. 2013). A point of difference in the results from the retrospective arm of this study was that aspects of both antenatal and neonatal costs were considered, and rates of vaginal birth were higher.

Australian research has shown surgical intervention in birth costs more for healthy women and babies and uses more hospital resources (Tracy et al. 2014). When complications occur as a result of these interventions, cost and resource use increase further (McIntyre, Chapman & Francis 2011; Tracy 2011; Tracy & Tracy 2003). Within the Donabedian framework, over-intervention and complications that result from over-intervention reduce the efficacy and efficiency of the maternity services. This causes increased short- and long- term morbidity for women and babies and increased costs for the health system. In this study, hospital admissions and bed stay were variables commonly associated with increased intervention in childbirth. Interventions and complications resulting from childbirth also increased requirements for hospital staffing and cost (Commonwealth Department of Health and Ageing 2010; Duckett et al. 2015; National Health Performance Authority 2014, 2015). The capacity of maternity models to reduce unnecessary hospitalisation and resource use across the childbearing continuum, therefore, was an important public health objective (National Health Performance Authority 2013; Vitikainen, Street & Linna 2009) and was demonstrated by the MGP model in the retrospective arm of this study.

Elective caesarean surgery and other childbirth interventions are not cost neutral when compared with uncomplicated vaginal birth (von Gruenigen et al. 2013). In 2011–12 in Australia, the average cost per public hospital admission for vaginal birth without complications was A$4600 (range A$2200–A$6500). In contrast, during the same period, the average cost for caesarean surgery without complications was A$8800 (range A$5500–A$15,300) (National Health Performance Authority 2015, pp. 28–9). While this study did not show significant difference in length of postnatal bed stay between MGP and SHC (Table 4.12, p. 145), National Health Performance Authority data showed that the hospital at which this study was conducted continued to be a significant national outlier for prolonged bed stay post-caesarean surgery (National Health Performance Authority 2013, p. 11). Therefore, models of care such as the MGP that reduced the caesarean rate for the hospital also benefited the public purse. Maternity models such as the MGP also cross-subsidised hospital cost in other care models, such as the SHC, where the rate of bed stay was increased by a higher incidence of elective surgical birth.

Cost savings in the retrospective arm of this study may relate to the higher rate of vaginal birth in the MGP or to the characteristics of women in the model, especially their higher socioeconomic status and self-selection for model of care. International cost ratios, however, showed lower system costs when the rate of vaginal birth was increased. This included associated resource benefits of early discharge of mothers and babies from hospital facilities (Bellanger & Or 2008). The cost savings shown by the database analysis results for MGP and SHC in this study were supported by the subanalyses of combined DRG costs for the hospital, and in the summary tables from the National Hospital Cost Data Report. These both showed increased system costs for high volume/high cost DRGs (caesarean births with and without complications), and reduced system costs for high volume/lower cost DRGs (vaginal births without complications).

While reasons for the difference in the rate of vaginal birth between MGP and SHC in this study may be unknown, identifying differences in mode of birth in comparative maternity models was important to further understand what influences cost and resource use in the maternity services for women with a defined pregnancy risk classification. Critically, in this study costs were modelled over a defined time period in multivariate GLM models that accounted for potential confounders. While previous ‘mixed risk’ Australian studies also have accounted for confounders, these studies have not done so over the extended timeframe that was undertaken in this study. The 18 covariates included in the GLM models demonstrated specific areas where costs of care in all maternity models were likely to be influenced. Significantly, most of the covariates that were associated with predicting increased cost related to recognised areas of increased health morbidity for pregnant women. For example, increased BMI; smoking status; increased parity and number of births, especially caesarean section and repeat caesarean section; and to women with poorer social determinants of health, for example, non-English-speaking women who were born outside Australia, or who were residing in a local statistical area of economic disadvantage (AIHW 2015; Hilder et al. 2014) (Appendices 4.7 & 4.8).

Previous studies showed that postnatal costs were either no different, or may be increased in midwifery models. Only two studies showed reduced postnatal costs in the midwife model (Morrell & Spiby 2000; Petrou & Boulvain 2004). By contrast, in this study, prospective arm 2010–2012 (Commonwealth-based) postnatal use of MBS resources was significantly less for women in MGP than SHC. Adjusted IRR showed a 41% lower rate of MBS visits for women in the MGP model (95% CI 0.46–0.76, p<0.001). Predictors for increased MBS use included women of gravid 2 status and those who experienced birth by elective caesarean section. While provider charges and out-of-pocket costs were higher for women in MGP, the reason for this was unknown. The finding of reduced use of federally funded MBS health services in the four months after giving birth by women who received MGP model, compared with SHC, may have been related to state-funded postnatal home visiting services provided in the MGP model. Alternatively, reduced MBS use by women in the MGP model may have been related to optimised childbirth outcomes (for example, higher rates of physiologic birth and reduced childbirth co-morbidity, and babies who achieved gestations > 37 weeks and birth weights > 3000 grams), or to demographic differences in the population, including the women's higher socioeconomic status. Applying the Donabedian evaluation lens and the principles of net benefit, improvements in health status if attributable to the model of maternity care, and if able to lower the cost of services without eroding or compromising achievable improvements in maternal and infant health, justifies expansion of those options from a public health perspective (Donabedian 2003, Donabedian, Wheeler & Wyszewianski 1982).

In this study the data for PBS analysis was limited. In MGP 85.26% (n = 81) of women recorded no pharmaceutical prescription items, as compared with 61.26% (n = 68) women in SHC. Post-analysis audit of outliers, however, showed six women in SHC group violated postcode inclusion criteria; namely, they had postcodes outside the metropolitan area. This meant few conclusions were able to be drawn in respect of PBS use. It was notable, however, that half of the total pharmaceutical claims in SHC related to five women, two of whom were from rural areas. Moreover, each of the six women with a rural postcode had more Medicare and pharmaceutical benefit claims than any women in either group with a metropolitan postcode. These findings were consistent with research that indicates higher morbidity and poorer health status for mothers and babies in regional and rural Australia (Dietsch et al. 2008; Hilder et al. 2014; Pilcher, Kruske & Barclay 2014). The fourth and final critical issue identified by this study concerned the combined impact of state and federal funding on midwifery models and maternity services.

State- and federal- funding issues: effects on maternity models

Funding is a core component of the Donabedian framework that has an impact on all quality pillars. This includes the structure, process and outcomes of public health maternity models and the capacity to expand them to adequately address population health needs (Donabedian 1980, 1982, 1983, 1985, 1990, 2003, 2005). A fundamental challenge in the provision of maternity services in Australia is that funding responsibility for public health midwifery caseload models, including the MGP in this study, continues to rest with state and territory governments. The service model is financed from an acute care budget nested within a Local Health Network and metropolitan maternity hospital state budget. In the study both MGP and SHC services used consumables, resources, the institutional infrastructure, and the finances of the hospital. The major cost component of public health caseload midwifery models were midwife salaries, while Federal Medicare funding (Commonwealth) was available to general medical practitioners and obstetricians for episodes of antenatal and postnatal care provided to childbearing women. By contrast the salaried components of service costs within public health midwifery models were born by the state health budget. In the medical model costs shifted to the Federal purse. These funding arrangements currently act as a disincentive to cash-strapped state governments and impede the expansion of public health midwifery models in Australian states and territories, including South Australia. Only 15% of childbearing women in SA could access a public health midwifery model (Scheil et al. 2014), as compared to 8% of childbearing women nationally who are able to access midwifery models (Dawson et al. 2015).

This study found that South Australia's maternity system was challenged by health care financing arrangements that influence the optimal organisation of services and expansion of efficient, clinically effective maternity models. This contributed to inequitable supply and access to public health midwifery models. Similar concerns have consistently been identified in previous public inquiries across all Australian states and territories.

One issue identified by the retrospective and prospective arms of the database analysis undertaken in South Australia was the effect of cost shifting between state and federal governments for outpatient and inpatient hospital services. An example includes antenatal and postnatal outpatient care provided to women by general medical practitioners and obstetricians for women in SHC (Federally funded through Medicare). This reduced state costs for provision of antenatal and postnatal midwifery services for public hospital patients, especially when used with early discharge. As shown in this study, however, antenatal emergency attendance, including antenatal hospital admissions, were greater for women in SHC. This results in increased costs for the state. These costs flow on to the Federal government via Federal funding that is provided back to state and territory hospitals to fund acute hospital inpatient services, resulting in increased cost overall to the public purse. Similarly, the higher rates of medical intervention, including elective surgical birth, and associated higher morbidity in childbearing women in SHC, increased admissions to Special Care Baby Units for babies, and increased MBS and PBS use postnatally also increase federal government costs. These patterns of resource use and shifting cost impact the public health resources and services available to women with moderate risk pregnancy, which included limited expansion of midwifery caseload services and inequitable access to midwifery models for women with social disadvantage and elevated pregnancy risks. Applying the Donabedian health evaluation lens and quality pillars of optimality, acceptability and legitimacy, lead to the conclusion that current federal–state funding arrangements and cost shifting may be sub-optimally impacting the development and expansion of public health maternity models at the structural level of health financing in Australia.

In the national review of maternity services the federal government recognised that the measurement and effect on clinical outcomes, patterns of service use, resource consumption and public cost for groups of women who have experienced different models of pregnancy and childbirth care was an important consideration for allocation of health resources, especially given that 71% of women give birth in public hospitals (Australian Government 2009, p. 51; Hilder et al. 2014, p. 56). The federal review showed also that the majority of maternity service funding across Australian state and territory governments (70%) was attributable to public hospital expenditure and that state and territory governments developed services in accord with local policies and health planning needs across their jurisdictions. This has resulted in widespread variation in maternity models and inconsistencies between jurisdictions (Commonwealth of Australia 2011 p. 17). It has also resulted in continued cost shifting between federal, state and territory governments for different episodes of maternity care, and in different models of care. These were significant public health issues that affected the MGP and SHC examined in this study. The impact of current funding arrangements and cost shifting in maternity care deserves broader consideration, particularly in other states and territories where the volume of pregnant and childbearing women attending care through the public system is even greater.

This study was unique in that it identified the combined effect of state and federal funding on the allocation of public health resources in maternity care and midwifery models. Moreover, previous analysis and critique of the organisation of Australian maternity services have not adequately addressed these funding effects on the structure, process and outcome components of the broader maternity system, or the impact on women who experienced elevated pregnancy risk classification. This was unsurprising given that comprehensive national mapping of maternity services (Homer et al. 2011), including development of a rural birth index (Pilcher, Kruske & Barclay 2014), and examination of the effect of closure of rural maternity services on pregnant women (Kildea et al. 2015), have also only recently been undertaken in Australia.

In Australia, public hospitals financed by the state reduce and shift their antenatal and postnatal service costs to the federal government by encouraging women who received SHC to undertake care in the community with Medicare-funded GPs and obstetricians. Under these arrangements, women receive fragmented care at the hospital for booking and the birth episode only. In the MGP continuity model the entire cost of the midwifery caseload services provided across the childbearing continuum by salaried midwives is born by the state.

In this study, cost and revenue for AR-DRG separations for antenatal hospital admissions, including mode of birth, showed significant savings and improved outcomes in the MGP model for women with a moderate risk pregnancy. For state health departments and governments facing budget austerity and the challenges of state–

federal cost shifting these savings are effectively cross-subsidising other less-efficient services and models, rather than being used to expand access to effective public health services and models, including MGPs with waiting lists, that are dependent on state funding (Buttery 2015; Cornwell, Donnellan – Fernandez & Nixon 2008). This compounds the problem of inequitable services distribution for women with higher socioeconomic disadvantage and pregnancy risk, as does limiting access to postnatal midwifery services provided in MGP models after women have been discharged from hospital. The following section considers the strengths and limitations of the study.

Strengths and limitations of the study

This study used a two-armed non-experimental research design with both retrospective and prospective data linkage. Use of Net benefit principles enabled analysis of both cost and quality attributes, in two maternity models. This strengthened the rigour of descriptive comparative findings as related to productivity, efficiency and economic aspects of the study (Eckerman & Coelli 2013; Kelman, Holman & Bass 2002; Folland, Goodman & Stano 2007). The research design also enabled evaluation of obstetric outcomes and inequities in access to maternity models among women and their babies with different socioeconomic characteristics. In summary, the study strengths included a robust non-experimental study design, adequate power in the retrospective and prospective study arms, high reliability, use of validated tools, instruments and datasets, and the application of statistical analysis, tests and models that adjusted for potential confounding variables. A further strength of this study lies in the use of a robust health evaluation framework, the Donabedian SPO Model, and seven pillars of quality health care that were applied to interpret the data (Donabedian 1990, 2003, 2005).

While the non-experimental design of this study was a strength, a limitation of the study relates to the weaknesses inherent in all non-experimental study designs as applied to the database analysis of comparative clinical, resource and cost outcomes for MGP and SHC. In non-experimental research the researcher cannot control, manipulate or alter the predictor variable, in this study the model of care received by women (Webb & Bain 2011). The study therefore could not demonstrate true cause and effect relationships (Folland, Goodman & Stano 2007), but was able to demonstrate important associations for clinical outcomes, cost and resource use in two models of maternity care, MGP and SHC.

The limitations of a non-experimental study design for the database analysis of comparative outcomes between MGP and SHC also meant that the research findings could be influenced by bias (Holman 2012; Munro 2005; Webb & Bain 2011). In both the retrospective and prospective arms of this study women self-selected for the model of care. Self-selection carried the risk that women in the groups possessed traits or characteristics that unduly influenced the variables under investigation, and therefore the research results (Harris & Taylor 2004). The issue of self-selection as bias and confounding effect was also raised as a critique in relation to comparative clinical effectiveness findings published in the 2004–2005 demonstration study (Turnbull et al. 2009). Because there was no random assignment to service model groups, the groups compared were not considered equivalent.

The adoption of standardised risk classification criteria in case record selection in this study, however, supported obstetric risk homogeneity and enabled credible service comparisons to be made (Appendix 3.1a).

In addition to bias associated with the self-selection of model of care, there also were multiple potential confounding variables. These included features of demography, clinical outcomes, data collection and the time parameters during which the study was conducted. While use of retrospective and prospective study arms and linkage of multiple datasets enabled rich data collection and comparisons, women in MGP and SHC models were non-homogenous. In non-experimental descriptive studies, confounding variables and selection bias limit both the validity and generalisability of findings (Webb & Bain 2011), however, confounders are only a problem if not accounted for. In this study the use of robust statistical methods, tests and models accounted for confounders and these were applied in both arms of the study. Issues of selection bias and extraneous and potential confounding variables were addressed through the use of multivariate generalised linear model (Gaussian family) with log link function (adjusted model) (Hilbe 2009, 2011; Hyndman, Holman & Hockey 1995; Tabachnick & Fidell 2013). This strengthened and ensured the integrity of the database analysis in both arms of the study.

Other limitations included the variables selected for costing. This study did not account for workforce costs such as staff recruitment, development, attrition and replacement. Additionally, the net benefit approach to the evaluation of each service model was limited to consideration of gross resource allocation, ‘top-down costing’. It measured clinically effective outcomes and morbidity across the short term, namely antenatal, birthing and early postpartum care continuum. This did not take into account other important and significant factors such as maternal satisfaction nor direct consumer costs associated with participation in different service models, for example travelling time, waiting time, time spent away from workplace for appointments, parking costs and childcare costs (Davison et al. 2015; McLachlan et al. 2015).

The scope of this study focused on the perspectives of state and federal resource allocation in maternity services in the public sector. Evaluation of the longer term costs of particular outcomes of care from the consumer’s point of view – for example, the physical recovery time associated with birth by caesarean section, treatment for complications, and the recovery and additional resource supports required for longer term services sequelae such as postnatal distress and depression, birth trauma or child protection issues – were not included. While these issues constituted important areas of public policy and resource allocation they were beyond the scope of the study. The inability to model the longer term costs of chronic disease and morbidity associated with disutility outcomes that may arise from the childbearing episode across the life course was a further limitation. Policy and practice recommendations arising from the results of this study have been made in the section that follows.

Policy and practice recommendations

The objectives of the *Transforming Health* agenda advanced by the current South Australia government have been stated as orienting the health system and services to achieve six quality care principles: patient-centred, safe, effective, accessible, efficient, and equitable (Government of South Australia 2015). Several issues were identified in the findings of this study that require attention by decision makers responsible for policy, allocation of public health resources and implementation of maternity services if those objectives are to be achieved in relation to women with elevated pregnancy risks.

In answering the research question posed by this study:

> *How effective on productivity/efficiency measures across a defined time horizon was Midwifery Group Practice compared to Standard Hospital Care in achieving net benefit for quality, measured by clinical effectiveness, resource use, cost and equity in a group of women with pregnancies classified as 'moderate obstetric risk' and their babies?*

the following conclusions were drawn when the data were interpreted through the Donabedian evaluation framework:

Critical evaluation of MGP compared to SHC in this study showed that different components of the Donabedian SPO model and quality measures were suboptimal in both service models for women with complex pregnancies (Donabedian 1990, 2003). Process components (i.e. how the two maternity models provided care to women and their families), demonstrated distinct differences, as did outcome components, including effective optimisation of physiologic childbirth and the risk of routine medical intervention and associated morbidity.

In this study, even though women were able to access universal maternity services they were not able to access mainstream midwifery models. At a structural level the results in this study showed significant inequity and lack of access to midwifery care for women with the greatest socioeconomic disadvantage. Improving quality care and net benefit in maternity services for women with complex pregnancies therefore needs to be a critical public health objective in South Australia. On this basis the following policy recommendations are made:

- Expand access to midwifery continuity models (MGP) in the public health system in South Australia for all pregnant women, including women with an elevated pregnancy risk classification. Currently, only 8% of women nationally can access public health midwifery models, including 15% of women in SA. Many MGP models in Australia and South Australia, unlike the one in this study, are currently restricted to women with 'low risk' pregnancy. The results in this study showed that the cost and clinical effectiveness benefits of the midwifery model, including the higher rate of physiological vaginal birth and reduced childbirth interventions and associated morbidities, can safely extend to those women with a defined moderate risk pregnancy classification, and their babies. This optimises early maternal and infant health and reduces health system costs.

- Address inequitable access barriers to MGP models for pregnant women with social disadvantage and other groups; for example, Aboriginal and Torres Strait Island women, culturally and linguistically diverse women, and women living in country areas. Most public health midwifery models are concentrated in metropolitan areas, including the three largest MGPs in South Australia. These models are currently attached to city hospitals and acute care budgets. There is a need to reorient the maternity system to primary health services provided in the community close to where women live and work. This includes collaborative midwifery services integrated with tertiary hospitals to enable seamless services as well as local community engagement with individuals and groups who demonstrate disadvantage and higher levels of childbearing related morbidity. Encouraging early uptake of antenatal care and engagement with health services for groups with identified disadvantage has demonstrated improved outcomes for these women and their babies (Bertilone & McEvoy 2015; Jongen et al. 2014). Services should have a woman-centred pregnancy-parturition-parenting focus that enables multidisciplinary care and use of evidence-based practice guidelines for women with higher risk/complex pregnancies, as demonstrated by the midwifery model that was the subject of this study.

- Implement a systemic, consistent approach to inter-jurisdictional policy between federal and state governments for the planned expansion and implementation of public health midwifery models based on a population needs health approach. This is critical to solving current structural barriers and challenges in the maternity system, for example, funding models where state–federal cost shifting acts as an impediment to the expansion of MGP models, perpetuating inefficient allocation of resources, including inefficient configuration and use of skilled midwifery workforce across the childbearing continuum. This study demonstrated significant cost savings over time as well improved clinical outcomes for women with elevated pregnancy risk who received care in the public health MGP model, when compared to SHC. A coordinated systemic approach to policy development and transparent, funded implementation and expansion of midwifery models has the potential to maximise cost savings, efficiencies, quality improvement, and clinical outcomes for women with moderate complex pregnancies and their babies, in SA and in other states and territories.

- Undertake funded evaluation and benchmarking of public health maternity models that engage all stakeholders and incorporate a range of research methods. Maternity evaluation should occur within an identified framework and provide comprehensive information in relation to quality health care that informs the structure, process, outcome components of service models and the maternity system. This includes consideration of clinical outcomes, cost, resource use, and satisfaction of the principal service users, childbearing women.

Suggestions for future research

In addition to these recommendations, several issues were identified in the study indicating that further research is required. Because results showed inequitable service access to midwifery models for socially disadvantaged women and those from a non-English-speaking background, investigation of how to reduce barriers and improve engagement and service use by these groups is critical (Rayment-Jones, Murrells & Sandall 2015; Yelland et al. 2015). Additionally, exploration of reasons for the difference in elective caesarean section rate between MGP and SHC should be undertaken. This may relate to the bias of women, or to features of the maternity care model, or to health provider behaviour in relationships where power imbalance influences complex decision-making (Campo-Englestein et al. 2015). Similarly, establishing the factors that contribute to reducing the number of antenatal admissions and hospital emergency presentations by women with elevated pregnancy risk factors may also provide further information about specific features of the midwifery model and/or relationships with women that contributed to reducing resource use in this area in this study. Future costing studies that compare outcomes between different maternity models in Australia need to clearly define the risk classification status of the women, their population characteristics, and the model of care. Further studies should adopt common economic evaluation frameworks and include outcomes across the childbearing continuum to assess quality attributes for net benefit as well as monetary measures (Eckermann 2009a; Vitikainen, Street & Linna 2009), and consumer preferences.

Conclusion

In conclusion, this study was motivated by the researchers' long-term work and policy interest in expanding maternity health service access and equity to midwifery caseload continuity models in the public system in Australia. During the life of the project this interest was shared by the national review of maternity services and development of a National Maternity Services Plan. As the study unfolded its objectives also aligned with development of the *Transforming Health* reform agenda of the South Australian government. Currently there are significant limitations associated with maternity care policy and service provision in Australia that have not been adequately addressed in policy or translated into improved models of care or improved outcomes for some of the most disadvantaged mothers and babies in the population. Despite the changing profile of women giving birth and the disparate health outcomes for different groups of mothers and babies, configuration and delivery of mainstream maternity services in Australia have changed very little over the past decade (Gray Jamieson 2012; Guilliland & Tracy 2015, pp. 16-19). While policy development in the maternity services has progressed at a federal level, governments in all states and territories of Australia have struggled to implement and expand access to public health midwifery models. Development of the National Maternity Services Plan promised much in the way of policy change; however, widespread implementation of integrated public health maternity models that deliver on the promises have not been met. Change is required to accommodate both the changing demographic profile of women having a baby in Australia, and community demand for more responsive, person-centred services, including increased access to midwifery services and models.

Results in this study showed comparative inequity of access and outcomes and significant cost differences in relation to benefits in two maternity models in South Australia. These issues were compounded in the provision of services for women with complex pregnancies. When examined through the lens of the Donabedian evaluation framework the results of this study of comparative clinical, resource and cost outcomes for two public maternity models, retrospective arm 2004–2010 (state-based), and prospective arm 2010–2012 (Commonwealth-based), showed significant difference and challenges in structure, process and outcomes for women and babies who received care through MGP or SHC model. In this study, women with greater social disadvantage did not have the same access to the midwifery model as did other women with the same health needs

The results in both arms of this study demonstrated significant and sustained cost savings and efficiencies in the MGP model over time, as compared to SHC, and improved clinical effectiveness outcomes for women with ‘moderate obstetric risk’ pregnancies and their babies. This included a cost saving of A$863.93 per hospital separation per woman and higher rates of vaginal birth, improved birth weights and clinical gestation for babies, fewer hospital admissions, and reduced medical intervention and associated morbidity in childbirth, including elective surgical birth. Women in the MGP model also made 41% fewer Commonwealth Medicare benefits claims in the first month after giving birth and pharmaceutical claims also were reduced. Future allocation of resources, including addressing state- and federal-funding barriers to the expansion of public midwifery models for women with complex pregnancies should be prioritised, as must access for those women and babies most disadvantaged.

APPENDICES

Appendix 1.1 Reviews, Reports & Government Inquiries into Childbirth Services in Australia

1989 Maternity Services NSW Shearman Report (Department of Health NSW 1989)

1990 Having a Baby in Victoria (Health Department Victoria 1990)

1990 Western Australia Maternity Review (Western Australia Ministerial Taskforce to Review Obstetric Neonatal and Gynaecological Services in Western Australia 1990)

1993 ACT Maternity Services Review (ACT Department of Health 1993)

1995 Report SA Models of Care Working Party (South Australian Health Commission 1995)

1995 Select Committee on Intervention in Childbirth Report: Turnbull Report (Western Australian Legislative Assembly 1995)

1998 NSW Alternative Birthing Services Program – Evaluation of Phase 2 – Aboriginal Strategies (NSW Health Department 1998)

1999 And the women said . . . Reporting on Birthing Services for Aboriginal Women from Remote Top End Communities (Kildea 1999)

1999 Rocking The Cradle: A Report Into Childbirth Procedures (Senate Community Affairs Reference Committee 1999)

2000 NSW Framework for Maternity Services 2000 – 2005 (Department of Health NSW 2000)

2001 Final Report of the Inquiry into Obstetric and Gynaecological Services at King Edward Memorial Hospital 1990–2000 (Douglas, Fahy & Robinson 2001)

2002 National Maternity Action Plan: For the Introduction of Community Midwifery Services in Urban & Regional Australia (Maternity Coalition 2002)

2004 Future Directions for Victoria's Maternity Services (Department of Human Services Victoria 2004)

2005 Re-Birthing: Report of the review of Maternity Services in Queensland (Hirst 2005)

2005 South Australian Women's Health Policy (Government of South Australia 2005)

2007 Improving Maternity Services – Working Together Across Western Australia: A Policy Framework (Government of Western Australia 2007)

2007 Maternity Services Review in the Northern Territory (Banscott Health Consulting 2007)

2008 Primary Maternity Services in Australia – A Framework for Implementation (Australian Health Ministers Advisory Council 2008a)

2009 Improving Maternity Services in Australia – the report of the Maternity Services Review (Australian Government 2009)

2011 National Maternity Services Plan (Commonwealth of Australia 2011)

Appendix 2.1 Tools Used in Appraising the Literature

Table 2.1.1 Evidence Hierarchy – National Health & Medical Research Council

NHMRC Evidence Hierarchy: designations of 'levels of evidence' according to type of research question (including explanatory notes)

Level	Intervention 1	Diagnostic accuracy 2	Prognosis	Aetiology 3	Screening Intervention
I [4]	A systematic review of level II studies	A systematic review of level II studies	A systematic review of level II studies	A systematic review of level II studies	A systematic review of level II studies
II	A randomised controlled trial	A study of test accuracy with: an independent, blinded comparison with a valid reference standard,[5] among consecutive persons with a defined clinical	A prospective cohort study[7]	A prospective cohort study	A randomised controlled trial
III-1	A pseudorandomised controlled trial (i.e. alternate allocation or some other method)	A study of test accuracy with: an independent, blinded comparison with a valid reference standard,[5] among non-consecutive persons with a defined	All or none[8]	All or none[8]	A pseudorandomised controlled trial (i.e. alternate allocation or some other method)
III-2	A comparative study with concurrent controls: Non-randomised, experimental trial[9] Cohort study Case-control study Interrupted time series with a control group	A comparison with reference standard that does not meet the criteria required for Level II and III-1 evidence	Analysis of prognostic factors amongst persons in a single arm of a randomised controlled trial	A retrospective cohort study	A comparative study with concurrent controls: Non-randomised, experimental trial Cohort study Case-control study

Level	Intervention 1	Diagnostic accuracy 2	Prognosis	Aetiology 3	Screening Intervention
III-3	A comparative study without concurrent controls: Historical control study Two or more single arm study[10] Interrupted time series without a parallel control group	Diagnostic case-control study[6]	A retrospective cohort study	A case-control study	A comparative study without concurrent controls: Historical control study Two or more single arm study
IV	Case series with either post-test or pre-test/post-test outcomes	Study of diagnostic yield (no reference standard)[11]	Case series, or cohort study of persons at different stages of disease	A cross-sectional study or case series	Case series

NHMRC (2008) NHMRC Additional levels of evidence and grades for recommendations for developers of guidelines, p. 15

Table 2.1.2 Eight Quality Appraisal Questions

Quality Appraisal Questions

Does the philosophy behind the research study address the aims of the review?
Is the sample size adequate to answer the question of the study and draw meaningful conclusions?
Are the selected data collection methods appropriate for the research question?
Is there sufficient evidence that ethical issues have been considered?
Does the study demonstrate data analysis rigor; can the data analysis strategy be identified and logically followed?
Is there a clear statement of findings; are the results presented clearly, objectively and in sufficient detail?
Does the study identify strengths, weaknesses or limitations?
Does the research make a valuable contribution to existing knowledge?

Table 2.1.3 PRISMA Checklist – for systematic reviews and Meta-analysis

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	

Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	
Section/topic	**#**	**Checklist item**	**Reported on page #**
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	

Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

Appendix 2.2 Summary Tables of literature included in the review

Table 2.2.1 Summary of Eight Systematic Reviews conducted 2015; 2013/2010; 2008/2005; 2007; 2001 *

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
1. Sandall et al. (2015) Midwife-led continuity models versus other models of care for childbearing women (Review) United Kingdom √	To compare the effects of midwife-led continuity models of care with other models of care for childbearing women and their infants Primary outcomes = birth & immediate postpartum outcomes Secondary outcomes = birth intervention & morbidity, some aspects of resource use & cost where measured (5 studies only re cost)	Included 15 RCTs of 17 674 women in total Excluded 22 studies Studies were from health systems in Canada, Ireland, Australia & UK Only 6 of 15 studies included measured costs of model: Tracy et al. 2013 Homer et al. 2001 Young et al. 1997 Rowley et al. 1995 Kenny et al. 1994 Flint et al. 1987 (4 Australian; 1 Scottish; 1 UK)	Systematic review Search: Cochrane Pregnancy & Childbirth Group's trials Register + reference lists of retrieved articles Selection criteria: published and unpublished trials, pregnant women randomly allocated to midwife-led continuity models of care or other models of care (pregnancy & birth). Studies: Allen et al. 2013 Begley et al. 2011 Biro et al. 2000 Flint et al. 1989 Harvey et al. 1996 Hicks et al. 2003 Homer et al. 2001 Kenny et al. 1994 MacVicar et al. 1993 McLachlan et al. 2012 North Stafford 2000 Rowley et al. 1995 Tracy et al. 2013	Risk Ratios (RR) & Confidence Intervals (CI): Primary 0utcome in midwife – led models (RR) (CI) ↓ regional analgesia 0.85, 0.78 – 0.92 ↓instrumental birth 0.90, 0.83 – 0.97 ↓ pre-term <37 wks 0.76, 0.64 – 0.91 ↓ fetal loss <24 wks 0.84, 0.71 – 0.99 ↑spontaneous vaginal birth 1.05, 1.03 – 1.07 No difference for caesarean section or intact perineum Secondary 0utcome midwife – led models (RR) (CI)	Combined results for low and mixed risk pregnant women Low risk pregnant women = 8 studies Mixed risk pregnant women = 7 studies Only 4 studies were caseload continuity / named midwife models; 11 studies were 'team midwifery' 6 Studies only included cost: 4 mixed risk RCTs from Australia = narratively reported due to a lack of consistency in assessment Strong evidence for improved clinical effectiveness outcomes in midwifery models, reduced intervention, and increased satisfaction with care in low risk women, and in

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
			Turnbull et al. 1996 Waldenstrom et al. 2001	↓amniotomy 0.80, 0.66 – 0.98 ↓ episiotomy 0.84, 0.77 – 0.92 ↓ fetal loss <24 wks 0.81, 0.67 – 0.98 No intrapartum analgesia 1.21, 1.06 – 1.37 Longer labours (MD) 0.50 hrs, 0.27 – 0.74 Know birth midwife 7.04, 4.48 – 11.08 No difference for: Fetal loss >24 wks Labour induction A/N admission A/N haemorrhage Labour augmented PPH Low birthweight 5 min Apgar < 7 SCBU admission Initiate breastfeed	some mixed risk studies, although should be 'interpreted with caution' Cost effectiveness (mean costs) Midwife vs Control (Kenny et al. 1994) $1122 vs $1220AUD (Rowley et al. 1995) $3324 vs $3475AUD (Young et al. 1997) See Table 2.2.2 Study 30 Calculated on Caseload numbers / midwife (29 or 39) (Homer et al 2001) $2579 vs $3483AUD (Tracy et al 2013) Median cost / birth ↓ $566.74 / woman in midwife model (95% CI 106.17 – 1027.30; p=0.02) Limited evidence for cost – effectiveness for women with complex pregnancy

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
2. Sutcliffe et al. (2012). Comparing midwife-led and doctor-led maternity care: a systematic review of reviews United Kingdom √	*A systematic review of reviews to examine the impact of midwife-led maternity care for low risk women, rather than doctors	3 meta-analytic reviews included: Studies from health systems: Canada, USA, Australia, UK Brown & Grimes 1995 15 studies, 13 CTs, 2 RCTs (n = 7066) Hatem et al. 2008 11 studies, all RCTs (n = 12, 276) Villar et al 2001 3 studies, all RCTs (n=1763)	Narrative review of systematic reviews, based on stated quality criteria for inclusion 3 reviews included (column 3) 2 reviews excluded: Muthu & Fishbacher 2004; Walsh & Downe 2004	Pooled data for Midwife vs Doctor maternity care: Care outcome with significant difference favouring midwife: ↑ spont vaginal birth ↓ instrumental birth ↓ episiotomy ↓intrapartum analgesia/anaesthesia Use of nil analgesia / anaesthesia Avoidance of opiate analgesia No difference between providers for: Caesarean section A/N haemorrhage PPH Induction of labour Labour augmentation Mean length labour Manual removal placenta Mixed evidence for: Pregnancy induced hypertension Amniotomy Perineal injury	Results confined to women of ‘low risk’ pregnancy classification only Women who received care by midwives accessed a range of physical benefits and increased satisfaction; were not any risks identified for low risk women receiving care by midwives rather than doctors Concluded it was not possible to establish the cost effectiveness of replacing doctor led care with midwife – led care on basis of studies included

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
3. Ryan, P., P. Revill et al. (2013). An assessment of the cost-effectiveness of midwife-led care in the United Kingdom United Kingdom √	*To analyse existing evidence on cost – effectiveness of midwife-led care compared with consultant –led care in UK settings *To estimate potential cost savings that would accrue from expansion of midwife – led care in UK *Publication based on Section 3 cost – effectiveness findings of Devane, Brennan et al. 2010 systematic review below (1b)	Included 4 RCTS evaluated against quality guidelines for economic reviews devised by Drummond and Jefferson in 1996: Flint et al. 1987 Hundley et al. 1995 Young et al. 1997 Begley et al. 2009 (3 UK + 1 Republic of Ireland) *three studies included in economic synthesis (2 UK, 1 RI) *Flint study excluded as sub-group costing for only 49 of 1001 women in this RCT had been completed	Systematic review of 12 electronic databases for costs of midwife led models: MIDIRS; ASSIA; HMIC; Cochrane SR; Cochrane Central; MEDLINE; CINAHL; EMBASE; DARES; NHSEED; Health Technology Assess Database; Cochrane Methodology Register *Adopted NICE methods and multiple one-way sensitivity analysis for economic synthesis of costs using 3 studies *applied result to 8 situations/scenarios *Cost effectiveness measure used was Incremental Net Benefit (INB): expressed as Net Monetary Benefit (NMB) – £ value, and Net Health Benefit (NHB) – QALY, Quality adjusted life year gain	*Mean cost saving on each maternity for midwife led care estimated at £ 12.38 *Expansion of midwife led care to 50% of all eligible women in UK projects an aggregated cost saving of £ 1.16 million per year *Sensitivity analysis showed cost changes per maternity varied from a saving of £ 253.38 (equivalent to 37.5 QALYs gained per year) to a cost increase of £ 108.12 depending on assumptions used; i.e. corresponding aggregate annual savings of £ 23.75 million, or aggregate annual cost increase of £ 10.13 million	*All cost estimations based on original RCT – Level 1 evidence/studies *3 studies only *Rigorous health economic assessment measures used (INB, NMB, QALYs) *Generalisable / limited to UK setting and system only *Excluded Level 1 studies from Australia and other countries where comparison was not with a consultant – led model *Results not only limited to Low Risk pregnancy profile; *tentative claim used sub-group analysis undertaken in Devane et al. 2010 (low and mixed risk trials) that cost results remained consistent for these groups as relative risk (RR) fetal loss and

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
					neonatal death overlap with 1.00
4. Devane, D., M. Brennan et al. (2010). Socioeconomic Value of the Midwife, A systematic review, meta – analysis, meta – synthesis and economic analysis of midwife – led models of care United Kingdom √	*Section 3: specifically Assessed cost effectiveness of midwife-led care compared with consultant –led care. Included estimation of potential cost savings from expansion of midwife-led care in UK (pp. 33–45)	Based on 3 of 4 selected RCTs as described in 1. above Flint et al. 1987 sample 1001 women (excluded); Hundley et al. 1995 sample 2844 women; Young et al. 1997 sample 1299 women; Begley et al. 2009 sample 1653	Systematic review as described in 1. above Sensitivity analysis x 3 based on 8 scenarios: SA 1: Systematically varying estimated cost savings SA 2: Systematically varying risk ratio for overall fetal loss & neonatal death using low risk and 'mixed risk' maternities SA 3: Systematically varying assumed uptake of midwife-led services	*As published in Ryan, Revill et al. 2013 above	*Cochrane collaborations bias assessment tool used to assess internal validity of trials *Limited generalizability due to small number of studies included *Cost effectiveness varied with unit size, location and volume
5. Henderson, J. and S. Petrou (2008). Economic implications of home births and birth centers: a structured review United Kingdom √	*Structured review that examined economic implications / cost effectiveness of home births and Birth Center births compared with hospital maternity care (Clinical results also reported where included)	*Included 11 studies from USA, Canada, UK & Australia. (2 studies homebirth; 9 studies Birth Centers): Anderson et al. 1999 Byrne et al. 2000 Henderson et al. 1997 Hundley et al. 1995 Lubic, 1983 Ratcliffe, 2003 Reinharz et al. 2000 Stone & Walker, 1995 Stone et al. 2000	Systematic review of data bases: MEDLINE 1950 > CINAHL 1982 > EMBASE 1980 > Econ2 (in-house) English language; MeSH & free – text. Yield: 201 papers 18 selected 11 included	*Resource use was generally lower for women who had home birth and Birth Center care due to lower birth interventions and shorter length of stay. *Some studies showed increased cost (UK) where higher grades of midwives were employed or facilities were developed	*Low risk pregnancies *Selection bias in non-RCT studies (only 3 studies were RCT; others observational; quasi-experimental; decision – analytic) *Paucity of specific economic literature re home births and Birth Centers *Quality of literature noted to be poor *Different health care systems; different

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
		Walker & Stone, 1996 Young et al. 1997			methods; different costs included *Absence of bottom – up costing
6. Stewart, M., R. McCandlish et al. (2005). Report of a structured review of birth center outcomes United Kingdom √	*Structured review of literature on the evidence about cost – effectiveness of different models of maternity care. Included summary study evidence re: Antenatal Care Home Birth Birth Centers Postnatal Care Midwifery team and Caseload midwifery continuity compared to traditional care and medical / specialist care	*Included 11 studies as cited above (2a), in addition to 8 further studies in similar health systems + antenatal costings based on RCT results from Cuba/Thailand: Petrou et al. 2004 Tracy & Tracy 2003 Homer et al. 2001 Villar et al. 2001 Henderson et al. 2000 Morrell et al. 2000 Ratcliffe et al. 1996 Rowley et al. 1995	*Structured review/search of database in June 2003 included MEDLINE and Econ2 (in-house) – perinatal health economic literature MeSH & free – text terms limited to English literature *Yield: 201 papers 18 selected	*Review included discrete costs for antenatal / postnatal care & team/caseload midwifery also: *↓ cost midwife/GP antenatal care vs specialist OB; 12 – 14 antenatal visits not clinically or economically justified *Home birth ↓ cost vs hospital birth except when > 2/3 women transferred during labor *Birth Centers – costs highly variable, dependent on inclusion of capital & staffing costs *Postnatal – 2 economic evaluation alongside RCTs show ↓ cost for home care superior to hospital even with additional staffing	*Almost all economic evaluations limited to low risk pregnancy *Models of care for women at higher risk are unevaluated from an economic perspective *Different study interventions *Different models of care (caseload / team / episodic) *Different costs included *Variable quality of studies *Confounders included location and staffing costs
7. Villar J., G. Carroli et al. (2007) Patterns of routine antenatal care	*To assess the effects (outcomes, cost and satisfaction) of	*Included 10 RCTs of > 60, 000 women in total; *Seven trials evaluated	*Cochrane Review; *Trial quality assessed & data extracted by two	*Reduction in antenatal visits was not associated with ↑ in	*Trials and review focused on 'low-risk' women only;

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
for low risk women (Cochrane Review conducted in 2001) and updated Various countries √	antenatal care programs for low risk women	number of antenatal clinics visits; *Three trials evaluated type of care provider	reviewers independently – most trials assessed as of acceptable quality; *Pooled data	any negative maternal or perinatal outcomes reviewed [see examples in 24. next Table]; *Trials from developed countries suggest women less satisfied with ↓ antenatal visits; *Similar clinical effectiveness amongst providers (midwife, general practitioner, obstetrician), but women more satisfied with midwife/general practitioner managed care; *Lower costs for mothers and providers can be achieved	*Trial / Study authors were contacted for additional information; *Provider, woman and health system perspectives included
8. Henderson, J., R. McCandlish et al. (2001) Systematic review of economic aspects of alternative modes of delivery See also, Petrou S., J. Henderson et al. (2001).Economic aspects of caesarean section and alternative modes of delivery United Kingdom /	A systematic review of the literature, (electronic and non – electronic for 1990 – 1999) relating to economic aspects of alternative modes of delivery (birth) Identify research on cost or resource use of health care (including formal economic	*Industrialized countries only (OECD 'developing' excluded) *49 of 975 papers met methodological quality / criteria for the review for primary or secondary cost or utilization data *32 papers from USA; others UK, Italian,	*Multi-D team: 2 health economist + midwife epidemiologist and information officer * Reviewer categorization used defined quality appraisal tool and Kappa statistic 0.22 (z value 3.75) with agreement between reviewers (P<0.01) for papers included	*Caesarean section costs substantially more than other birth modes *Uncomplicated vaginal delivery cost: £ 629 – £ 1298 *Caesarean cost: £ 1238 – £ 3551 *Aggregate costs reported in American studies were 4–5 times	*All risk pregnancies; no differentiation between type of caesarean (elective or emergency; antepartum or intrapartum) *Distinguished between indirect and direct costs * Description of method to estimate quantities

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
Scotland √	evaluation) related to mode of birth	Scandinavian, Australian, European *Databases: MEDLINE, CINAHL, Econlit, EMBASE, Cochrane, DARE, NHS Economic evaluation, COPAC, ASSIA, SIGLE, ASLIB * Additional access/analyses of 3 large observational data sets: a)Nth West Thames Region hospitals 1995 – 1997 b)Survey of 21 maternity units in European Union c)Random sample 20% women (n=1242) receiving care postnatally in Grampian Region of Scotland 1990–1991	*Reported staff costs, summary/aggregate costs and calculations with and without length of postnatal stay *Cost and resource data converted to £ sterling and inflated to 1998/1999 prices *Data sets used to source hospital resource utilization data	higher than costs reported in other studies (often comprised medical fees only; no disaggregation of resource components)	and unit costs provided *Currency / price dates reported; adjustments for inflation *Considered only short term health costs; failed to account for short and long term costs associated with adverse maternal and neonatal outcomes *Majority of American studies of poor quality * Few studies reported / included cost for equipment / consumables

*Articles presented in reverse chronologic order; √ denotes a minimum PRISMA score of 20 based across a possible total of 27 check-list items (Appendix 2.1 Table 2.1.3)

Only 2 of the studies considered in the 2 systematic reviews did not meet inclusion criteria for primary research articles included at Table 2.2.2: Flint et al. (1987) and Lubic (1983). Both fell outside the time parameter for the current review. Additionally, the Flint study was excluded in the economic synthesis undertaken by Devane et al. (2010) due to limitations of sub-group costing that were undertaken for only 49 of the 1001 RCT participants in that trial.

Table 2.2.2 Summary of Primary Articles Reviewed*

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
1. Tracy, S.K., W. Welsh et al. (2014). Caseload midwifery compared to standard or private obstetric care for first time mothers in a public teaching hospital in Australia: a cross sectional study of cost and birth outcomes. **Australia** √	Compared birth outcomes and cost of care for women booked to one of three available models: Caseload Midwifery (MGP); Standard Hospital Care (SHC); or Private Obstetric Care (POC) between July 2009 – December 2010	*Public metropolitan tertiary teaching hospital in NSW, Australia *1, 379 low risk women defined as 'standard primipara'	*Cross-sectional study of birth outcomes and cost between three service models over one financial year at same hospital site	*Women more likely to have spontaneous labour and unassisted vaginal birth in: MGP vs SHC vs POC 58.5% vs 48.2% vs 30.8% ($p<0.001$) *Women less likely to have elective caesarean section MGP vs SHC vs POC 1.6% vs 5.3% vs 17.2% ($p<0.001$) *Over one financial year average cost of care for standard primipara in MGP = AUS $ 3, 903.78 / woman *$ 1, 375.45 more for those in POC, and $ 1, 590.91 more for those in SHC ($p<0.001$)	Sample confined to low risk first time mothers 'standard primipara'
2. Gao, Y., L. Gold et al. (2014). A cost-consequences analysis of a Midwifery Group Practice for Aboriginal mothers	*Compared the cost – effectiveness of two models of service delivery, Midwifery Group Practice (MGP)	*Regional hospital in Northern territory, Australia. *MGP cohort included aboriginal women from 7	*Economic evaluation comprised of retrospective records audit (Baseline cohort) and prospective data collection (MGP cohort)	*MGP cohort: ↑ antenatal care ↑ultrasounds ↑AN hospital admissions ↑PN care in town	*Mixed risk sample *Limitations: small sample size; study design; assumptions; missing data (3.7% –

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
and infants in the Top End of the Northern Territory, Australia. **Australia** √	newly established, and a baseline cohort for Aboriginal mothers and their infants. *Included clinical and cost analysis	communities who birthed (Sept 2009 – June 2011) MGP mothers n = 310 MGP babies n = 315 *Baseline cohort included aboriginal women from 2 communities who birthed (Jan 2004 – Dec 2006) Baseline mothers n = 412 Baseline babies n = 416	to establish comparative cost and changes post establishment MGP service from first antenatal appointment to 6 weeks postpartum for Aboriginal mothers and babies *Measured/calculated direct costs per group	↓average length of SCN stay for babies *No significant difference for major birth outcomes of: Mode of birth Pre-term birth, or Low birth weight between groups, but ↓catastrophic outcomes of vaginal birth ($p<0.001$) MGP *Cost saving of AUS $ 703 / mother-infant episode for MGP cohort not statistically significant ($p=0.566$) *MGP model: ↓birth cost -$ 411, $p=0.049$ ↓SCN cost – $ 1 767 $P=0.144$ ↑ AN cost + $ 272, $p<0.001$ ↑PN cost + $ 277, $P<0.001$ ↑infant readmit cost + $ 476, $p=0.05$ ↑travel cost = $ 115, $p=0.001$	24.5%); 51% of all cases had missing data; time trend confounding *Cost assumptions used for economic analysis – expert opinion not primary data collection *Hostel costs & transport costs not included
3. Tracy, S.K., D.L. Hartz et al. (2013).	Assessed maternal and perinatal	*Women of all pregnancy risk status	2 arm RCT design comparing Caseload	Reduced birth interventions and	*Level 1 evidence – Registered Trial

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
Caseload midwifery care versus standard maternity care for women of any risk: M@NGO, a randomized controlled trial. **Australia** √	efficacy, safety and cost of caseload midwifery compared with standard hospital maternity care for women irrespective of identified risk factors (Timeframe: Dec 2008 – May 2011)	*Sample 1748 women *2 sites: two metropolitan teaching hospitals in 2 states of Australia (NSW & Queensland)	care with named midwife n = 871 and Standard Hospital Care n = 877 *Outcomes defined apriori – primary & secondary; clinical & cost *Analyses by intention to treat *Univariate logistic regression for estimated odds ratio with 95% CIs and Pearson χ2 tests to calculate p values comparing proportions between study groups; non-parametric bootstrap percentile CIs to infer significance of effects	reduced cost for women in Caseload Median cost saving of $ 566 AUS / woman with Caseload / named midwife 30% > spontaneous onset of labor; ↓ pharmacological analgesia; ↓elective caesarean section. No significant difference in overall rate of caesarean section between groups. Similar safe outcomes for mothers and babies between groups	ACTRN12609000349246 *Women of all pregnancy risk status Defined eligibility, inclusion/exclusion criteria *Study sufficiently powered (80%) and Type 1 error of 5% *Population/sample bias challenged external validity *Cross-overs – did not receive assigned model of care *non-masking of group allocation from clinicians *No differentiation or stratification of risk levels
4. McLachlan, H., D.A. Forster et al. (2012).Effects of continuity of care by a primary midwife (caseload midwifery) on caesarean section rates in women of low obstetric risk: the COSMOS randomized controlled trial. McLachlan, H., D.A.	*To determine whether primary midwife care (caseload midwifery) decreases the caesarean section rate compared with standard maternity care	*Tertiary care women's hospital in Melbourne, Australia *Sample total: 2, 314 women of low risk pregnancy classification Caseload Midwifery n = 1, 156	*2 Arm RCT Design with economic evaluation part of secondary outcome analyses *Primary Outcome measure=caesarean section birth *Women randomized to Caseload Midwifery care (continuity model) or to Standard Care	*Women who received Caseload Midwifery care: ↓Caesarean rate 19.4% vs 24.9%; risk ratio [RR] 0.78 95% CI 0.67–0.91; p = 0.001 ↑Spont vaginal birth 63% vs 55.7%; [RR] 1.13	*Level 1 evidence – Registered Trial ACTRN012607000073404 *Low risk pregnant women only *Awaiting publication results for economic evaluation / secondary analyses

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
Forster et al.(2008). Study Protocol COSMOS: Comparing Standard Maternity Care with One-to-one midwifery Support: a randomized controlled trial Costs and cost-effectiveness results pending **Australia** √		Standard Care N = 1, 158	(varying providers, varying levels continuity)	95% CI 1.06–1.21; P<0.001 ↓Epidural analgesia 30.5% vs 30.6% [RR] 0.88 95% CI 0.79–0.996; P=0.04 ↓ Episiotomy 23.1% vs 29.4% [RR] 0.79 95% CI 0.67–0.92; P=0.003 ↓Infants admitted SCN 4.0% vs 6.4% [RR] 0.63 95% CI 0.44 – 0.90; P=0.01	
5. Toohill, J., Turkstra, E., Gamble, J., Scuffham P.A. (2011) A non-randomised trial investigating the cost – effectiveness of Midwifery Group Practice compared with standard maternity care arrangements in one Australian hospital. **Australia** √	Compared cost effectiveness of 2 maternity services: Midwifery Group Practice (MGP) at a Birth Center vs Standard care	*Australian metropolitan hospital *Total sample 119 women recruited MGP n = 52 SC n = 50 Followed through to 6 weeks postnatal	*A prospective non-randomized trial *Generalized linear models with covariates of age, nulliparity, private health insurance & household income *Outcome measures: health care costs to hospital & govt *Data collected from diaries, handheld pregnancy record,	*Comparative Cost per woman: MGP: AUS $ 4, 696 vs SC:AUS $ 5, 521 (Hospital) (p<0.001) MGP: AUS $ 4, 722 vs SC: AUS $ 5, 641 (Government) (p<0.001) MGP women:	*Low risk women meeting Birth Center eligibility criteria *Selection bias *Small sample size *71% return rate of diarized records *Included antenatal, birth and postpartum care costs

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
			medical records, hospital accounting system	$\downarrow$IOL; $\downarrow$AN visits; $\downarrow$babies admitted to NICU; $\uparrow$postnatal visits	
6. Jan S., S. Conaty et al. (2004). An holistic economic evaluation of an Aboriginal community-controlled midwifery programme in Western Sydney **Australia** √	Holistic economic evaluation of an Aboriginal Community Controlled Midwifery Program in Western Sydney (Timeframe: 1990 – 1996)	Comparative Sample: 2 groups of Aboriginal women resident in Western Sydney who gave birth between Oct 1990 – Dec 1996 at Nepean or Blacktown hospitals n = 834 births *Women received antenatal care at Daruk Aboriginal Community Controlled Program, or Women received antenatal care at Nepean or Blacktown hospital	*Cost analyses that estimated Direct Program costs to health sector + Downstream savings *Quantitative clinical outcome data from clinic case records and NSW Midwives Data Collection 1991–1996 *Data for hospitalization used Australian National Diagnostic Related Group cost weights; medication used Pharmaceutical Benefits Schedule; diagnostic tests used Medicare Benefits Schedule *Sensitivity analyses model led uncertainty	*Daruk AN service saw 245 women for 339 pregnancies during study period with 76 returning for subsequent pregnancies *Net cost estimated at AUS $ 1, 200 per client – calculated by subtracting cost savings to other centers *No statistically significant difference in birth weights or perinatal survival between services *Daruk AN care = Gestational age @ 1'st visit lower; mean number AN visits higher; attendance for AN tests better	*Mixed risk pregnancy *Evaluation framework combined quantitative and qualitative methods *Focused on antenatal care attendance and access, but costs considered were broader than used in conventional economic analyses & included clinical outcomes for birth and antenatal attendance in a subsequent pregnancy *Assumptions used to conduct sensitivity analyses and estimate downstream health service costs
7. Tracy S., and M. Tracy (2003).Costing the cascade: estimating the cost of increased obstetric intervention in childbirth using population data	*Estimated the cost of 'the cascade' of obstetric interventions implemented in labor for women with 'low risk' pregnancy (age-adjusted rates)in a	*NSW, Australia *Population sample: 171, 157 all women who had a live baby during 1996 & 1997 31, 700 primiparous	*Constructed cost model applied to primiparous and multiparous women *Model applied to defined population using 4 groups of	*Cost of birth $\uparrow$ up to 50% for primips and to 36% for multips as interventions in labor accumulate *Epidural $\uparrow$cost up to 32% for primips & up to	*Low risk pregnancy only *Assumptions based on predictive cost modelling * Includes only labor and birth

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
Australia √	population sample over a defined timeframe	51, 039 multiparous	identified labor interventions against 3 birth outcomes *4 Intervention sub-groups: No intervention IOL or augmentation Epidural only Epidural and IOL or augmentation, for *3 Outcomes with assigned cost ratios: Vaginal = 1 Instrumental = 1.3 Caesarean = 2.5 *Cost calculations made for 3 care types: a. Private OB care in private hospital b. Private OB care in public hospital c. Routine public hospital care	36% for multips *Private OB care $\uparrow$cost by 9% for primips, and by 4% for multips	*No estimated antenatal or postnatal costs *No consideration of cost effect of length of stay *No estimate / consideration of secondary costs associated with readmission to hospital or neonatal admissions to Special care Nursery (SCN)
8. Homer C.S., D.V. Matha et al. (2001). Community based continuity of midwifery care versus standard hospital care: a cost analysis, based on Homer C.S., G.K. Davis et al. (2001).	Examined clinical and cost differences of community based continuity of midwife care (CMWC) compared to control/ standard hospital care (SHC)	NSW, Australia Sample of women of mixed pregnancy risk n = 1089 CMWC = 550 SHC = 539	*RCT (Zelen Design) cost analysis of community based continuity of midwifery care compared to standard hospital care. *Specific criteria used inclusion/exclusion	*Caesarean section rate 13% vs 18% (unclear if data analyzed by intention to treat) *Mean costs/woman: CMWC AUS $2 579 vs SHC AUS $3 483	*Cost analysis alongside RCT *Mixed pregnancy risk sample (low and high) *Costs included resource use, clinician travel and neonatal care *No equipment, capital or program development

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
Collaboration in maternity care: a randomised controlled trial comparing community-based continuity of care with standard hospital care **Australia** √	Timeframe: 1997 – 1998)		*Costs included: AN Clinic; Day Assessment; inpatient admissions; on-call; labor/ birth, hospital PN care; domiciliary care; Special Care Nursery admissions of baby	Excluding neonatal costs: CMWC AUS $1 504 (95% CI 1449–1559) SHC AUS $1 643 (95% CI 1563–1729)	costs *No transfer rates *Caseload per midwife key to cost effectiveness. *Not possible to determine optimal caseload numbers in this evaluation
9. Byrne J.P., C.A. Crowther et al. (2000).A randomised controlled trial comparing birthing centre care with delivery suite care in Adelaide, Australia **Australia** √	Compared Birth Center care (co-located within hospital) with traditional delivery suite care	*Adelaide, Australia *Sample: 200 women randomized to BC care or traditional care	RCT with integrated cost study: 'cost modelling approach' – costs not specified; midwives estimated time for procedures; resource use from case files	*No difference between groups found *No difference in clinical outcomes *67% transferred from BC to conventional care	*Low risk pregnancy (uncomplicated AN before 31 weeks) *Underpowered *23% of eligible women consented to randomization *Infrastructure costs excluded
10. Rowley, M.J., M.J. Hensley et al. (1995). Continuity of care by a midwife team versus routine care during pregnancy and birth: a randomized trial **Australia** √	Examined clinical and cost differences (for birth) between 2 groups: i.e. Continuity provided by team of 6 midwives or routine hospital care	NSW, Australian hospital Sample 814 women of mixed pregnancy risk randomized to either team midwife care (n= 405) or routine hospital care (n = 409)	*RCT between 2 groups: continuity provided by a team of 6 midwives and routine care in pregnancy and birth *Measurement of clinical outcomes + Australian National Cost Weights for Diagnostic Related Groups (DRG) per delivery were used	*Women in team midwifery care had: ↑attendance AN class 25% vs 16% P=0.001 ↓ birth interventions 36% vs 24% Odds ratio [OR] 1.73 95% CI 1.28 – 2.34 P<0.001 ↓ pethidine use [OR] 0.32 95% CI 0.22 – 0.46 ↓ newborn resuscitatn [OR] 0.59 95% CI 0.41 – 0.86	*Cost study alongside RCT *Included women of all pregnancy risk status *Mode was team midwifery care, not caseload continuity *Costs based only on DRGs; i.e. top – down/ not detailed

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
				↑Satisfaction with care Stillbirth and neonatal death rate no difference *Mean costs/birth: Team MW AUS $3 324 Routine AUS $3 475 Cost reduction was 4.5%	
11. Kenny, P., P. Brodie et al. (1994). Final Report: Westmead Hospital Team Midwifery Project Evaluation **Australia** √	*Cost analyses of Team Midwifery Care compared to Standard Hospital Care *Clinical outcomes and costs included *Study period September 1992 – July 1993	*Westmead public hospital, NSW, Australia *Sample total = 446 women *Team Midwifery Project group (213) *Standard Hospital Care (233)	*RCT 2 Arm Study *Cost analyses study *Cost estimates based on resource use at AN, birth and PN care (included domiciliary) *Costs estimated where statistically significant differences in service use between groups was shown *Costs included direct costs, infrastructure and staff salaries and were calculated for 'low' and 'high' risk clients in each service group	*Team Midwifery vs Standard Care: (average costs) AN Costs / woman: High risk pregnancy $ 427 vs $ 456 Low risk pregnancy $ 135 vs $ 133 Birth Costs / woman Significant differences between groups for manipulative vaginal birth, episiotomy & perineal tears. Average additional cost was $ 4.21 vs $ 9.36 PN Costs / woman: Hospital stay $ 356.64 vs $ 397.26 Domiciliary $ 45.45 vs $ 45.80	*RCT Level 1 evidence *All risk pregnancy included (women low & high risk) *Discrete costs for AN, birth and postpartum *Extensive, bottom –up costing *Team midwife model, not caseload *Low risk of bias, although blinding not stated *Some loss to follow up (19 in Team Midwife Care & 22 in Standard Hospital Care)

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
12. Bernitz, S., E. Aas et al. (2012). Economic evaluation of birth care in low-risk women. A comparison between a midwife-led birth unit and a standard obstetric unit within the same hospital in Norway **Norway** √	Investigated cost – effectiveness of birth care in an alongside midwife – led unit (MU) compared to a standard obstetric unit (SCU)	Ostfold Hospital Trust, Norway, MU and SCU at same hospital Sample: 1, 110 healthy women with low – risk pregnancy at onset of labor MU, n = 411 SCU, n= 699	*Cost – effectiveness study piggy-backed onto an RCT *Data extracted from hospital activity based costing system = detailed Cost per Patient (CPP) *Costs calculated by costs/ day multiplied with length of stay; added costs for procedures *Intention to treat analyses: independent sample t-test; means; 95% CI & p values *Costs expressed in incremental cost effectiveness ratios (ICERs) with SCU as comparator *Effect measures: avoided caesarean sections; instrumental deliveries; complications requiring operating room treatment; epidural analgesia and oxytocin	*ICER showed MU was dominant strategy where costs calculated based on 90% capacity of each unit *Total costs/stay: MU € 1, 672 vs SCU € 1, 950 (p<0.001) *Mean cost/LOS MU € 1, 515 SCU € 1, 746 (p<0.001) *Statistical significant ↓cost and ↓ clinical procedures in MU vs SCU: Epidural 15.6 vs 23.9% P=0.001 Augment / oxytocic 26.3% vs 37.2% P<0.001 *MU more cost effective for low – risk women, but not a dominant strategy for all outcomes: i.e. no significant difference in mode of delivery or rate of complications	*Low risk pregnancies at onset of labor only *No inclusion of antenatal care costs, long – term costs, or admission of babies to Neonatal Intensive Care / Special care Nursery *Limited in hospital costs only; i.e. human resource costs including time were not measured *No generic measurement such as Health Related Quality of Life [HRQoL] enabling comparison with other studies *Included both bottom – (Devane et al. 2010)up and top – down approaches *Similar findings to cost – effectiveness analysis of Birthplace in England Study (Schroeder et al. 2012) *Results only generalizable to low risk women with no preference for place of

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
			augmentation *Sensitivity analyses = non-parametric bootstrap method	requiring treatment in Operating Theatre	birth
13. Schroeder, E., S. Petrou et al. (2012).Cost effectiveness of alternative planned places of birth in woman at low risk of complications: evidence from the Birthplace in England national prospective cohort study. **United Kingdom** √	Estimate cost effectiveness of alternative planned place of birth in four settings: Home vs Midwife Unit(FS) vs Midwife Unit (AS) vs Obstetric Unit Varying time points, April 2008-April 2010	*Sample: 64, 548 women at low risk of complication before onset of labour *142 of 147 trusts providing homebirth *53 of 56 Midwife Units (free standing) *43 of 51 Midwife Units (alongside) *random sample of 38 of 180 Obstetric Units stratified by size and geography	*Economic evaluation that used individual data from Birthplace National Prospective Cohort Study *Outcome measures: Incremental cost per adverse perinatal outcome avoided; adverse maternal morbidity avoided; additional normal birth *Non-parametric bootstrap used for Net Monetary Benefit & to generate cost effectiveness acceptability curves at different thresholds	*Total unadjusted mean costs: Home £ 1, 066 Mid Unit(FS) £ 1, 435 Mid Unit(AS)£ 1, 461 OB Unit £1, 631 *Planned birth at home for multiparous women had 100% probability in generating greatest mean net benefit with perinatal outcomes considered. *Increased incidence of adverse perinatal outcome with planned birth at home in nulliparous low risk women	*Low risk pregnancy *Minimal selection bias *Used nationally agreed design & reporting guidelines *Sufficient size to detect clinically important differences in adverse perinatal outcomes *Sensitivity analysis had limited effect on results *Some unit cost data modelled from secondary sources *Limited time horizon *Did not consider postnatal cost / outcomes for mother or baby
14. Begley, C., D. Devane et al. (2011) Comparison of midwife-led and consultant –led care of healthy women at low risk of childbirth complications in the Republic of Ireland: a randomised trial.	Clinical and cost – effectiveness study comparing an alongside Midwife-led unit (MLU) with a Consultant – led Unit (CLU) 2004 – 2007	*Cavan & Drogheda, Republic of Ireland *Sample 1, 653 women (healthy, without risk factors) *Antenatal care shared between midwives and	*Pragmatic RCT Midwife care n=1101 Consult care n = 552 *Cost – effectiveness analysis (incremental costs and standard deviation) *Compared rates of interventions between two units, maternal	*Average cost, intention to treat analysis UK £ 1937.76 vs UK £ 2191.14 (MLU saved UK £ 253.38) *Average cost of normal birth UK £ 437.25 (MLU) vs UK £ 480.91 (CLU)	*Level 1 evidence RCT *Low risk sample *Capital costs not included – considered equivalent between two units; no productivity changes reported

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
Based on: Begley, C., Devane, D., Clarke, M., (2009). An Evaluation of Midwifery-led Care in the Health Service Executive North Eastern Area: The Report of the MidU Study **Ireland** √		general practitioners; intranatal and postnatal care provided by midwives	satisfaction, costs and neonatal/maternal outcomes	*Breakdown of cost saving from MLU in £ (cost increase = neg) Antenatal 81.03 Antenatal LOS 177.13 Intrapartum -1.47 Postnatal -3.31 *Sensitivity analysis showed ↑midwife visits after birth with shorter hospital stay	*Bulk of cost saving was in antenatal period
15. O'Brien, B., S. Harvey et al. (2010). Comparison of Costs and Associated Outcomes between Women Choosing Newly Integrated Autonomous Midwifery Care and Matched Controls: A Pilot Study **Canada** √	*Compared costs and outcomes of newly integrated publically funded midwife care with existing health care services in 1 Canadian province	*Four Alberta health regions (2 rural, 2 urban) *Integrated midwife care n = 146 *Control group, existing care services n = 292	*Matched control design of women in Alberta giving birth during 8.5 month study period – used deterministic linkage of health data * 1:2 matched sample for risk score; age; parity; postcode *Used multiple linear regression & bootstrapping *Cost data included: Physician fee for service; out and in-patient records; health datasets	*Average saving per woman in midwife group per course of care was CAN $ 1, 172 *Cost reductions realized through: ↓IOL and service provision outside hospital, i.e. home birth *No difference between groups for caesarean section or assisted birth	*Low risk pregnancy *Sample size insufficient to compare events associated with high costs or rare or catastrophic perinatal outcomes *Four regions (Hospital/outpatient cost data unavailable for 2 regions)
16. Gibbons, L., J.M. Belizan et al. (2010). The Global Numbers and Costs of Additionally Needed	Estimated the resource-use and global cost implications of 'needed' and	National caesarean section rates for 137 countries from 192 United Nations member countries	*Estimation of costs were based on a standardized ingredient/resource approach (i.e. quantity	*Unequal distribution of global C-Section: 54 countries rate↓10% 69 countries rate↑15% 14 countries 10%-15%	*Mixed risk pregnancies *Mode of birth only *Direct costs only *Validity of analyses

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
and Unnecessary Caesarean Sections Performed per Year: Overuse as a Barrier to Universal Coverage **Global Analysis** √	‘excess’ caesareans; i.e. estimated the numbers of needed caesarean sections required in countries with lower than recommended national rates and the number of excess caesarean sections in countries where the procedure may be overused (2008 year)	[totalling 95% of global births] were obtained for the year 2008	of inputs at point of care directly associated with C-section procedure) *Calculations were based on WHO recommended upper rate of 15% [overuse] and lower rate of 10% [underuse] *4 main Data sources provided nation – wide C-Section estimates; i.e. statistical surveillance systems / national surveys–12 countries; WHO datasets-52 countries; National demographic health surveys-59 countries; Ministry of Health communication-4 countries *Primary & secondary analyses	3.18 million additional C-Section ‘needed’ & 6.20 million C-Section ‘excess’ performed *Cost of global needed C-Section US $ 34 million *Cost of global Excess C-Section US $ 2.32 billion *Average cost for ‘needed’ C-Section US $ 135 vs average cost for ‘excess’ C-section US $ 373 Cost Range: $ 97 – $ 18, 040 *’Excess’ C-Section could finance ‘needed’ C-Section 5 times over *6 countries = 50% of ‘needed’ C-Sections: Nigeria; India; Ethiopia;, Congo Democratic Republic, Pakistan & Indonesia	dependent on data quality / accuracy of C-Section rates [45% of estimates from DHS surveys]– rates more imprecise in low income countries *Validity also dependent on evidence that 15% and 10% C-Section rates are acceptable upper and lower thresholds *Likely that ‘needed’ number of C-Sections more imprecise than ‘excess’ estimates
17. Hendrix, M., S. Evers et al. (2009). “Cost Analysis of the	*Compared societal costs of home births with those of births in	*Dutch obstetric system; primary health care services	*Cost analysis based on multi-center non-randomized study	*Secondary analyses supported base case analyses; i.e.	*Low risk pregnancy only *nulliparous women only

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
Dutch Obstetric System: low-risk nulliparous women preferring home or short-stay hospital birth – a prospective non-randomised controlled study **Netherlands** √	a short stay hospital setting	and integrated secondary hospital care *449 women with low risk pregnancy from 529 women consented *Preference for Homebirth n = 241 *Preference for Short Stay Hospital n = 177	comparing 2 groups with different preferences for birth place *Base case analyses and sensitivity analysis performed (imputation for missing data) – both based on intention to treat *Arithmetic means and non-parametric bootstrapping *Included health care sector costs + non health care sector costs	Total Costs comparable for place of birth for low risk nulliparous women: Home V Hospital/SS: € 4, 364 V € 4, 541 Statistically significant difference between groups in cost categories: Carer/contact @ birth € 138.38 V € 87.94, -50 (2.5–97.5 percentile range(PR)-76;-25), p<0.05) Cost of care @ home € 1551.69 vs € 1240.69, -311 (PR -485; -150, p<0.05) Cost of hospitalization € 707.77 V € 959.06, 251 (PR 69; 433), p<0.05	*limited to place of birth *Selection bias *Missing data; incomplete health / cost diaries * 7% participant withdrawal rate / loss to follow up *Broader consideration of cost – health sector + societal *Highest single cost was for hospitalization (41%), but levelled by other costs of care at home
18. Bellanger & Or (2008). What can we learn from a cross country comparison of the costs of child delivery? **Cross Country - European** √	*To compare costs and prices (reimbursement rates) of an episode of care (normal delivery) in the hospital setting *To explore main factors behind	*9 European countries involved in Health BASKET Project: Denmark, England, France, Germany, Hungary, Italy, The Netherlands, Poland & Spain;	*Cost measurement of non-assisted vaginal birth without any complications *Vignette approach to estimate & compare costs of different health services at the micro level in a range of	*Average total cost for standardised profile NVB = € 1, 260 (all countries); *Significant differences in average cost within & between countries: Range = € 342 (Hungary) to € 2,	* Structural & methodological limitations of vignette approach, i.e. Data collected & analysed by researchers in each country; Different research teams adopted different approaches to data collection; University

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
	variations in costs across providers within and among countries studied *Analysis of costs of child delivery in hospitals across 9 European countries	*Sample of 47 hospitals in 9 countries (at least 5 healthcare providers in each country)	countries (i.e. patient characteristics such as age & medical condition were standardised); *Two main cost components measured were personnel costs vs overhead costs *Delivery data collected from hospital accounting departments in national currencies & converted into euros using 2005 exchange rate; *Multi-level modelling approach was used with regression analysis to identify determinants of hospital delivery costs within & across countries	365 (Germany); *All differences in cost at the country level stemmed from prices & not differences in resource use; at the unit level they stemmed from average length of stay [0.84 days in Netherlands to 4.9 days in France] & medical & nurse pay levels; *10% ↑ LOS resulted in 6% ↑ cost; * In countries that employed more midwives or nurses in lieu of obstetricians, the cost of delivery was lower	hospitals were excluded; *Costs were calculated from provider perspective; *Hospital delivery volume varied as did staff ratios
19. Mooney, S., M. Russell et al. (2008). Group Prenatal Care: An Analysis of Cost **USA** √	*Construction of Cost Analysis Model to understand & compare the economic performance of group prenatal care (Centering Pregnancy model) at a small rural community access hospital with one-on-one prenatal care for	*Alice Peck Day Memorial Hospital in rural New Hampshire – a 25 bed non-profit, critical access hospital; *Sample: services provided by 3 certified nurse midwives (CNMs) and 3 physician providers – all hospital employees	*Volume, cost & revenue estimates were sourced using 2005 Medicare Cost Report; 2005 – 2006 hospital delivery volume; 2006 Outpatient Billing Records, and an economic model [productivity / efficiency frontiers] were created based on patient volume;	*With group sizes of 8 – 12, time efficiency of lower cost providers (CNMs) improves from an average of 7 to 4 hours of prenatal care per patient; *Smaller groups ↓ efficiency & ↑ costs; *Baseline financial breakeven point of 305 deliveries a year ↓ to 302 if all women receive	*Estimates and prediction based on modelling of actual hospital service, cost & reimbursement data; *used direct & indirect costs; *Single rural hospital only; *results of model highly sensitive to both volume of deliveries and prenatal group size required to = or exceed time efficiency

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
	pregnant women	[fiscal years 2005 – 2006]	*3 Stage Analysis: Comparative measurement of total time spent providing prenatal care; Financial breakeven point; & Number of hours of prenatal care per woman; *Sensitivity analysis based on shifting prenatal care from higher cost physician providers to lower cost CNM providers & shifting deliveries [NVB] CNMs.	group care; *Shifting pre-natal care to lower cost providers (CNMs)↓ breakeven point to 218 deliveries per year if acquired physician time was used to provide gynaecologic services for hospital	varied; *results context specific & not generalizable to other settings where cost / reimbursement data and volume may vary
20. Petrou S., M. Boulvain et al. (2004). Home-based care after a shortened hospital stay versus hospital based care postpartum: an economic evaluation **Switzerland** √	Compared cost effectiveness of early postnatal discharge and home midwifery support with traditional postnatal hospital stay	*University hospital of Geneva * 459 deliveries of single infant at term following uncomplicated pregnancy	*Cost minimization analysis within a pragmatic randomized controlled trial *Prospective economic evaluation alongside RCT. *Women allocated to early discharge combined with home midwifery support (n=228) or traditional postnatal hospital stay (n=231) *Primary Outcome	*Clinical & psychosocial outcomes similar in 2 trial arms *Overall early discharge combined with home midwifery support showed cost saving of 1221 francs per mother/infant dyad *Reduced postnatal hospital care cost [bootstrap mean difference 1524 francs, 95% CI 675–2403] *Increased community	*Rigorous study design and methods optimize economic evaluation result; i.e. Level 1 evidence as piggy – backed to RCT *Results showed policy of early postnatal discharge combined with home midwife support indicated weak economic dominance over traditional institutional care, i.e. reduced cost without compromise to health of mother or infant

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
			Measure = cost in Swiss francs to health service, social services, patients, carers and society accrued between delivery and 28 days postpartum. *Also considered clinical / psychosocial outcomes mother and infant	costs [bootstrap mean difference 295 francs, 95% CI 245 – 343] *No significant difference in readmission rates, outpatient care, direct non-medical and indirect costs between two groups	
21. Ratcliffe J. (2003). The economic implications of the Edgware birth centre **United Kingdom** √	Compared Unit costs for: F/Standing Birth C vs Homebirths vs Hospitals (2) 1999 – 2000 prices	*UK- Nth West Thames Regional Health Authority *Total sample 99 women: Birth Center n=35 Home n=26 Hospitals n=68	*Bottom-up cost study that compared unit inpatient costs and unit postnatal costs based on data from finance departments	*Inpatient costs: BC £ 297 vs Home £ 194 vs Hospital 1 £ 424 vs Hospital 2 £ 428 *Postnatal costs: BC £ 392 vs Home £ 217 vs Hospital 1 £ 609 vs Hospital 2 £ 636 *Where capital costs added BC cost ↑ 59% & Hospital cost ↑53%	*Women accepted for Birth Center care (criteria not stated) *Likely selection bias *Comprehensive bottom up costs included: type/time of birth; staff; drugs; consumables; equipment; investigations; interventions; transfers; length of stay & PN admissions
22. Petrou S., P. Cooper et al. (2002). Economic costs of post-natal depression in a high-risk British cohort **United Kingdom** √	To estimate economic costs of post-natal depression in a defined cohort (geographical) of women at high risk of developing PND	*Town of Reading in South-East England *206 women recruited from antenatal clinics at 26–28 weeks gestation (following screening of 2257 women using validated predictive	*Economic study in which unit costs were applied to resource-use data (Health & social care) collected alongside longitudinal study of women identified at high risk of developing PND. *Primary analysis of total costs measured	*Mother – infant dyad costs estimated at: £ 2419.00 for PND and £ 2026.90 w/out PND *Mean cost difference £392.10 (p=0.17) *Mean cost differences reached statistical significance for women with & without PND for community care	*Used combined, pooled data from women enrolled in an RCT of a preventive intervention for PND with observational data from women who were not; *Unit costs followed guidelines on costing health& social care as part of economic appraisal *Sensitivity analysis was

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
		index for PND) May 1997-April 1999	over different time-points; multiple regression analysis for potential confounders *Net costs per mother – infant dyad over the first 18 months postpartum were estimated	services (p=0.01). Costs were higher for women with extended experience of PND	undertaken * Sample size large enough to detect significant differences between groups
23. Petrou S., and C. Glazener. (2002) The economic costs of alternative modes of delivery during the first two months postpartum: results from a Scottish observational study **Scotland** √	To estimate economic costs of alternative modes of delivery during the 1'st two months postpartum using hospital and community health service utilization data	*1242 women receiving postnatal care in the Grampian region of Scotland during period June 1990 – May 1991	*Data collection via Self – completed postal questionnaires after discharge from hospital and @ 2 months postpartum, and linked with obstetric data from Aberdeen Maternity and Neonatal databank & medical case notes; *Unit costs 1999–2000 prices collected for each item of resource use. Combined with resource volumes to obtain a net cost per woman; *Cost difference between women undergoing 3 modes of delivery [SVB; instrumental vaginal delivery & caesarean were tested using 1 way analysis of variance with SPSS;	*Significant differences in initial hospitalization cost between 3 modes of delivery: SVB = £1431 Instrument = £1970 Caesarean = £2924 P<0.001; *Significant differences in cost of hospital readmissions, community midwifery care & GP care between 3 modes of delivery, however total post discharge health costs did not vary significantly. *Total health care costs estimated at: SVB = £1698 Instrument = £2262 Caesarean = £3200 P<0.001 *Mean cost difference £564 (95%CI £505-	*Large random sample in a geographically defined area; *Comprehensive cost accounting included all significant cost items according to established principles in economic theory; Broad range of hospital & community service resource data included provided a reliable basis for estimating economic implications of alternative models of birth; Viewpoint is that of NHS; Limited to 2 months postpartum may mean analysis underestimated long term cost differentials

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
			*Cost estimates reported as mean values with 95% CI	£624) between SVD & instrumental delivery; £938 (95%CI £860-£1016) between instrumental & caesarean; £1503 (95%CI £1446-£1559) between SVB & caesarean	
24. Villar J., H. Ba'aqeel H et al. (2001). WHO antenatal care randomised controlled trial for the evaluation of a new model of routine antenatal care **Argentina, Cuba, Saudi Arabia & Thailand** √	To compare the Standard Model of Antenatal care with a New Model emphasizing actions known to be effective in improving maternal or neonatal outcomes and has fewer clinic visits (Detailed economic analysis performed on 2 of the 4 participating countries, Cuba & Thailand.	*Antenatal Clinics in Argentina, Cuba, Saudi Arabia or Thailand: New model = 27 clinics (n=12, 568) Standard Model = 26 clinics (n=11, 958) women *Sample: all women enrolled in these clinics over an 18 month period	*Multicentre RCT comparing 2 models of antenatal care; *Analysis by intention to treat; *Primary Outcome measures were: low birthweight (<2500 gms); pre-eclampsia/eclampsia; severe postpartum anaemia (<90g/L Hb), & treated urinary tract infection with adjustment for several confounding variables; *Outcomes linked with assessment of quality of care and economic evaluation	*Women in New Model had a median 5 visits compared with 8 in Standard Care; *Rates of hospital admission; diagnosis & length of stay were similar; *Similar rates of low birthweight; postpartum anaemia and urinary tract infection; slightly higher rate of pre-eclampsia/eclampsia in new model (95%CI); *Care satisfaction (providers & women) in both models *No cost increase & in some settings new model ↓ cost	*Level 1 evidence; *Economic evaluation linked to clinical trial; *Sample size large enough to detect significant difference in outcomes, quality & cost; Adjusted for confounding variables
25. Henderson, J., T. Roberts et al. (2000). An economic evaluation comparing two schedules of	*Economic Evaluation comparing 2 schedules of antenatal visits	*Antenatal Clinics in South-East London; *Sample: 2794 women at low risk of complications	*Secondary Analysis Economic Evaluation based on 1996 RCT undertaken by Sikorski et al. – estimated	*Estimated baseline costs (NHS) for Traditional Care £544 per woman (£251 ante-natal), Range £327 –	*Low risk pregnancies only; * NHS perspective; *Secondary analysis based on trial data but was

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
antenatal visits Secondary Analysis of Sikorski, J., J. Wilson et al (1996). A randomised controlled trial comparing two schedules of antenatal visits: the antenatal care project **United Kingdom** √	(Traditional Care Schedule vs Reduced Care Schedule) for women at low risk of complications	between 1993–1994	baseline costs for UK NHS based on comparison 10 versus 8 antenatal visits; Sensitivity analysis based on possible variations in unit costs and resource use and modelled postnatal stay	£1203/woman; Reduced Schedule £563 per woman (£225 ante-natal), Range £274 – £1741/woman; *Savings from new style of care were offset by greater number of babies in this group requiring Special Care or Intensive Care;↑ dissatisfaction from women with reduced schedule & poorer psychosocial outcomes	conducted later, i.e. not piggy-backed or linked at the same time; *Unit cost data was taken from a variety of external sources
26. Stone P.W., J. Zwangziger et al. (2000). Economic analysis of two models of low risk maternity care: a freestanding birth centre compared to traditional care **USA** √	Compared cost effectiveness of Freestanding Birth Center care provided by Certified Nurse Midwives with Hospital care provided by Doctors (1996 prices)	*New York *Sample: 146 women Birth Center (n = 69) Hospital (n = 77)	*Quasi-experimental *Calculations include fixed & variable costs (hospital, medical practices and BC) *Sensitivity analysis showed↑ women in BC care would ↓cost	*Mean costs for maternity care: BC $ 6, 087 Hospital $ 6, 803 (no significant difference) *Mean Intra-partum: BC $ 4, 257 Hospital $ 5, 729 (p<0.01)	*Low risk pregnancy (65 item specific eligibility criteria) *Likely selection bias
27. Morrell C., H. Spiby et al. (2000). Costs and effectiveness of community postnatal support workers: randomised controlled trial **United Kingdom** √	To establish relative cost effectiveness of postnatal support in the community in addition to usual care provided by community midwives	*Recruitment in a university teaching hospital & care provided in women's homes *623 postnatal women allocated at random to	*RCT with 6 month follow up *Intervention: up to 10 home visits in the first postnatal month of up to 3 hours duration by community postnatal support worker *Main outcome	*At 6 weeks there was no significant improvement in health status in women in intervention group; mean total NHS costs = £635 intervention group & £456 per woman for control group (P=0.001);	*Level 1 evidence; *NHS perspective; *Sample size large enough to detect significant differences; *Effectiveness of intervention and cost was not compared amongst specific groups of women

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
		intervention (311) or control (312) group	measures: general health status measured by SF – 36; risk of Postnatal depression; breastfeeding rates, satisfaction with care; use of services; personal costs	*At 6 months mean total NHS costs = £815 intervention group & £639 per woman for control group (P=0.001)	
28. Reinharz D., R. Blais et al. (2000). Cost-effectiveness of midwifery services vs. medical services in Quebec **Canada** √	Compared cost effectiveness of care by midwife in local community Birth Center (pilot projects) vs Physician care in hospital - price year not stated (data gathered Jan 1995 – July 1996; price year not reported)	*7 pilot projects in Quebec *Sample of 1000 women who gave birth in Birth Centers, matched with 1000 women who gave birth in hospital	*Cohort Study with randomized matched control group *Costing alongside observational study *Prospective cost effectiveness study *Data collection & calculations included: hospital case notes; physician billing; average staff salaries; other service charges *Payer perspective: Ministry of Health, regional Board, and patient	*Total Direct Costs per woman: Midwife CAN $ 2, 294 ($ 2, 062 – $ 2, 930 range) Hospital CAN $ 3, 020 ($ 3, 016 – $ 3, 027 range) *BC group showed: ↑ satisfaction ↓caesarean 6% vs 13% ↓severe perineal injury 1.7% vs 5.9% ↓preterm/LBW babies ↑infant resuscitation 1.5% vs 0.7% ↑stillbirth	*Low risk pregnancy (134 exclusion criteria listed) *Intervention not standardized *Data collected in 7 centers *Selection bias *Disaggregated health outcomes resulted in cost consequences analyses *No statistical analyses of costs or confounders *Limited internal validity *Low external validity *Generalizability not addressed
29. Anderson R.E. and D.A. Anderson. (1999). The cost-effectiveness of home birth **USA** √	Compared costs for home birth with costs for hospital birth across US for period 1987 – 1991	*Across USA *Sample included 11, 718 home birth 11, 592 hospital birth	*Data on costs collected by survey (midwives) and literature (OB Gyns); included costs for transfer	*Average charges for 1991 year: Home $ 1, 711 Hospital $ 5, 382 *No clinical comparisons made	*Low risk pregnancy (criteria undefined) *Selection bias *71% response rate
30. Young, D., A. Lees et al. (1997). The	Compared Midwife-led care with Shared	*Glasgow Royal Maternity Hospital,	*RCT for clinical effectiveness data	*Clinical care safe & efficacious between	*Level 1 evidence RCT effectiveness data

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
costs to the NHS of maternity care: midwife managed vs shared Economic analysis based on RCT undertaken by Turnbull et al. (1996) **Glasgow Scotland** √	– care (hospital doctors, midwives, GPs) Midwife led care = Team of 20 midwives used birth rooms at hospital with a named midwife assigned to each woman	Scotland *Sample 1,299 women (low risk of complications)	Midwife care n = 648 Shared care n = 651 *Cost – effectiveness intention to treat analysis *individual patient-based costing approach explored impact of caseload size per midwife on cost *statistical analysis used T-tests, Mann-Whitney U-tests for median *Sensitivity analysis increased median caseload from 29 to 39 women/midwife	groups. *Midwife care ↓antenatal visits, ↓ inductions & ↓ postnatal daycare attendances *Cost differential favored consultant – led care: *Intention to treat **29 caseload/midwife:** Antenatal/intrapartum no cost difference; Postnatal control group ↓ cost by UK £ 172.63 **39 caseload/midwife:** No cost difference intrapartum; Antenatal and Postnatal control group↓ cost by UK £ 45.35	*Low risk women *Capital cost not included except for intrapartum continuous electronic fetal heart monitoring *Limited measure of benefit
31. Henderson, J., and M. Mugford (1997).An economic evaluation of home births; In: *Homebirths: the report of the 1994 confidential enquiry by the National Birthday Trust Fund* **United Kingdom** √	Compared cost to National Health Service (NHS) of planned homebirth vs planned hospital birth – 1994 prices	*Across UK *Sample included: 4, 191 planned home 3, 470 planned hosptl 806 booked home, but birthed in hosptl	*Cohort study *Utilized data from the 1994 National Birthday Trust Fund: Women booked for birth @ home @ 37 weeks compared with matched control group of women booked for birth in hospital *Unit costs calculated from literature – applied to antenatal, intrapartum & PN	*NHS costs/birth: Home £ 205 Hospital £ 332 Home booked but hospital birth £ 405 *Equivalent clinical outcomes (Unplanned birth @ home estimate £ 100 ↑ stillbirth/neonatal death rate)	*Response rate 61 % *Selection bias + response bias

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
			resource use		
32. Walker P, and P. Stone (1996). Exploring cost and quality: Community based versus traditional hospital delivery **USA** √	Compared cost of free standing Birth Center care by Certified Nurse-Midwives vs Women's Clinic (assorted hospital staff) vs Obstetric Practice	*New York *Sample 75 women purposefully selected, unclear how many in each group	*Quasi-experimental *Costing based on DRG charges	*Comparative professional fees for prenatal care & birth showed BC with CNMs was lowest cost: BC CNM $ 1, 076 vs WC Hos $ 1, 658 vs OB Gyn $ 2, 228 *BC CNM group had: ↓uterine monitoring ↓IV fluids ↓ episiotomies & Shorter stay	*Low risk pregnancy *Selection bias *Fixed and variable costs from BC, hospital and obstetric practice
33. Ratcliffe J., M. Ryan et al. (1996). The costs of alternative types of routine antenatal care for low-risk women: shared care vs care by general practitioners and community midwives **Scotland / United Kingdom** √	Compared costs of routine antenatal care by traditional Obstetric-Led Shared Care V GP/Community Midwife Care	Site: 51 general practices linked to 9 maternity hospitals in Scotland *Sample: 1, 667 low risk pregnant women	*Multi-center RCT compared costs of antenatal care between two groups: OB-Led V GP/Midwife *Sensitivity analysis	*GP/Midwife antenatal care cost significantly less than OB-Led shared antenatal care: Diagnostic Tests £ 87.25 V £ 91.15 P = 0.05 Staff Costs £ 127.76 V £ 131.09 P = 0.001 Non-routine care not statistically significant £ 83.74 V £ 94.43 P = 0.46	*Level 1 evidence *Limited to low risk pregnancies *Limited to antenatal care only *Costs to health service in addition to costs for women and families
34. Stone P.W. and P.H. Walker (1995). Cost-effectiveness analysis: birth centre	Modelled comparative birth cost in free-standing Birth Center vs	*USA *Data derived from a literature review based on The	*Decision – analytic modelling *Included sensitivity analysis *Costs included: patient	*Mean cost per birth: BC $ 3, 385 vs HC $ 4, 673	*Low risk pregnancy *Selection bias *Crude utility method used

Study – author/s, year, country	Aim of Study	Sample / Setting	Design / Methods	Major Findings	Strengths / Limitations
vs. hospital care **USA** √	Hospital Care in USA	National Birth Center Study.	charges (DRG); professional fees; accommodation + ambulance; Building lease & equipment	*Sensitivity analysis suggested BC dominant for transfer rate up to 62%	
35. Hundley, V.A., C. Donaldson et al. (1995). Costs of intrapartum care in a midwife-managed delivery unit and a consultant-led labour ward. Based on Hundley, V.A., F.M. Cruickshank et al. (1994). Midwife managed delivery unit: a randomised controlled comparison with consultant led care **Aberdeen/Scotland** √	Clinical and cost effectiveness study comparing a Midwife-led Unit (MLU) with a Consultant –led Unit (CLU) within a hospital setting over a standard year	*Aberdeen, Scotland *Sample of 2, 844 women (Low risk pregnancy)	*RCT comparing 2 models of care *Cost – effectiveness analysis *Intra-partum costing only; analysis based on intention to treat *Prospective costing of effectiveness data *Calculated average costs only (not incremental) *Postnatal costs were calculated separately / not included in average *Sensitivity analysis conducted varying midwife staffing levels and capital cost of new infrastructure	*Costs ↑ by UK £ 66 per woman in MLU vs CLU for intra-partum *Scenario analysis varying staffing parameters & capital costs showed cost savings results that ranged from UK £ 15.64 to cost increase results of UK £ 71.01 / woman (inflated from year of study to 2010 prices) *Varied average cost **Base case** MLU UK £ 687 CLU UK £ 621 **No increase staff cost** Save UK £ 9.50 **Postnatal** Save UK £ 21.74	*Level 1 evidence RCT effectiveness data *Low risk women *Capital costs were analyzed *No inclusion of indirect costs, productivity changes or community health care costs

*Australian, then International studies are presented in reverse chronologic order; √ denotes a minimum score of 6 (from possible 8) quality appraisal questions (Appendix 2.1, Table 2.1.2); yellow shading denotes randomised controlled trial with linked economic evaluation

Appendix 3.1a Classification of Pregnancy Risk Profile in South Australia Standardised Hospital Pregnancy Risk Criteria and Categories – WCHN HRPS

Category 1 Low / No Risk Factors
Those pregnancies representing low to no risk. This includes Midwifery Care or Shared Care arrangements in routine hospital clinics.
Categories for Inclusion in the High Risk Perinatal Service **Category 2 Moderate / High Risk Factors***
Obstetric History Medical Scarred uterus Anaemia < 105 Mid trimester abortion Minor cardiac disease Three or more 1st trimester abortions Minor/Moderate Hypertension Previous difficult labour/delivery Sexually transmitted diseases Previous low birth weight infant Epilepsy (mild controlled) Previous perinatal death/non-recurrent factors Asthma (mild, controlled) Previous preterm labour Previous venous thrombosis/embolism Previous preterm rupture of membranes Rheumatoid arthritis Previous retained placenta Glucose intolerance including: Previous postpartum haemorrhage * diet controlled gestational diabetes * impaired carbohydrate metabolism Obstetric Complications (Current Pregnancy) Medical History Mild pre-eclampsia Previous eye surgery Uncomplicated twin pregnancy Family history pre-eclampsia /eclampsia Suspected cephalo pelvic disproportion Pregnancy greater than 42 weeks gestation Anaesthetic Risk Factors Malpresentation including breech Women with potential airway problems Polyhydramnios Grande Multipara Age PPROM/threatened prem labour < 37 weeks * teenage < 20 years Pregnancy related skin disease eg: Herpes * mature >35 years Assisted Reproduction Pregnancy Height < 150 cms Weight – underweight/overweight < 45 kg > 90 kg Minor Substance Dependence Drugs, alcohol, tobacco > 10 cigs Previous Psychotic Illness
Category 3 High to Very High Risk Factors
Complications of Pregnancy Previous perinatal death/recurrent factors Thrombo-embolic disease Previous preterm delivery x 2 Connective tissue disorders Antepartum haemorrhage Hepatic disorders (excludes cholestasis) Suspected fetal dysmorphology Haematological disorders * IUGR Inflammatory bowel disorders (not in remission) * Congenital anomalies Neurological disorder Isoimmunization eg: epileptics on drug therapy Complicated multiple pregnancy Severe thyroid disorders Preterm rupture of membranes Threatened preterm labour Insulin Dependent Diabetes Cervical Suture gestational Pre-existing Major Substance Abuse Severe Hypertension includes prescribed methadone Managed in HDU Systolic BP > 170

Severe medical Disorders	Diastolic BP > 110
Severe respiratory disease	Hypertension with proteinuria
Severe cardiac disease	Infective Disorders e.g. HIV positive

*Risk category for all women included in both arms of this study

Appendix 3.1b Model of Midwifery Group Practice (MGP) in Study

A summary of models of midwifery care implemented in Australia was published in Establishing Models of Continuity of Midwifery Care in Australia: A Resource Guide for Midwives and Managers (Homer, Brodie & Leap 2001). Development of these models was updated in Midwifery Continuity of Care: A Practical Guide (Homer, Brodie & Leap 2008). These resources documented a diversity of midwifery services and models. Detailed description of the Midwifery Group Practice model (MGP) that was the subject of this study was included (Cornwell, Donnellan – Fernandez & Nixon 2008, pp. 107 – 126).

This MGP was established in 2004 as an ‘all – risk’ caseload midwifery model at the largest publicly funded tertiary referral teaching hospital for maternity, neonatal and paediatric services in the state of South Australia. The hospital provides centralised specialist services for approximately 4600 births per annum (> half the public health system births for the state) and is located in the city centre of the state capital. The hospital also receives retrievals and referrals from rural centres and service recipients are culturally and socio-demographically diverse. As an ‘all – risk’ maternity model a named midwife was available in MGP to provide care for each woman with a pregnancy risk classification (whether ‘low’, ‘moderate’ or ‘high’ risk Appendix 3.1a) throughout the antenatal period, during birth, and in the postpartum period until 4 – 6 weeks after childbearing. For women with a low risk pregnancy classification (34%), midwives provided all lead care (Chapter 3, Table 3.3). Where women experienced a moderate or high risk pregnancy classification (58% and 8% respectively), her midwife continued to provide one-to-one care in collaboration with other relevant health professionals using standardised Australian and South Australian maternity care guidelines. The midwives supported each other in four group practices (6 full time equivalent staff per group) with on-call requirements, leave cover and an annualised salary governed by a state industrial award. Care was delivered in community clinics, in hospital, and in women's homes. In 2004 the first two MGP groups commenced service delivery for 500 women. By 2007 four MGPs (comprising 24 full-time equivalent midwife positions and 2 midwifery managers) provided caseload continuity of care to approximately 1000 women and babies per annum across all risk categories within a defined geographic area. Midwives ordered relevant laboratory investigations and diagnostic tests and consulted and referred with other services and providers utilising the Australian College of Midwives National Midwifery Guidelines for Consultation and Referral (2008) and state based Perinatal Practice Guidelines. Each full time equivalent midwife was allocated a caseload of 36 – 40 women per annum, adjusted for acuity. Key features of the MGP Annualised Salary and Aims and objectives of the MGP as described by Cornwell, Donnellan – Fernandez & Nixon (2008, pp. 112 – 113) are replicated below.

Key features of the MGP Annnualised Salary
This was the Midwifery Caseload Practice Agreement in July 2005: • caseload of 40 women per annum for 1 full-time equivalent midwife • caseload of 10 women per annum for Unit Head position • 38 hour working week, flexible and averaged over 8-week period • 2 days off with no work in every 7 days • 12 hours limit to a continuous period of work, minimum 8 hours break before recall • 6 weeks annual leave • reimbursement for private vehicle use • salary loading in addition to base grade salary: 35% for midwives; 17.5% for Unit Head.

(Reproduced from Homer, Brodie & Leap 2008, p. 112)

Aims and objectives of the MGP
Aim To restructure midwifery services and introduce a sustainable model of midwifery continuity of care and carer into the WCH, so that midwives work within a revised Industrial Agreement, providing this model of care to women in all risk groups, throughout their pregnancy, labour, birth and early postnatal period, in partnership with medical and other health care providers, as necessary.

Objectives

- To ensure similar or improved clinical outcomes for women cared for in this model.
- To ensure women's satisfaction, choice and control.
- To ensure the satisfaction of midwives working in this model.
- To provide this model within a revised Industrial Agreement.
- To provide midwives with the opportunity to practise within the full scope of the internationally recognised definition of the midwife.

(Reproduced from Homer, Brodie & Leap 2008, p. 113)

Appendix 3.2 Database Analysis – Retrospective and Prospective Study Arms Definition of Key Terms for Quality Measures from the Literature

(Clinical effectiveness; cost; quality; equity; productivity; efficiency)

Clinical Effectiveness

Clinical effectiveness was defined by the UK National Health Service (NHS) Executive in 1996 as

> "the extent to which specific clinical interventions, when deployed in the field for a particular patient or population, do what they are intended to do; i.e. maintain and improve health and secure the greatest possible health gain from the available resources. To be reasonably certain that an intervention has produced health benefits, it needs to be shown to be capable of producing worthwhile benefit (efficacy and cost-effectiveness) and that it has produced that benefit in practice" (Brayford et al. 2008 p.4).

Clinical effectiveness was integrally related to the core value of applying 'evidence – based healthcare.' Evidence based healthcare has been defined as

> "conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence – based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research" (Sackett, Rosenberg & Muir Gray 1996 p.71–2).

Cost

In this study 'cost' referred to a numeric measurement (Australian dollars $AUS) commonly accepted in economic evaluation as a requirement for analysing the comparative expenditure of alternative health care programmes (Drummond et al. 1997 p.52; Drummond et al. 2005). Costs were based on standardised Australian Refined – Diagnostic Related Group case mix funding allocations (Australian Government Department of Health and Ageing 2010) and Medicare Australia generic costs for Medicare Benefits Schedule and Pharmaceutical Benefits Schedule items – Medicare Online (Australian Government Department of Human Services 2014).

Quality

At an international level high quality in maternity services requires providing a minimum level of care to all pregnant women and their new born babies and a higher level of care to those who require it to achieve the best possible outcomes for mother and baby. Included in this definition is the expectation that the care provided satisfied both users and providers whilst maintaining sound managerial and financial performance (Pittrof, Campbell & Filippi 2002 p.277–283).

These principles were considered consistent with the aims of managing all risk populations in tertiary referral maternity facilities as well as upholding the seven pillars of quality articulated by Donabedian: efficacy, effectiveness, efficiency, optimality, acceptability, legitimacy and equity (Donabedian 1990). Further, it was recognised that prioritising amongst competing requirements, including the influences of culture, values, expectations and available resources was difficult. Nevertheless, the issues of system design, including incentives for provision of care in inappropriate settings, weaknesses in coordinated care, and provision of ineffective treatment contributing to poor quality in many areas of Australian health care has been well documented (Duckett et al. 2015; Duckett & Willcox 2011, p. 303).

Equity

Principles of equity were based around competing theories of social justice. The most accepted egalitarian perspective in health care is that services be horizontally equitable. This was understood as the principle that two individuals experiencing the same health need should be able to receive the same treatment or services (Wagstaff & van Doorslaer 2001). In the Australian context there has been differentiation between two elements of equity; equity of access and equity of outcomes (Duckett & Willcox 2011, pp. 300 – 2). Both elements of equity were considered relevant to this study and are essential components of the integrated SPO (structure / process / outcome) model (Donabedian 2003), and to reducing population health disparities (Buttner & Muller 2011).

Equity of access encompassed equity in financing, equity in services availability and equity in the provision of culturally appropriate services. Equity of outcomes required addressing differences in health status and outcomes for different population groups, e.g. Aboriginal, Torres Strait Islander, culturally and linguistically diverse populations, low income groups and taking account of other measures of disadvantage that contribute to disparate health states. This included the influence of Socio Economic Index for Area (SEIFA) status and social determinants of health (Woodruff et al. 2009).

Productivity

The definition of productivity utilised in this study was the common dictionary definition of 'efficiency in production' as related to optimising the number of healthy mothers and babies relative to optimising resource use.

Efficiency

Efficiency in healthcare remains a contested term. The measurement of and relationship between concepts of 'technical efficiency' and 'quality of care' have been considered by health economists (Eckermann & Coelli 2008). These authors have highlighted difficulties in measuring efficiency, outputs and throughput of production including the associated challenges of contested meanings as relates to a consideration of quality variables in healthcare. Two aspects of efficiency have been recognised. Both were relevant to this study: 'allocative efficiency' considered the best allocation of resources and 'dynamic efficiency' considered the broader ability of the health system to adapt to change and innovation (Duckett & Willcox 2011, pp. 304 – 6).

Distortion in resource allocation in health care has been directly attributed to different funding rules and systems that have failed to support resource allocation and redistribution to efficient interventions and services (Dalziel, Segal & Mortimer 2008; Elshaug et al. 2007; Segal 2009). At the local level the South Australian Metropolitan Hospital Efficiency and Performance Review Report defined the purpose of efficiency review as 'optimising and / or maximising the level of patients who require treatment (outputs) consistent with the level of resources (inputs) allocated (Paxton Partners Pty Ltd 2008 p.8). The South Australian Hospital Budget Performance and Remediation Review also highlighted the importance of workforce and service reforms that would maximise efficient use of resources within hospitals to align with the new Commonwealth – led Activity Based Funding initiative (Government of South Australia 2012; Independent Hospital Pricing Authority (IHPA) 2013).

Appendix 3.3 Hospital Ethics Approval

Received 24. 5. 2010.

Government of South Australia
SA Health

Women's & Children Hospital

14 May 2010

Research Secretariat
72 King William Road
North Adelaide SA 5006
Tel 08 8161 6521
Tel 08 8161 6390
Fax 08 8161 8177
www.cywhs.sa.gov.au

Ms R Donnellan-Fernandez
PhD Candidate, Faculty of Health Sciences
School of Nursing & Midwifery
Flinders University
GPO Box 2100
ADELAIDE SA 5001

Dear Ms Donnellan-Fernandez

Re: A cost and resource study: Midwifery Group Practice and standard hospital care. REC2260/3/13

I refer to your letter dated 7 May 2010 in which you responded to matters raised by the CYWHS Human Research Ethics Committee at its March 2009 meeting. I am pleased to advise that your protocol has been granted full ethics approval and meets the requirements of the *National Statement on Ethical Conduct in Human Research*.

I note that you have provided signed Confidentiality Agreement/s and National Police Certificate/s for non-CYWHS staff involved in the study. If in the future, the study involves other non CYWHS staff or students, a signed Confidentiality Agreement will be required and, if they visit any CYWHS site or access identifiable patient information, a National Police Certificate provided to the Ethics Committee and the Human Resources Department. The study may proceed on this proviso.

I remind you approval is given subject to:

- immediate notification of any serious or unexpected adverse events to subjects;
- immediate notification of any unforeseen events that might affect continued ethical acceptability of the project;
- submission of any proposed changes to the original protocol. Changes must be approved by the Committee before they are implemented;
- immediate advice, giving reasons, if the protocol is discontinued before its completion;
- submission of an annual report on the progress of the study, and a final report when it is completed. It is your responsibility to provide these reports – without reminder from the Ethics Committee.

Approval is given for three years only. If the study is more prolonged than this, an extension request should be submitted unless there are significant modifications, in which case a new submission may be required. Please note the approval number above indicates the month and year in which approval expires and it should be used in any future communication.

If University of Adelaide personnel are involved in this project, you, as chief investigator must submit a Human Research Approval notification form online at http://www.adelaide.edu.au/ethics/human/guidelines/ within 14 days of receiving this ethical clearance to ensure compliance with University requirements and appropriate indemnification.

Yours sincerely

TAMARA ZUTLEVICS (DR)
CHAIR
CYWHS HUMAN RESEARCH ETHICS COMMITTEE

Women's
& Children's
Hospital

Research Secretariat
Level 2, Samuel Way Building
72 King William Road
Tel 08 8161 6390
Tel 08 8161 6521
www.wch.sa.gov.au

29th May 2015

Ms R Donnellan-Fernandez
School of Nursing and Midwifery
Flinders University
GPO BOX 2100
ADELAIDE SA 5001

Dear Ms Donnellan-Fernandez

Re: A Cost and Resource Study: Midwifery Group Practice and Standard Hospital Care. REC2260/3/2016.

At its meeting on 27th May 2015, the WCHN Human Research Ethics Committee approved your request to extend ethical approval for a further year. Please note the amended approval number above reflecting the extension, and use it in any future communications.

As the consideration of annual reports is now part of research governance monitoring, I have referred your annual report to the A/WCHN Research Governance Officer, Ms Katherine McPhail.

I remind you continued approval is given subject to:
•immediate notification of any serious or unexpected adverse events to participants;
•immediate notification of any unforeseen events that might affect continued ethical acceptability of the project;
•submission of any proposed changes to the original protocol. Changes must be approved by the Committee before they are implemented;
•immediate advice, giving reasons, if the protocol is discontinued before its completion;
•submission of an annual report on the study's progress and a final report on completion to the WCHN Research Governance Officer. It is your responsibility to provide these reports, without reminder from the Committee.

I also remind you of the institution's research governance requirements. If the study involves non WCHN staff or students, a signed Confidentiality Agreement is to be provided to Ms K McPhail, A/Research Governance Officer, WCHN Research Secretariat. Additionally, if they visit any WCHN site or access identifiable patient information, a verified copy of their Department for Communities & Social Inclusion (DCSI) National Criminal History Record Check (Child related employment screening) is to be provided to Ms K McPhail and the Human Resources Department. The study may continue on this proviso.

Yours sincerely

TAMARA ZUTLEVICS (DR)
CHAIR
WCHN HUMAN RESEARCH ETHICS COMMITTEE

Government
of South Australia
SA Health

Appendix 3.4 University Ethics Approval

Flinders University and Southern Adelaide Health Service

SOCIAL AND BEHAVIOURAL RESEARCH ETHICS COMMITTEE

Research Services Office, Union Building, Flinders University
GPO Box 2100, ADELAIDE SA 5001
Phone: (08) 8201 3116
Email: human.researchethics@flinders.edu.au

FINAL APPROVAL NOTICE

Principal Researcher: Ms Roslyn Donnellan-Fernandez

Email: roslyn.donnellanfernandez@flinders.edu.au

Address: School of Nursing and Midwifery,

Project Title: A Cost and Resource Study: Midwifery Group Practice and Standard Hospital Care

Project No.: **4742** Final Approval

Date: 27 May 2010 Approval

Expiry Date: **1 December 2011**

The above proposed project has been **approved** on the basis of the information contained in the application, its attachments and the information subsequently provided.

Please ensure that any outstanding permission letters (item D8) that may have been previously requested by the Committee are forwarded as soon as possible. Additionally, for projects where approval has also been sought from another Human Research Ethics Committee (item G1), please be reminded that a copy of the ethics approval notice will need to be sent to the Committee on receipt.

In accordance with the undertaking you provided in your application for ethics approval for the project, please inform the Social and Behavioural Research Ethics Committee, giving reasons, if the research project is discontinued before the expected date of completion.

You are also required to report anything which might warrant review of ethical approval of the protocol. Such matters include:
- serious or unexpected adverse effects on participants;
- proposed changes in the protocol (modifications); and
- unforeseen events that might affect continued ethical acceptability of the project.

In order to comply with monitoring requirements of the *National Statement on Ethical*

Conduct in Human Research (March 2007) an annual progress and/or final report must be submitted. A copy of the pro forma is available from http://www.flinders.edu.au/research/info-for-researchers/ethics/committees/social-behavioural.cfm. Your first report is due on **27 May 2011** or on completion of the project, whichever is the earliest. *Please retain this notice for reference when completing annual progress or final reports.* If an extension of time is required, please email a request for an extension of time, to a date you specify, to human.researchethics@flinders.edu.au before the expiry date.

Andrea Jacobs
Executive Officer
Social and Behavioural Research Ethics Committee
27 May 2010
c.c Dr Sheryl De Lacey, sheryl.delacey@flinders.edu.au
Dr Ingrid Belan, ingrid.belan@flinders.edu.au

Appendix 3.5 Supplementary Birth Record (SBR) – South Australia

Government of South Australia
SA Health

2007 SUPPLEMENTARY BIRTH RECORD

FOR COMPLETION BY MIDWIVES AND NEONATAL NURSES

4 0 7

Mother's name........ Surname .... Given Names

Child's surname (if different)........ Hospital/Place of birth........

Mother's address........ Mother's Case Record Number........

.... Postcode Plurality (1=single, 2=twin, 3=triplet, 4=quad)

Personal information above this line is confidential SLA For multiple births, please complete a separate baby form for each baby.

MOTHER'S INFORMATION

1 Mother's date of birth (day month year)

2 Race
1. Caucasian
2. Aboriginal
3. Asian
4. Torres Strait Islander (TSI)
5. Aboriginal & TSI
6. Other

3 Country of birth

4 Type of patient
1. Hospital/Public
2. Private

5 Marital status
1. Never married
2. Married/De facto
3. Widowed
4. Divorced
5. Separated

OCCUPATION

6 Baby's father

Baby's mother

PREVIOUS PREGNANCY OUTCOMES

7 Number of previous pregnancies

8 Number of previous pregnancies resulting in births >20 weeks (parity)

9 Number of previous outcomes (Singleton / Multiple)
- Livebirths, not neonatal deaths
- Livebirths, neonatal deaths
- Stillbirths
- Miscarriages
- Ectopic pregnancies
- Terminations of pregnancy

10 Outcome of last pregnancy

11 Date of delivery/termination of last pregnancy (month year)

12 Method of delivery in last birth
0. No previous birth
1. Vaginal
2. Caesarean
9. Not known

13 Number of previous caesareans

THIS PREGNANCY

14 Date of last menstrual period (day month year)

15 Intended place of birth
1. Hospital
2. Birth centre
3. Home
4. Other (specify) ....
5. Not booked

16a Number of antenatal visits

16b First antenatal visit
- Gestation (weeks)
- Height (cm)
- Weight (kg)
- BMI

Please return top copy to:
Pregnancy Outcome Unit, PO Box 6, Rundle Mall, Adelaide SA 5000

17 Type of antenatal care
1. ☐ No antenatal care
2. ☐ Hospital clinic
3. ☐ Obstetrician in private practice
4. ☐ General practitioner
5. ☐ Birth centre
6. ☐ Home birth midwife
7. ☐ Obstetrician/midwife (shared care) in private practice
8. ☐ GP/midwife (shared care)
9. ☐ Other (specify)........
10. ☐ Not stated

18 Tobacco smoking status at first visit
1. Smoker
2. Quit in pregnancy before first visit
3. Non smoker
4. Unknown smoking status

19 Average number of tobacco cigarettes smoked per day in 2nd half of pregnancy
- ☐ None
- ☐ Number per day = ...
- ☐ <1 (occasional)
- ☐ Unknown number

20 Medical conditions present in this pregnancy
1. ☐ None
2. ☐ Anaemia
3. ☐ Urinary tract infection
4. ☐ Hypertension (pre-existing)
5. ☐ Diabetes (pre-existing)
6. ☐ Epilepsy
7. ☐ Asthma
8. ☐ Other (specify)........

21 Obstetric complications
1. ☐ None
2. ☐ Threatened miscarriage
3. ☐ APH - Abruption
4. ☐ APH - Placenta praevia
5. ☐ APH - Other & unknown cause
6. ☐ Pregnancy hypertension (all types)
7. ☐ Suspected IUGR
8. ☐ Gestational diabetes
9. ☐ Other (specify, including impaired glucose tolerance)

22 Date of admission prior to delivery (day month year)

23 Procedures performed in this pregnancy
Tick if Yes — Tick if Unknown
1. ☐ MSAFP (NTD etc) ☐
2. ☐ Triple/Quadruple screen (Down's etc) ☐
3. ☐ Ultrasound examination ☐
4. ☐ Chorion villus sampling ☐
5. ☐ Amniocentesis ☐
6. ☐ Cordocentesis ☐
7. ☐ Other surgical procedures (specify)

LABOUR AND DELIVERY

24 Onset of labour
1. Spontaneous
2. No labour (LSCS)
3. Induction (excluding augmentation)

Give reason/s for induction
(If postdates, state T+ .... days)

25 If induction, or augmentation after spontaneous onset, specify method/s
1. ☐ ARM
2. ☐ Oxytocics
3. ☐ Prostaglandins
4. ☐ Other (specify)

26 Presentation prior to delivery
1. Vertex
2. Breech
3. Face
4. Brow
5. Other
6. Unknown

27 Method of delivery
1. Normal spontaneous
2. Forceps
3. Assisted breech (no forceps)
4. LSCS (elective)
5. LSCS (emergency)
If LSCS state reason/s:
6. Ventouse
7. Breech extraction
8. Breech spontaneous
9. Unknown
10. Assisted breech (with forceps for head)

28 Complications of labour, delivery and puerperium
1. ☐ None
2. ☐ PPH (Primary) ☐600 - 999ml ☐1000ml or more
3. ☐ Fetal distress
4. ☐ Retained placenta
5. ☐ Prolonged labour (>18 hrs)
6. ☐ Cord prolapse
7. ☐ Wound infection
8. ☐ Failure to progress (specify)
9. ☐ Other (specify)

29 Perineal status after delivery
Tick tear, repair & episiotomy if all
1. ☐ Intact
2. ☐ 1st degree tear/vaginal graze
3. ☐ 2nd degree tear
4. ☐ 3rd degree tear
5. ☐ 4th degree tear
6. ☐ Repair of tear
7. ☐ Episiotomy
8. ☐ Other (specify)........
9. ☐ Not stated

30 CTG performed during labour
1. None
2. External
3. Scalp clip

31 Fetal scalp pH taken during labour
1. No
2. Yes

32 Analgesia for labour
1. ☐ None
2. ☐ Nitrous oxide and oxygen
3. ☐ Narcotic (parenteral)
4. ☐ Epidural (lumbar/caudal)
5. ☐ Spinal
6. ☐ Other (specify)........
7. ☐ Combined spinal-epidural

33 Anaesthesia for delivery
1. ☐ None
2. ☐ Local anaesthesia to perineum
3. ☐ Pudendal
4. ☐ Epidural (lumbar/caudal)
5. ☐ Spinal
6. ☐ General anaesthesia
7. ☐ Other (specify)........
8. ☐ Combined spinal-epidural

34 Mother's outcome for birth hospital/home birth
1. ☐ Discharged
2. ☐ Transferred
3. ☐ Died

Transferred to ....
on (day month year)

35 MOTHER'S FINAL DISCHARGE/DEATH
Date (day month year)

BABY DETAILS

1 Case record number

2 Place of birth
1. Hospital
2. BBA
3. Domiciliary
4. Birthing unit/centre

3 Date of delivery (day month year)

4 Hour of birth (24 hour clock)

5 Sex
1. Male
2. Female
3. Indeterminate

6 Birthweight (grams)

7 Gestation at birth (best clinical estimate in weeks)

CONDITION AT BIRTH

8 Apgar Score 1 minute / 5 minute

9 Time to establish regular breathing (to nearest minute)

10 Resuscitation at delivery
1. ☐ None
2. ☐ Aspiration
3. ☐ Oxygen
4. ☐ IPPV - bag & mask
5. ☐ IPPV - intubation
6. ☐ Narcotic antagonist
7. ☐ Sodium bicarbonate
8. ☐ Ext. cardiac massage
9. ☐ Other (specify)

11 Condition occurring during birth
1. ☐ None
2. ☐ Fracture
3. ☐ Dislocation
4. ☐ Nerve injury
5. ☐ Other (specify)

12 Congenital abnormalities
1. ☐ Nil apparent
2. ☐ Yes (specify)

13 Treatment given
1. ☐ None of the treatments below
2. ☐ Oxygen therapy > 4 hours
3. ☐ Phototherapy for jaundice
4. ☐ Gavage feeding more than once
5. ☐ Any intravenous therapy

14 Nursery care required
1. ☐ Level 1 only
2. ☐ Special nursery (Level 2)
Number of days........
3. ☐ Neonatal Intensive Care Unit (NICU) - FMC/WCH (Level 3)
Number of days........
4. ☐ Paediatric Intensive Care Unit (PICU) - WCH
Number of days........

15 Was transfer to NICU/PICU for a congenital abnormality?
- ☐ Yes
- ☐ No

OUTCOME OF BABY

16 Outcome of baby
1. Fetal death
2. Discharged
3. In hospital at 28 days
4. Neonatal death

17 Baby transferred to
on (day month year)

18 Date of final discharge (or death) (day month year)

Appendix 3.6 Postcodes of Women, SHC and MGP Retrospective Study Arm 2004 – 2010

	P/Code	Postcode Regions	SHC	MGP	Total
1	5000	Adelaide CBD	89	42	131
2	5001	Adelaide CBD	1	0	1
3	5006	North Adelaide	36	35	71
4	5007	Bowden, Brompton, Hindmarsh, Welland	104	72	176
5	5008	Croydon, Devon Park, Renown Park, Dudley Park, Ridleyton	313	110	423
6	5009	Allenby Gdns, Beverley, Kilkenny,	109	38	147
7	5010	Angle Pk, Ferryden Pk, Regency Pk,	167	40	207
8	5011	Woodville, Woodville Pk, Woodville Sth, Woodville West	202	56	258
9	5012	Athol Park, Mansfield PK, Woodville Gdns	341	62	403
10	5013	Gillman, Ottoway, Pennington, Rosewater	272	61	333
11	5014	Albert Park, Alberton, Cheltenham, Hendon, Queenstown, Royal Park	209	90	299
12	5015	Birkenhead, Ethelton, Glanville, Pt Adelaide	97	39	136
13	5016	Largs Bay, Largs Nth, Peterhead	121	41	162
14	5017	Osborne, Taperoo	131	22	153
15	5018	North Haven, Outer Harbour	58	17	75
16	5019	Exeter, Semaphore, Semaphore Pk / Sth	152	65	217
17	5020	West Lakes Shore	25	7	32
18	5021	West Lakes	35	19	54
19	5022	Grange, Henley Bch, Tennyson, Kirkcaldy	128	64	192
20	5023	Findon, Seaton	317	102	419
21	5024	Fulham, Fulham Gdns, West Beach	88	55	143
22	5025	Flinders Park, Kidman Park	101	53	154
23	5031	Mile End, Thebarton, Torrensville	147	77	224
24	5032	Brooklyn Pk, Lockleys, Underdale	169	65	234
25	5033	Cowandilla, Hilton, Marleston, Richmond	117	59	176
26	5034	Clarence Pk, Goodwood, Kings Pk, Millswood, Wayville	51	51	102
27	5035	Ashford, Black Forest, Everard Pk, Forestville, Keswick	51	38	89
28	5037	Glandore, Kurralta Pk, Netley, Nth Plympton	93	57	150
29	5038	Camden Pk. Plympton, Plympton Pk,	111	59	170
30	5039	Clarence Gdns, Edwardstown, Melrose Pk	65	38	103
31	5040	Novar Gardens	9	3	12
32	5041	Colonel Light Gdns, Cumberland Pk, Daw Pk, Panorama, Westbourne Pk	41	50	91
33	5042	Bedford Pk, Clovelly Pk, Flinders University, Pasadena, St Marys	45	11	56

	P/Code	Postcode Regions	SHC	MGP	Total
34	5043	Ascot Pk, Marion, Mitchell Pk, Park Holme, Morphetville	78	22	100
35	5044	Glengowrie, Somerton Pk	23	19	42
36	5045	Glenelg, Glenelg North, Glenelg South	58	38	96
37	5046	Oaklands Pk, Warradale, Warradale Nth	32	6	38
38	5047	Darlington, Seacombe Gdn/Hts, Sturt	31	1	32
39	5048	Brighton (Nth and Sth), Dover Gdns, Hove	28	7	35
40	5049	Kingston Pk, Marino, Seacliff, Seacliff Pk	8	2	10
41	5050	Bellevue Heights, Eden Hills	9	0	9
42	5051	Blackwood, Coromandel Valley, Hawthorndene, Craigburn Farm	33	4	37
43	5052	Belair, Glenalta	17	8	25
44	5061	Hyde Pk, Malvern, Unley	39	39	78
45	5062	Brown Hill Ck, Clapham, Hawthorn, Kingswood, Mitcham, Lynton, Netherby, Springfield, Torrens Pk	44	56	100
46	5063	Eastwood, Frewville, Fullarton, Highgate, Parkside	73	49	122
47	5064	Glen Osmond, Glenunga, Mt Osmond, Myrtle Bank, St Georges, Urrbrae	36	19	55
48	5065	Dulwich, Glenside, Linden Pk, Toorak Gdns, Tusmore	39	23	62
49	5066	Beaumont, Burnside, Erindale, Hazlewood Pk, Stonyfell, Waterfall Gully, Wattle Pk	38	31	69
50	5067	Beulah Pk, Kent Town, Norwood, Rose Pk	49	51	100
51	5068	Heathpool, Kensington, Kensington Gdns, Leabrook, Marryatville, St Morris, Trinity Gdns	50	55	105
52	5069	College Pk, Evandale, Hackney, Maylands, St Peters, Stepney	59	48	107
53	5070	Felixstow, Firle, Glynde, Joslin, Marden, Payneham, Payneham Sth, Royston Pk	141	83	224
54	5072	Auldana, Magill, Magill Nth & Sth, Rosslyn Pk, Skye, Teringie, Woodforde	69	44	113
55	5073	Hectorville, Rostrevor, Tranmere,	125	81	206
56	5074	Campbelltown, Newton	182	60	242
57	5075	Dernancourt, Paradise	116	49	165
58	5076	Athelstone, Castambul	73	25	98
59	5081	Collinswood, Gilberton, Medindie, Medindie Gdns, Vale Pk, Walkerville	46	33	79
60	5082	Fitzroy, Ovingham, Prospect, Thorngate	182	113	295
61	5083	Broadview, Nailsworth, Sefton Pk	99	48	147
62	5084	Blair Athol, Kilburn	385	82	467
63	5085	Clearview, Enfield, Northfield, Northgate	359	115	474
64	5086	Gilles Plains, Greenacres, Hampstead Gdns, Hillcrest, Manningham,, Oakden	300	95	395
65	5087	Klemzig, Windsor Gardens	211	96	307

	P/Code	Postcode Regions	SHC	MGP	Total
66	5088	Holden Hill	67	22	89
67	5089	Highbury	40	22	62
68	5090	Hope Valley	64	13	77
69	5091	Banksia Pk, Tea Tree Gully, Vista	56	4	60
70	5092	Modbury, Modbury Hts, Modbury Nth	187	16	203
71	5093	Para Vista, Valley View	119	49	168
72	5094	Cavan, Dry Creek, Gepps Cross	22	6	28
73	5095	Mawson Lakes, Pooraka	305	46	351
74	5096	Gulf View Hts, Para Hills, Para Hills W	213	10	223
75	5097	Redwood Pk, Ridgehaven, St Agnes	130	16	146
76	5098	Ingle Farm, Walkley Heights	210	42	252
77	5102	None Listed	1	0	1
78	5106	Parafield, Parafield Airport, Salisbury Sth	5	0	5
79	5107	Greenfields, Parafield Gdns	163	10	173
80	5108	Paralowie, Salisbury, Salisbury Downs	313	10	323
81	5109	Brahma Lodge, Salisbury East, Salisbury Hts, Salisbury Park, Salisbury Plain	142	4	146
82	5110	Bolivar, Burton, Direk, Globe Derby Pk, St Kilda, Waterloo Corner	69	4	73
83	5112	Elizabeth, Elizabeth East, Elizabeth Gve, Elizabeth Sth, Elizabeth Vale, Hillbank	61	3	64
84	5113	Davoren Pk (Nth & Sth), Elizabeth Dwns, Elizabeth Pk, Elizabeth (Nth & West)	104	5	109
85	5114	Andrews Farm, Blakeview, Craigmore, Gould Ck, Humbug Scrub, One Tree Hill, Sampson Flat, Smithfiled Plains Smithfield West, Uleybury, Yattalunga	101	5	106
86	5115	Kudia, Munno Para, Munno Para Dwns, Munno Para West	19	1	20
87	5116	Evanston, Evanston Gdns, Evanston Pk, Evanston Sth, Hillier	13	0	13
88	5117	Angle Vale	5	0	5
89	5118	Bibaringa, Buchfelde, Concordia, Kingsford, Reid, Kangaroo Flat, Hewett, Kalbeeba Gawler Belt, Ward Belt, Willaston	24	1	25
90	5120	Buckland Park, Virginia	14	0	14
91	5121	Macdonald Park, Penfield, Penfield Gdns	2	0	2
92	5125	Golden Grove, Golden Grove Village, Greenwith	135	8	143
93	5126	Fairview Pk, Surrey Dwns, Yatala Vale	45	5	50
94	5127	Wynne Vale	58	2	60
95	5131	Houghton, Lower Hermitage, Upper Hermitage	4	0	4
96	5132	Paracombe	1	0	1
97	5133	Inglewood	3	0	3
98	5134	Cherryville, Montacute	3	1	4
99	5135	None Listed	0	1	1

	P/Code	Postcode Regions	SHC	MGP	Total
100	5136	Norton Summit	1	3	4
101	5137	Ashton, Marble Hill	5	3	8
102	5138	Basket Range	2	0	2
103	5140	Greenhill	5	3	8
104	5141	Horsnell Gully, Summertown	2	4	6
105	5142	Uraidla	1	5	6
106	5151	Piccadilly	2	1	3
107	5152	Cleland, Crafers, Crafers West, Mt Lofty, Stirling	23	13	36
108	5153	Biggs Flat, Bradbury, Chapel Hill, Echunga, Flaxley, Green Hills Range, Heathfield, Ironbank, Jupiter Ck, Longwood, Macclesfield, Mylor, Scott Ck	23	3	26
109	5154	Aldgate	11	9	20
110	5155	Bridgewater, Mt George	16	6	22
111	5156	Upper Sturt	4	2	6
112	5157	Ashbourne, Bull Ck, Cherry Gdns, Clarendon, Dorset Vale, Kangarilla, Mcharg Ck	3	0	3
113	5158	Hallet Cove, O'Halloran Hill, Sheidow Pk, Trott Pk	39	4	43
114	5159	Aberfoyle Pk, Chandlers Hill, Flagstaff Hill, Happy Valley	47	10	57
115	5161	Old Reynella, Reynella, Reynella East	15	2	17
116	5162	Morphett Vale, Woodcroft	45	4	49
117	5163	Hackham, Hackham West, Huntfield Heights, Onkaparinga Hills	32	1	33
118	5164	Christie Downs	7	0	7
119	5165	Christies Beach, Christies Beach North	5	2	7
120	5166	O'Sullivan Beach	2	0	2
121	5167	Port Noalunga, Port Noalunga South	5	1	6
122	5168	Noarlunga Centre, Noarlunga Downs, Old Noarlunga	14	0	14
123	5169	Moana, Seaford, Seaford Hts, Seaford Meadows, Seaford Rise	20	2	22
124	5170	Maslin Beach	1	1	2
125	5171	Blewitt Springs, McLaren Flat, McLaren Vale, Pedler Ck, Tatachilla	1	0	1
126	5172	Hope Forest, Kuitpo Colony, Kyeema, Montarra, Pages Flat, The Range, Willunga, Yundi, [Adelaide Hills]	1	0	1
127	5173	Aldinga, Aldinga Beach, Port Willunga, Silver Sands	17	0	17
128	5174	Sellicks Beach, Sellicks Hill	3	0	3
		TOTAL	**10 077**	**3385**	**13 462**

Appendix 3.7 Residential Postcode Clusters by Statistical Local Area / SEIFA* – Women in SHC and MGP (Both Study Arms)

	Postcodes [SEIFA, Socioeconomic index for area based on Social Health Atlas SA where SEIFA 1 highest advantage and SEIFA 6 lowest advantage]*
1	**[SEIFA 1] Adelaide CBD & North Adelaide:** 5000; 5001; 5006
2	**[SEIFA 2] Eastern Suburb**s: 5064–5073 Glen Osmond, Myrtle Bank, St Georges, Urrbrae, Dulwich, Glenside, Linden Pk, Toorak Gdns, Tusmore, Beaumont, Burnside, Erindale, Hazlewood Pk, Stonyfell, Waterfall Gully, Wattle Pk, Beulah Pk, Kent Town, Norwood, Rose Pk, Heathpool, Kensington, Kensington Gdns, Leabrook, Marryatville, St Morris, Trinity Gdns, College Pk, Evandale, Hackney, Maylands, St Peters, Stepney, Felixstow, Firle, Glynde, Joslin, Marden, Payneham, Payneham Sth, Royston Pk, Auldana, Magill, Magill (Nth & Sth), Rosslyn Pk, Skye, Teringie, Woodforde, Hectorville, Rostrevor, Tranmere
3	**[SEIFA 3] Adelaide Hills: 5131–5142; 5151 -5157; 5172** Houghton, Lower Hermitage, Upper Hermitage, Paracombe, Inglewood, Cherryville, Montacute, Norton Summit, Aston, Marble Hill, Basket Range, Greenhill, Horsnell Gully, Summertown, Uraidla, Piccadilly, Cleland, Crafers, Crafers West, Mt Lofty, Stirling, Biggs Flat, Bradbury, Chapel Hill, Echunga, Flaxley, Green Hills Range, Heathfield, Ironbank, Jupiter Ck, Longwood, Macclesfield, Mylor, Scott Ck, Aldgate, Bridgewater, Mt George, Upper Sturt, Ashbourne, Bull Ck, Cherry Gdns, Clarendon, Dorset Vale, Kangarilla, Mcharg Ck, Hope Forest, Kuitpo Colony, Kyeema, Montarra, Pages Flat, The Range, Willunga, Yundi
4	**[SEIFA 4] Western & Beach Suburbs: 5009–5012;5014–5033; 5035; 5038;5040** Allenby Gdns, Beverley, Kilkenny, Angle Park, Ferryden Pk, Regency Pk, Woodville, Woodville Pk, Woodville Sth, Woodville West, Athol Pk, Mansfield Pk, Woodville Gdns, Albert Park, Alberton, Cheltenham, Hendon, Queenstown, Royal Park, Birkenhead, Ethelton, Glanville, Port Adelaide, Largs Bay, Largs Nth, Peterhead, Osborne, Taperoo, North Haven, Outer Harbour, Exeter, Semaphore, Semaphore Pk, Semaphore Sth, West Lakes Shore, West Lakes, Grange, Henley Beach, Tennyson, Kirkcaldy, Findon, Seaton, Fulham, Fulham Gdns, West Beach, Flinders Pk, Kidman Park, Mile End, Thebarton, Torrensville, Brooklyn Pk, Lockleys, Underdale, Cowandilla, Hilton, Marleston, Richmond
5	**[SEIFA 5] Southern Suburbs: 5034; 5037; 5039; 5041 – 5063; 5158–5171; 5173–5174** Clarence Pk, Goodwood, Kings Pk, Millswood, Wayville, Glandore, Kurralta Pk, Netley, Nth Plympton, Clarence Gdns, Edwardstown, Melrose Pk, Colonel Light Gdns, Cumberland Pk, Daw Pk, Panorama, Westbourne Pk, Bedford Pk, Clovelly Pk, Flinders University, Pasadena, St Marys, Ascot Pk, Marion, Mitchell Pk, Park Holme, Morphetville, Glengowrie, Somerton Pk, Glenelg, Glenelg Nth, Glenelg Sth, Oaklands Pk, Warradale, Warradale Nth, Darlington, Seacombe Gdns, Seacombe Hts, Sturt, Brighton (Nth & Sth), Dover Gdns, Hove, Kinfston Pk, Marino, Seacliff, Seacliff Pk, Bellevue Heights, Eden Hills, Blackwood, Coromandel Valley, Hawthorndene, Craigburn

	Postcodes [SEIFA, Socioeconomic index for area based on Social Health Atlas SA where SEIFA 1 highest advantage and SEIFA 6 lowest advantage]*
	Farm, Belair, Glenalta, Hyde Pk, Malvern, Unley, Brown Hill Creek, Clapham, Hawthorn, Kingswood, Mitcham, Lynton, Netherby, Springfield, Torrens Pk, Eastwood, Frewville, Fullarton, Highgate, Parkside, Hallet Cove, O'Halloran Hill, Sheidow Pk, Trott Pk, Aberfoyle Park, Chandlers Hill, Flagstaff Hill, Happy Valley, Old Reynella, Reynella, Reynella East, Morphett Vale, Woodcroft, Hackham, Hackham West, Huntfield Heights, Onkaparinga Hills, Christie Downs, Christies Beach, Christies Beach North, O'Sullivan Beach, Port Noarlunga, Port Noarlunga South, Noarlunga Centre, Noarlunga Downs, Old Noarlunga, Moana, Seaford, Seaford Rise, Seaford Heights, Seaford Meadows, Maslin Beach, Blewitt Springs, McLaren Flat, McLaren Vale, Pedler Ck, Tatachilla, Aldinga, Aldinga Beach, Port Willunga, Silver Sands, Sellicks Bch/Hlll
6	**[SEIFA 6] North & North East Suburbs: 5007; 5008; 5013; 5074–5076;5081–5098; 5102–5127** Bowden, Brompton, Hindmarsh, Welland, Croydon, Devon Park, Renown Park, Dudley Park, Ridleyton, Gillman, Ottoway, Pennington, Rosewater, Campbelltown, Newton, Dernancourt, Paradise, Athelstone, Castambul, Collinswood, Gilberton, Medindie, Medindie Gdns, Vale Pk, Walkerville, Fitzroy, Ovingham, Prospect, Thorngate, Broadview, Nailsworth, Sefton Pk, Blair Athol, Kilburn, Clearview, Enfield, Northfield, Northgate, Gilles Plains, Greenacres, Hampstead Gdns, Hillcrest, Manningham, Oakden, Klemzig, Windsor Gardens, Holden Hill, Highbury, Hope Valley, Banksia Pk, Tea Tree Gully, Vista, Modbury, Modbury Hts, Modbury Nth, Para Vista, Valley View, Cavan, Dry Creek, Gepps Cross, Mawson Lakes, Pooraka, Gulf View Hts, Para Hills, Para Hills West, Redwood Pk, Ridgehaven, St Agnes, Ingle Farm, Walkley Heights, Parafield, Parafield Airport, Salisbury Sth, Greenfields, Parafield Gdns, Paralowie, Salisbury, Salisbury Downs, Brahma Lodge, Salisbury East, Salisbury Hts, Salisbury Park, Salisbury Plain, Bolivar, Burton, Direk, Globe Derby Pk, St Kilda, Waterloo Corner, Elizabeth, Elizabeth East, Elizabeth Gve, Elizabeth Sth, Elizabeth Vale, Hillbank, Davoren Pk (Nth & Sth), Elizabeth Dwns, Elizabeth Pk, Elizabeth (Nth & West), Andrews Farm, Blakeview, Craigmore, Gould Ck, Humbug Scrub, One Tree Hill, Sampson Flat, Smithfiled Plains Smithfield West, Uleybury, Yattalunga, Kudia, Munno Para, Munno Para Dwns, Munno Para West, Evanston, Evanston Gdns, Evanston Pk, Evanston Sth, Hillier, Angle Vale, Bibaringa, Buchfelde, Concordia, Kingsford, Reid, Kangaroo Flat, Hewett, Kalbeeba Gawler Belt, Ward Belt, Willaston, Buckland Park, Virginia, Macdonald Park, Penfield, Penfield Gdns, Golden Grove, Golden Grove Village, Greenwith, Fairview Pk, Surrey Dwns, Yatala Vale, Wynne Vale

Appendix 3.8 AR DRG Obstetric Codes / Discharge Separations Recorded in ISAAC

(Version 6 replaced V 5.1 & 5.2 July 2009)*

DRG Code	Australian Refined Diagnostic Related Group Code Description	Coding Year Changes
O01A	Caesarean Delivery with Multiple Complicating Diagnosis, at least 1 Severe; to Caesarean Delivery with Catastrophic or Severe Complications	2003/04 – 2004/05 2005/06 – 2010/11
O01B	Caesarean Delivery with Severe Complicating Diagnosis; to Caesarean Delivery without Catastrophic or Severe Complications	2003/04 – 2004/05 2005/06 – 2010/11
O01C	Caesarean Delivery with Moderate Complicating Diagnosis; to Caesarean Delivery without catastrophic or Severe Complications	2003/04 – 2004/05 2005/06 – 2008/09: ceased
O01D	Caesarean Delivery without Complicating Diagnosis	2003/04: then ceased
O02A	Vaginal Delivery with Operation Room Procedure with Catastrophic or Severe Complications	2004/05 – 2010/11
O02B	Vaginal Delivery with Operating Room Procedure without Catastrophic or Severe Complication	2004/05 – 2010/11
O60A	Vaginal Delivery with Multiple Complicating Diagnosis, at least 1 Severe; to Vaginal Delivery with catastrophic or Severe Complications	2003/04 – 2004/05 2005/06 – 2008/09: then ceased
O60B	Vaginal Delivery with Severe Complicating Diagnosis; to Vaginal Delivery without catastrophic or Severe Complications	2003/04 – 2004/05 2005/06 – 2008/09: then ceased
O60C	Vaginal Delivery W Moderate Complicating Diagnosis; to Vaginal Delivery, Single Uncomplicated	2003/04 – 2004/05 2005/06 – 2008/09: then ceased
O60D	Vaginal Delivery without Complicating Diagnosis	2003/04 only
O60Z	Vaginal Delivery	2009 – 2010/11
O61Z	Post – partum and post Abortion without Operating Room Procedure	2003/04 – 2010/11
O66A	Antenatal and Other Obstetric Admission	2004/05 – 2008/09
O66B	Antenatal and Other Obstetric Admission Same Day	2004/05 – 2008/09
O66Z	Antenatal and Other Obstetric Admission	2009/10 – 2010/11
168B	Non – surgical spinal disorder without Complication	New in 2009/2010
O02Z	Vaginal Delivery with Complicating Operating Room Procedure	2003/04: then ceased
O04B	Postpartum and Post Abortion with Operating Room Procedure without Catastrophic or Severe Complication	2009/10 only
O04Z	Post – partum and post Abortion W OR Procedure	2004/05 only
O63Z	Abortion without Operating Room Procedure	2008/09 only
O64A	False Labour < 37 week with complications	2006/07 & 2008/09
O64B	False Labour > 37 weeks without Catastrophic Complication to False Labour > or = 37 weeks without complication	2004/05 2005/06 – 2008/09

DRG Code	Australian Refined Diagnostic Related Group Code Description	Coding Year Changes
O64Z	False Labour	2003/04 – 2010/11
O65A	Other Antenatal Admission with Severe Complicating Diagnosis	2003/04 only
O65B	Other Antenatal Admission with Moderate or No Complicating Diagnosis	2003/04 only
X60A	Injuries with Catastrophic or Severe Complication	2009/10 only
OTHER	168B;O02Z;O04B;O04Z;O63Z;O64A;O64B;O64Z;O65A;O65B;X60A Note: a total of 31 separations only were recorded for all these codes	As above

***Australian Refined Diagnostic Related Group Obstetric Codes and Descriptors, Versions 5.1; 5.2 and Version 6 with Coding Year changes noted (Commonwealth Department Health & Ageing 2010)**

Appendix 3.9 AR DRG Obstetric Codes / Discharge Separations Recorded in ISAAC

Code Clusters in Analyses (26 AR DRG Codes into 15 clusters)*

Code Cluster	DRG Code	Australian Refined Diagnostic Related Group Code Description	Separations
1	O01A	Caesarean Delivery with Multiple Complicating Diagnosis, at least 1 Severe; to Caesarean Delivery with Catastrophic or Severe Complications	356
2	O01B	Caesarean Delivery with Severe Complicating Diagnosis; to Caesarean Delivery without Catastrophic or Severe Complications	1197
3	O01C	Caesarean Delivery W Moderate Complicating Diagnosis; to Caesarean Delivery without catastrophic or Severe Complications	1902
4	O01D	Caesarean Delivery without Complicating Diagnosis	79
5	O02A	Vaginal Delivery with Operation Room Procedure with Catastrophic or Severe Complication	171
6	O02B	Vaginal Delivery with Operating Room Procedure without Catastrophic or Severe Complication	290
7	O60A	Vaginal Delivery with Multiple Complicating Diagnosis, at least 1 Severe; to Vaginal Delivery with catastrophic or Severe Complications	969
8	O60B	Vaginal Delivery with Severe Complicating Diagnosis; to Vaginal Delivery without catastrophic or Severe Complications	4623
9	O60C	Vaginal Delivery W Moderate Complicating Diagnosis; to Vaginal Delivery, Single Uncomplicated	848
10	O60D	Vaginal Delivery without Complicating Diagnosis	256
11	O60Z	Vaginal Delivery	2380
12	O61Z	Post – partum and post Abortion without Operating Room Procedure	89
13	O66B	Antenatal and Other Obstetric Admission Same Day	49
14	O66A O66Z	Antenatal and Other Obstetric Admission Antenatal and Other Obstetric Admission	21

Code Cluster	DRG Code	Australian Refined Diagnostic Related Group Code Description	Separations
15	168B O02Z O04B O04Z O63Z O64A O64B O64Z O65A O65B X60A	Non – surgical spinal disorder without Complication Vaginal Delivery with Complicating Operating Room Procedure Postpartum and Post Abortion with Operating Room Procedure without Catastrophic or Severe Complication Post – partum and post Abortion W OR Procedure Abortion without Operating Room Procedure False Labour < 37 week with complications False Labour > 37 weeks without Catastrophic Complication to False Labour > or = 37 weeks without complication False Labour Other Antenatal Admission with Severe Complicating Diagnosis Other Antenatal Admission with Moderate or No Complicating Diagnosis Injuries with Catastrophic or Severe Complication	31
			13 261

***Australian Refined-Diagnostic Related Group Cluster Code categories used in analyses for this study**

Appendix 3.10 a Understanding Medicare Australia's Statistical Information

Legal, Privacy and Information Services Branch

July 2009

Understanding Medicare Australia's Statistical Information

Introduction

Medicare Australia is an Australian government agency and is responsible for administering a range of national government health and payment programs. Medicare Australia's purpose "to improve the health and wellbeing of Australians by delivering information and payment services" acknowledges that health information in the hands of health care decision makers has the potential to improve health outcomes. A range of health statistical information is published at http://www.medicareaustralia.gov.au/provider/index.shtml
This document explains the types of information available from Medicare Australia, some of its restrictions, and how to request information from Medicare Australia.

What type of information is available?

Information available from Medicare Australia includes (but is not limited to):

Pharmaceutical Benefits Scheme (PBS)

medicine: item code, generic name,
cost
original or repeat prescription
date of supply
payment category e.g. concession, safety net, doctor's bag
authority reason codes (but not for streamlined authorities)
state (supply—based on approval ID)
number of scripts
number of patients

Medicare

item number
Medicare benefit
date of service, processing or referral
indication of whether or not the service was provided in hospital
number of services, rendered or referred
number of patients
state of patient

Australian Childhood Immunisation Register (ACIR)

immunisation due date
statistical local area
local government area
provide details (type, state)
provider number (GP and ancillary) and sex
practice address
child's information (name, date of birth, sex, ACIR or Medicare address, immunisation history, immunisation due date)

Other programs include

General Practice Register (GPR)
Rural Retention Program (RRP)
General Practice Registrars Rural Incentives Payment Scheme (GPRRIPS)
Australian Organ Donor Register
Practice Incentives Program

Privacy

Medicare Australia is committed to protecting the privacy and security of personal information that it collects. Requests for Medicare, ACIR and/or PBS information are subject to the secrecy provisions including those under section 130 of the *Health Insurance Act 1973* (Medicare and ACIR information) and section 135A of the *National Health Act 1953* (PBS information). All personal information held by Medicare Australia is subject to the provisions of the *Privacy Act 1988*.

When dealing with personal information Medicare Australia has legal obligations to:

- collect it in a fair and lawful manner
- check the accuracy of the information before it is used
- keep it stored securely to safeguard against unauthorised access
- ensure it is used only for the purpose for which it was collected (unless provided for by law)
- ensure it is not disclosed to any other person (unless provided for by law).

In general, de-identified aggregated data may be released, subject to assessment of any potential privacy issues to ensure individuals cannot be identified or re-identified.

Information Considerations and Limitations

Medicare and PBS claims data are only held for the last 5 years. Medicare and PBS data greater than 5 years are held by the Department of Health and Ageing (DoHA). Medicare Australia can only retrieve this data from DoHA for operational purposes.

Medicare

Medicare records only include services that qualify for Medicare benefits and for which claims have been processed. They do not include services, which qualify for benefits under the Department of Veterans' Affairs National Treatment Account. Medicare Australia does not hold information about services, which have been provided in public hospitals to public patients, or services provided in outpatients or emergency departments of public hospitals. Only information related to claims is collected by Medicare Australia; therefore diagnostic or clinical information is not available.

"Episode Cone" may lead to an underestimation of some pathology item numbers. For a full definition of "Episode Cone" please refer to the current Medicare Benefits Schedule publication.

Pharmaceutical Benefits Scheme (PBS)

The PBS reimburses pharmacists who have dispensed eligible prescription pharmaceuticals at a cost that is greater than the patient contribution (general or concessional). Medicare Australia only collects sufficient information to enable these reimbursements to be made to pharmacists.

The accuracy of PBS records depends on a pharmacist identifying patients by their correct entitlement numbers (e.g. Medicare card or Health Care card) and prescribers by their correct prescriber number on claims for payment. Information held by Medicare Australia is restricted to data recorded from prescriptions where the cost of a pharmaceutical was greater than the patient contribution (at the general or concessional rate) and where a pharmacist required reimbursement i.e. if the cost is under a general threshold, no subsidy is required by the pharmacy and therefore Medicare Australia does not process a claim and data is not collected.

Repatriation Pharmaceutical Benefits Scheme (RPBS)

PBS information does not include items supplied under the RPBS. Requests for access to RPBS information should be directed to the Department of Veterans' Affairs. However, summary RPBS information is published on

Medicare Australia’s website. Some RPBS data is also included on the Divisions of General Practice web pages.

Schedule of Pharmaceutical Benefits

The Schedule of Pharmaceutical Benefits, available at the Department of Health and Ageing's website, provides detailed information regarding names and costs of eligible medicines. General information about the operation of the PBS is available on both Medicare Australia and the Department of Health and Ageing’s website.

The Request Process

The Client Liaison Unit (CLU) is the entry point for all requests for statistical information. Requests must be received by email, facsimile or letter, and are subject to a clarification and approval process.

Each request is assessed on an individual basis to determine if:

- Medicare Australia holds the information
- the information is available on Medicare Australia’s statistical website
- the request is in line with Medicare Australia’s strategic direction of Improving Australia’s health
- it will support the Australian public to make more informed choices about their health care
- it will support stakeholders in the health sector to develop and monitor initiatives aimed at improving Australia’s health sector
- it will support partnerships within the health sector
- it will support initiatives aimed at increasing the knowledge base of Australia’s health sector, and sharing that knowledge within relevant parts of the sector
- Privacy clearance is necessary
- the request requires further clarification.

Decision, Charge, Terms and Conditions

Medicare Australia may charge for the delivery of information to recover costs.

If the request is approved the client will be provided with a written cost estimation, details on the terms and conditions associated with the provision of Medicare Australia information as well as the expected delivery date. The request is only processed when a written acceptance is received.

If the request is denied, the client is notified and an explanation given as to why the request was not approved. Clients may redefine the requirements of the request to conform to the above criteria.

Information Requirements

The CLU can be consulted for advice about the information required.

Report Delivery

To reduce the likelihood of delays it is best to submit requests as soon as possible to allow sufficient time for review, clarification, privacy clearance and information retrieval which can be a lengthy process. If delays are likely the client will be contacted by the CLU.

Reports can be provided in hard copy, disc or email and can be formatted in ASCII (text) file or Excel.

Medicare Australia Website

A preliminary understanding of some of the information Medicare Australia maintains can be gained through Medicare Australia's website link:

http://www.medicareaustralia.gov.au/about/stats/index.shtml

Many of the reports are interactive, so that the user can specify the parameters of interest. The website contains summarised information only.

The Medicare Australia website displays the Annual Report Statistical Tables at link:

http://www.medicareaustralia.gov.au/about/governance/reports/index.shtml

Contacts

Requests for statistical information

statistics@medicareaustralia.gov.au

Help regarding your statistical information needs:

Client Liaison Unit 1800 101 099

Submission of personal or third party information requests and access to FOI information and/or privacy issues:

co.information.release@medicareaustralia.gov.au

co.foi@medicareaustralia.gov.au

co.privacy@medicareaustralia.gov.au

Disclaimer

The material contained in this information sheet is provided for general use and information purposes only. Medicare Australia recommends that end users apply their own skill and care with respect to its contents.

Appendix 3.10b Medicare Consented Study Questionnaire and Data Parameters

IRT number: (Medicare Australia use only)

Date received: (Medicare Australia use only)

Consented Study Questionnaire

Contact Details:

Title (Mrs/Miss/Mr/Dr. etc.)	**Mrs**
First Name	**Roslyn**
Surname	**Donnellan – Fernandez**
Occupation	**Midwifery Fellow, PhD Candidate**
Institution/Company Name	**Women's & Children's Hospital / Flinders University**
Type of Institution	**Tertiary Maternity & Children's Hospital / University**
Address	**7 Mulga Road Hawthorndene 5051**
State	**South Australia**
Postcode	**5051**
Telephone	**041 785 1883 (Mobile) 8201 5135 (Wk) 8278 1429 (Hm)**
Fax	**82013410**
E-mail	**roslyn.donnellanfernandez@flinders.edu.au**

Information Requirements:
Medicare Australia is committed to improving Australia's health through the provision of information to health consumers.

1. How does the information you are requesting contribute to improving Australia's health?
This study seeks to benefit the community by contributing information and data linkage on pre and post birth health outcomes for mothers and babies, service and pharmaceutical costs and workforce use that will inform public policy decision making in current reform of maternity services.

2. Are you requesting this information on behalf of someone else?
No
If yes, please provide details of third party.

3. Will this information be published/presented? Yes

If yes, in what forum/publication?

This information forms part of a costing and resource study for a PhD thesis being undertaken at Flinders University examining the Net Benefit comparison between Midwifery Group Practice and Standard Hospital Care whilst the researcher is the Midwifery Fellow at Women's & Children's Hospital, Children Youth & Women's Health Service Adelaide, South Australia. Findings will be presented to the Women's & Children's Hospital Foundation and it is expected written publications from the PhD thesis will be submitted to refereed health policy journals.

4. How many participants will you be recruiting for this study?

A total of 500 mother / baby pairs will be recruited for the study: 250 from Midwifery Group Practice service and 250 from Standard Hospital Care service.

5. From which program(s) do you require data?

Medicare and Pharmaceutical Benefits Scheme and Australian Childhood Immunization Register.

6. Please see and select the data parameters required from the attached list of available fields.

DATA PARAMETERS

Please fill in Request ID, Name of Study and mark all relevant fields required for your study

Request ID: 2009/CO06697
Name of Study:
A Cost And Resource Study: Midwifery Group Practice And Standard Hospital Care
Table 1. Medicare Items
Patient Details Claim Details Costs

Participant ID	Date of Service	Date of Processing	Item Description	Medicare Item No	Provider Charge	Schedule Fee	Benefit Paid
X	X	X	X	X	X	X	X
Service Provider and Referral							

Service Provider and Referral

Patient Out Of Pocket	Bill Type	Scrambled Ordering Provider No	Scrambled Rendering Provider No	Date of Referral	Rendering Provider Postcode	Ordering Provider Postcode	Hospital Indicator
X	X	X	X	X	X	X	X

*** Optional Extra Fields**

Provider Derived Major	Item Category

Specialty	

Table 2. PBS Items

Patient Item Description Costs

Participant ID	Date of Supply	Date of Prescribing	PBS Item Code	Item Description	Patient Category	Patient Contribution	Net Benefit
x	X	x	x	x	x	x	x

Prescribing Details

Scrambled Prescriber Number	Pharmacy Postcode	Form Category
X	X	X

*** Optional Extra Fields**

ATC Code	ATC Name	Prescriber Derived Major Specialty	**Medicare Australia use only: Delegate Approval** All selected fields approved: Yes / No If no: see comments above

*** Optional extra fields will incur additional costs**

MBS Definitions

Participant ID: Unique identifier provided by the study to reference the individual participants

Date of Service: The date on which the provider performed the service

Date of Processing: The date on which Medicare Australia processed the payment of a claim for Medicare benefits

Item Description: Describes the service provided by the provider as per Medicare Benefits Schedule

Medicare Item Number: A number that identifies the service provided by the provider as per Medicare Benefits Schedule

Provider Charge: The dollar amount the provider charged for the service

Schedule Fee: Fee listed in the Medicare Benefits Schedule

Benefit Paid: This is the Medicare benefit paid to the claimant

Patient Out of Pocket: The dollar amount the patient is out of pocket i.e. Provider charge minus benefit paid

Bill Type: The method by which the Medicare benefit was claimed i.e.cash, bulk bill, cheque to claimant, cheque to provider via claimant, PCe (Easyclaim patient claim), simplified bill and EFT

Scrambled Ordering Provider Number: A unique scrambled provider number identifying the doctor who referred the service

Scrambled Rendering Provider Number: A unique scrambled provider number identifying the doctor who provided the service

Date of Referral: This is the date of referral or request for a service by a provider

Rendering Provider Postcode: Postcode of servicing provider's practice location

Ordering Provider Postcode: Postcode of referring provider's practice location

Hospital Indicator: An indicator of whether the service was performed in hospital

Provider Derived Major Specialty: Specialty of provider

Item Category: The Medicare Benefits Schedule (MBS) comprises a Hierarchical structure of categories, Groups, Subgroups and items numbers, to group similar professional services together.

PBS Definitions

Participant ID: Unique identifier provided by the study to reference the individual participants

Date of Supply: This is the date on which the PBS item was supplied

Date of Prescribing: This is the date on which the prescription was written

PBS Item Code: Number which indicates item prescribed as per Schedule of Pharmaceutical Benefits

Item Description: The description of the item name as it appears in the Schedule of Pharmaceutical Benefits

Patient Category: The patient category refers to the patient's concessional status at the time of supply of the benefit of the item

Patient Contribution: The patient contribution actually paid by the patient

Net Benefit: Benefit that Medicare Australia paid to the Pharmacy

Scrambled Prescriber Number: A unique scrambled prescriber number identifying the doctor who prescribed the PBS item

Pharmacy Postcode: Postcode of Pharmacy where the prescription was dispensed

Form Category: Description of script type. Ie: OR: Original, RE: Repeat, DS: Deferred Script, AU: Authority, AR: Authority Repeat

ATC Code: The code allocated by the WHO Collaborating Centre for Drug Statistics Methodology (www.whocc.no/atcddd/)

ATC Name: In the Anatomic Therapeutic Chemical (ATC) classification system, the drugs are divided into different groups according to the organ or system on which they act and their chemical, pharmacological and therapeutic properties

Prescriber Derived Major Speciality: Specialty of prescribing doctor

7. What consent/data extraction period/s is required?

Medicare and PBS claims data is only held for the last 4 years and 11 months. In practice Medicare and PBS data extraction periods is limited to 4 years and 6 months.

From 30/6/20120 . . . To 30/6/2011

8. When do your require the data/report?

30'th July 2011

9. Please ensure you have answered and attached the following documentation:

- Check all questions have been answered in the consented study questionnaire.
- Data Parameters template completed.
- Draft copy of consent form.
- Draft copy of information sheet.
- Copies of ethics committee approvals.

Appendix 3.11 Letter of Introduction

School of Nursing & Midwifery
Room N216,Sturt North Wing
GPO Box 2100
Adelaide SA 5001
Tel: 08 8201 5353
Fax: 08 8201 3410
Sheryl.delacey@flinders.edu.au
www.flinders.edu.au/nursing/
CRICOS Provider No. 00114A

LETTER OF INTRODUCTION

Dear Consumer

This letter is to introduce, Ms Roslyn Donnellan – Fernandez who is a PhD student in the Faculty of Health Sciences, School of Nursing & Midwifery at Flinders University and the Women's & Children's Hospital Foundation Midwifery Fellow, Children Youth & Women's Health Service. She will produce her student and fellowship cards, which carry her photograph, as proof of identity.

She is undertaking research leading to the production of a thesis or other publications that will compare differences in cost, health outcomes and workforce use for pregnant women and their babies in two service models. This project is being undertaken in collaboration with the Women's & Babies Division at Women's & Children's Hospital and Flinders University. The two service models being compared are Midwifery Group Practice and Standard Hospital Care.

She would be most grateful if you would volunteer to assist this study by consenting to release of information about yourself and your babies' health outcomes after your birth. This will include information about how your baby was born as well as information about the number and cost of any services and medicines paid for under the Medicare Benefits and Pharmaceutical Benefits Schedules that are used by yourself or your baby in the first six months after birth. This information is currently collected by the South Australian Supplementary Birth Record and by the Medicare Australia and is confidential. You or your baby will not be identified by name. You will be approached to participate in this study by a person who is not involved with the research, requested to read an Information Sheet and to complete 2 written consent forms. The written consent gives permission for Medicare Australia to provide information to the researcher about the number and cost of services and medicines used by yourself and your baby in the postnatal period. Information from two groups of mothers and babies will be compared to see if there is any significant difference.

Be assured that any information provided will be treated in the strictest confidence. You or your baby will not be identified by the researcher. Information about services, medicines and the health outcomes of individual women and babies is private and confidential and the privacy and confidentiality of mother and baby participants will be maintained throughout the study. The information will be provided to the researcher in a non – identifying form and handled and stored securely. This will be achieved using a secure electronic password in addition to guidelines and confidential processes required by Medicare Australia and Commonwealth Privacy Law. No participant will be individually identifiable in the resulting thesis, report or other publications.

To participate in this study please complete the Consent Forms and return them to a midwife at your next antenatal appointment. Any enquiries you may have concerning this project should be directed to me at the address given above or by telephone on 8201 5353, by fax on 8201 3410 or by email (Sheryl.deLacey@flinders.edu.au)

Thank you for your attention and assistance.

Yours sincerely

A/Prof Sheryl de Lacey
Associate Dean Research
School of Nursing & Midwifery
Flinders University South Australia

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project Number (4742) and the Children Youth & Women's Health Service Human Research Ethics Committee (REC 2260/3/13). For more information regarding ethical approval of the project the Secretary of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au. Or by contacting CYWHS Human Research Ethics Committee Secretary Ms Brenda Penny, Research Secretariat, telephone 8161 6521

inspiring achievement

Appendix 3.12 Participant Information Sheet

Participant Information Sheet

Title:
A Cost and Resource Study: Midwifery Group Practice & Standard Hospital Care

Researcher: Roslyn Donnellan – Fernandez RM RN MHN BN MNg IBCLC WCH Foundation Midwifery Fellow

Research Supervisors: Dr Sheryl de Lacey & Dr Ingrid Belan, Flinders University

Purpose of Study: The purpose of this study is to compare the cost and resource use of two models of care available to women at the Women's & Children's Hospital, Midwifery Group Practice and Standard Hospital Care.

Procedures: If you decide to participate in this study your permission is required to access confidential health information about you and your baby after you have given birth. You will be requested to sign two written consent forms in order to participate. The researcher will have no contact with you or your baby during the study. If you give your permission researchers will receive your de-identified data from the Women's & Children's Hospital and Medicare. They will link de-identified health information received from the South Australian Supplementary Birth Record with de-identified service and cost information received from Medicare Australia. The scope and type of information that will be released by Medicare includes the number, cost and a description of health services and visits paid for by Medicare Australia received by you or your baby in the first 6 months after birth. This includes the number and cost of any medicines and vaccines that are prescribed. The type of information that will be received from the South Australian Supplementary Birth Record includes data such as age, occupation, marital status, number of pregnancies, type of birth, age and weight of your baby at birth. To participate in this study please complete and sign the two Consent Forms and return them to a midwife at your next antenatal appointment.

Possible Benefits of the study to participant & community: This study seeks to benefit the community by contributing information about public health outcomes, cost and workforce use that can inform public policy decision making in current reform of maternity services.

Possible Risks of Study: Participation in this study is voluntary. No known risks associated with participation have been identified. Participation will not affect either your or your baby's current care or relationship with this health service.

Explanation of Study Design: This study looks at two groups of mothers and their babies in the first 6 months after birth. The total number of mother and baby pairs that will be asked to participate in the project is 500: 250 from Midwifery Group Practice service and 250 from Standard Hospital Care service.

Withdrawal from Study: Participants may withdraw from the study at any time for any reason without prejudice. If you withdraw from this study your information will not be included in the analysis and results.

Information Source: Participant information will be obtained from Medicare Australia and the South Australian Supplementary Birth Record.

Future Approved studies: Information or samples from this study will not be used for any future studies.

Support: The researcher is the Women's & Children's Hospital Midwifery Fellow and supported by the WCH Foundation. She is a PhD student at Flinders University School of Nursing & Midwifery, Faculty of Health Sciences. This project is undertaken in conjunction with the Women's & Babies Division of WCH Children Youth & Women's Health Service.

Reimbursement: There is no payment or reimbursement to participants of this study.

Assurance of Confidentiality: Your information will remain confidential. You or your baby will not be identified by name, and your identity will not be revealed to the researcher. The privacy and confidentiality of all participants will be maintained throughout this study. If you give written permission for the researcher to receive health information about you and your baby it will be provided in a de-identified form and handled and stored securely. This will be achieved using a confidential electronic password and adopting the guidelines and process required by Medicare Australia procedures and Commonwealth Privacy Law. No participant will be individually identifiable in the thesis, report or other publications.

Researcher Contact Details: Roslyn Donnellan – Fernandez, Women's & Children's Hospital Foundation Midwifery Fellow, ph 8161 6468 (WCH) or ph 8201 5135 (Flinders University). Direct supervision contact is Associate Professor Sheryl deLacey, Associate Dean Research, School of Nursing & Midwifery, Flinders University, ph 8201 5353, email: Sheryl.deLacey@flinders.edu.au, or in writing to: School of Nursing & Midwifery, Flinders University, GPO Box 2100 Adelaide SA 5001.

Ethics Approval: This study has been given approval by the Children, Youth & Women's Health Service Research Ethics Committee **(REC2260/3/13)** and the Social & Behavioural Research Ethics Committee, Flinders University South Australia **(Project Number 4742)**. Should participants or potential participants wish to discuss the approval process, or have any concern or complaint they are invited to contact:

Secretary of the CYWHS Research Ethics Committee Ms Brenda Penny, Research Secretariat, ph: 8161 6521 and / or
Secretary of Flinders University Social & Behavioural Research Ethics Committee, ph: 8201 31116, fax: 8201 2035 or by email:

(human.researchethics@flinders.edu.au)

Appendix 3.13 Consent Form for Hospital

CONSENT FORM

TITLE: A Cost And Resource Study: Midwifery Group Practice &

Standard Hospital Care

I

____

hereby consent to myself and my child's involvement in the research project entitled: A Cost And Resource Study: Midwifery Group Practice & Standard Hospital Care

1. The nature and purpose of the research project described on the attached Information Sheet has been explained to me. I understand it and agree to myself and my child taking part.

2. I understand that myself and my child may not directly benefit by taking part in this study.

3. I acknowledge that there are no known risks or inconveniences associated with participation in this study, as outlined in the Information Sheet.

4. I understand that I can withdraw myself and/or my child from the study at any stage and that this will not affect medical care or any other aspects of my or my child's relationship with this healthcare service.

5. I understand that there will be no payment to myself or my child for taking part in this study.

6. I have had the opportunity to discuss taking part in this research project with a family member or friend, and/or have had the opportunity to have a family member or friend present whilst the research project was being explained by the researcher.

7. I am aware that I should retain a copy of the Consent Form, when completed, and the Information Sheet.

8. I consent to release of myself and my child's de-identified health information for use in the above project. I understand this will be in accordance with the dates and purposes described in the Information Sheet and the Consent for Release of Medicare and/or Pharmaceutical Benefits and Vaccination Data Form. I understand the researcher will receive de-identified information from two sources, Medicare and the South Australian Supplementary Birth Record.

I consent to release of myself and my child's de-identified Commonwealth Medicare Data for use in the above project in accordance with the dates and purposes described in the Information Sheet and the Consent for Release of Medicare and/or Pharmaceutical Benefits and Vaccination Data Form.
I consent to release of myself and my child's de-identified health information from the South Australian Supplementary Birth Record for use in the above study in accordance with the dates and purposes described in the Information Sheet.

I consent for de-identified information received from Medicare and the South Australian Supplementary Birth Record to be linked. I do not consent to the information provided for this study being used in any other research project
9. I understand that I am free to withdraw my consent to participate in this study at any stage, without giving any reason, and that my action of withdrawing consent will not affect myself or my child's care or relationship with this health service in any way.

10. I understand that myself and my child's information will be kept confidential as explained in the information sheet except where there is a requirement by law for it to be divulged.

Signed: . . . .

Relationship to woman: . . . .

Full name of woman: . . . .

Dated: . . . .

I certify that I have explained the study to the woman and consider that she understands what is involved.

Signed: . . . . Title: . . . .

Dated: . . . .

Appendix 3.14 Medicare Consent Form

Participant ID: . . . .

PARTICIPANT CONSENT FORM

Consent to release of Medicare, Pharmaceutical Benefits Scheme (PBS) and/or Immunisation claims information for the purposes of: A Cost and Resource Study: Midwifery Group Practice and Standard Hospital Care***.***

Important Information

Complete this form to request the release of personal Medicare claims information, PBS claims information and/or Immunisation claims information for the purposes of a Cost and Resource Study: Midwifery Group Practice and Standard Hospital Care.

Any changes to this form must be initialled by the signatory. Incomplete forms may result in the study not being provided with any information.

By signing this form, I acknowledge that I have been provided with information about this study. I have been given an opportunity to ask questions and have been fully informed about this study.

PARTICIPANT DETAILS

Mr Mrs Miss Ms Other
Family name: ______________________ First given name: ________________

Other given name (s): _____________________________

Date of birth: DD/MM/YY

Medicare card number: _________________________

Permanent address: ____

Postal address (if different to above): _________________________________

AUTHORISATION

I authorise Medicare Australia to provide my:

Medicare claims history OR Medicare & PBS claims history OR

PBS claims history OR Medicare, PBS & Immunisation claims history

For the period* **30/06/2010** to: **30/06/2011** for the purposes of a Cost and Resource Study: Midwifery Group Practice and Standard Hospital Care.

*Note: This period cannot exceed 4 ½ years

DECLARATION

I declare that the information on this form is true and correct.

Signed: ___________________________ (participant's signature) OR

Signed by __________(full name) on behalf of participant __________ (signature)

Parent (where the participant is under the age of 18)
Legal guardian* (where the participant is under the age of 18)
Power of attorney*
Guardianship order* *Please attach supporting evidence

Power of attorney – A power of attorney is a document that appoints a person to act on behalf of another person who grants that power. In particular, an enduring power of attorney allows the appointed person to act on behalf of another person even when that person has become mentally incapacitated. The powers under a power of attorney may be unlimited or limited to specific acts. Guardianship order – A Guardianship order is an order made by a Guardianship Board/Tribunal that appoints a guardian to make decisions for another person. A Guardianship order may be expressed broadly or limited to particular aspects of the care of another person.

A sample of the information that may be included in your Medicare claims history:

Date of service	Date of Processing	Item number	Item description	Provider charge	Schedule Fee	Benefit paid	Patient out of pocket	Bill type
20/04/09	03/05/09	00023	Level B consultation	$38.30	$34.30	$34.30	$4.00	Cash
22/06/09	23/06/09	11700	ECG	$29.50	$29.50	$29.50		Bulk Bill

Scrambled ordering Provider number*	Scrambled rendering Provider number*	Date of referral	Rendering Provider postcode	Ordering Provider postcode	Hospital indicator	Provider derived major speciality	Item category
	999999A		2300		N	General Practitioner	1
999999A	999999A	20/04/09	2300	2302	N	Cardiologist	2

* Scrambled Provider number refers to a unique scrambled provider number identifying the doctor who provided/referred the service. Generally, each individual provider number will be scrambled and the identity of that provider will not be disclosed.

A sample of the information that may be included in your PBS claims history:

Date of supply	Date of prescribing	PBS item code	Item description	Patient category	Patient contribution	Net Benefit	Scrambled Prescriber number*	Pharmacy postcode	Form Category
06/03/09	01/03/09	03133X	Oxazepham Tablet 30 mg	Concessional Ordinary	$5.30	$25.55	9999999	2560	Original
04/07/09	28/05/09	03161J	Diazepam Tablet 2 mg	General Ordinary	$30.85		9999999	2530	Repeat

ATC Code	ATC Name	Prescriber derived major speciality
N05 B A 04	Oxazepam	General Practitioner
N05 B A 01	Diazepam	Psychiatrist

* Scrambled Prescriber number refers to a unique scrambled prescriber number identifying the doctor who prescribed the prescription. Generally, each individual prescriber number will be scrambled and the identity of that prescriber will not be disclosed.

Appendix 3.15 Study Recruitment Poster

MIDWIFERY RESEARCH

STUDY

Are you currently pregnant?
Will you give birth in the next 3 to 4 months?
Are you interested in supporting Midwifery Research that aims to improve and increase women's access to midwife care & services through the public health system in South Australia?

If you answered YES to all 3 questions ring Roz to find out how to help!

Text ROZ: 041 785 1883 (She will ring to discuss how you can help)

OR

Ring ROZ* direct on 041 785 1883 (Monday – Friday: 9 am – 5 pm)

*** Roz Donnellan – Fernandez is the current WCH Midwifery Foundation Fellow**
Children Youth & Women's Health Services

This study looks at Commonwealth Medicare costs after you give birth to your baby.

To participate you need to:

1. **Text or Ring ROZ on 041 785 1883**
2. **Read a Participant Information Sheet**

Appendix 3.16 Request to Extend Recruitment Timeframe

Prospective Arm

26 July 2011 Roslyn Donnellan – Fernandez
WCH Foundation Midwifery Fellow
Department of Nursing &Midwifery
Research & Practice Development
Women's & Children's Hospital &
School of Nursing & Midwifery
Flinders University
GPO Box 2100 Adelaide SA 5001
Email roslyn.donnellanfernandez@flinders.edu.au
Research Secretariat
Women's & Children's Services
Human Research Ethics Committee
72 King William Road
North Adelaide SA 5006
Re: REC 2260/3/13
A Cost and Resource Study: Midwifery Group Practice and Standard Hospital Care

Request to extend recruitment timeframe for Prospective Study Arm in Protocol 'A Cost and Resource Study: Midwifery Group Practice and Standard Hospital Care'

Recruitment of target numbers (500 participants) for the prospective arm of this study has been slower than anticipated. Meaningful statistical analysis in this arm requires that initial recruitment targets be met. Permission has currently been sought and approval obtained through External Requests Evaluation Committee (EREC), Statistical Services Branch Medicare Australia in July 2011 (email attached), to continue recruitment of a subsequent cohort of women during the period extending 30/6/2011 – 30/6/2012, until recruitment numbers are sufficient. This approval includes the attached Consent Form (previously approved by Medicare Australia: EREC, CYWHS Human Research Ethics Committee, and Flinders University Social and Behavioural Research Ethics Committee with a date range of 30/6/2010 – 30/6/2011). Please note that the new form has an adjusted date range of 30/6/2011 – 30/6/2012 to accommodate continued recruiting for a subsequent cohort of women, including data sought for the immediate 6 month post birth period. **This adjusted date range to accommodate the subsequent cohort of recruits is the only change.**
Thank you for your consideration of this request to extend the recruitment timeframe in the prospective arm of this study, utilizing the attached EREC approved Consent Form.

Yours sincerely

Roslyn Donnellan – Fernandez

Appendix 3.17 Request for Medicare Claims Information

Faculty of Health Sciences
School of Nursing & Midwifery
Sturt Campus, Bedford Park 5042
GPO Box 2100
Adelaide SA 5001
Tel: 08 2015135
041 785 1883
Roslyn.donnellanfernandez@flinders.edu.au
www.flinders.edu.au/nursing/
CRICOS Provider No. 00114A

4 June 2012

Jamie Johnson / Shannon McGrath
Dept of Human Services
Information Strategy Team
Strategic Information Design & Governance Branch
Caroline Chisholm Centre
57 Athlon Drive
Greenway ACT 2900

Dear Jamie / Shannon

Request for Medicare Claims Information: Reference 2009/Co06697
Cost and Resource Study: Midwifery Group Practice and Standard Hospital Care

Please find enclosed original consent forms for the above study as discussed in attached email correspondence and telephone follow up with your office on 16 May 2012.

The consents (207 in total) have been batched into a Midwifery Group Practice Cohort and a Standard Hospital Care Cohort in numeric order of allocated Participant IDs as they appear in the password protected USB Electronic File Excel Spreadsheets, also enclosed. I understand you will telephone or email to obtain the secure access password to the USB electronic file once items are received by Registered Post.

As discussed 18 of the participants have 2 consent forms. This occurred as a result of follow up with these participants to affirm valid consent for a period of data extraction consistent with the aims of the research project when it became evident that the date these participants gave birth was inconsistent with the stated end date for data extraction (30 June 2011) listed on their original / first signed consent. Whilst a number of women have been lost to the study through this anomaly, the 18 who responded completed a second form (as approved by your office) covering data extraction dates from 30 June 2011 – 30 June 2012 when we were granted approval for a second round of recruiting.

You will note start and end dates for data extraction are individualized for each participant dependent on the date the participant gave birth. As discussed, whilst the initial request sought a six month time tranche for data extraction, this has now been revised to a four month time tranche in order to maximize the number of participants and valid consents received during both rounds of recruitment. Accordingly, request for data extraction start and end dates have been revised on the electronic data file for a period of four months for each participant.

We understand that once your office checks the validity of the enclosed consents you will contact us to confirm the cost of data matching and extraction based on your initial quote. Once authorization to proceed is granted we can expect a timeline of approximately 3 months required for receipt of data extraction from our end date of June 30 2012. Thank you for your assistance.

Yours sincerely

Roslyn Donnellan – Fernandez
PhD Candidate, Flinders University
cc: Associate Professor Sheryl DeLacey & Dr Ingrid Belan

inspiring achievement

Appendix 3.18 Medicare Australia Information Report

Australian Government

Department of Human Services

Department of Human Services

Strategic Information Design and Governance Branch

4/9/2012

MBS & PBS & ACIR INFORMATION REPORT – IN CONFIDENCE

Report for Request Id 2009/CO06697

MBS data for consenting participants of the 'A cost and resource study: Midwifery Group Practice and Standard Hospital Care' Study

All Medicare items for consented IDs listed in the fourth worksheet of this spreadsheet (i.e. ID Summary)

Data extracted for date of service period 01 November 2010 to 30 June 2011 as per data file for each participant in the worksheet "ID Summary"

The run date for this report is 23 August 2012, capturing all available data at the time for Participants with a consent value of 'Y'.

Date of Processing Start Date 15 September 2010, Date of Processing end date 22 August 2012

Please note that Medicare records include services that qualify for Medicare benefits and for which claims have been processed.

They do not include services that qualify for benefits under the Department of Veterans' Affairs National Treatment Account.

In addition, Medicare Australia does not possess information in relation to services that may have been provided to public patients in hospitals, to outpatients in public hospitals, or in emergency departments of public hospitals.

PBS data for consenting participants of the 'A cost and resource study: Midwifery Group Practice and Standard Hospital Care' Study

All PBS items for consented IDs listed in the fourth worksheet of this spreadsheet (i.e. ID Summary)

Data extracted for date of supply period 15 September 2010 to 30 June 2012 as per data file for each participant in the worksheet "ID Summary"

The run date for this report is 23 August 2012 (i.e. Date of Processing to 22 August 2012). This therefore includes a Date of Processing lag of 3 months and over, capturing all available data at the time for Participants with a consent value of 'Y'.

These figures include only those items that qualify for a Pharmaceutical Benefit and for which a claim has been processed and extracted for payment.

They do not include medications supplied by private prescriptions, or where the Commonwealth benefit is less than the patient’s contribution (co-payment), or items supplied under the Repatriation Pharmaceutical Benefits Scheme (RPBS).

Whilst the Department of Human Services (DHS) takes every care in the compilation and provision of the Information, DHS does not assume or accept any responsibility for the accuracy, quality, suitability and currency of the Information.

Appendix 3.19 Medicare Australia MBS PBS Data

IN CONFIDENCE

Australian Government
Department of Human Services

If not delivered return to PO Box 1001 Tuggeranong DC ACT 2901

Our Reference: 2009/CO06697

Ms Roslyn Donnellan-Fernandez
Community Midwife, WCH Foundation Midwifery Fellow
C/- Nursing & Midwifery Administration
Women's & Children's Health Network, Women's & Children's Hospital Campus
School of Nursing & Midwifery (Sturt Campus)
Flinders University
Bedford Park SA 5042

Dear Roslyn

I refer to your request dated 02 June 2010 and subsequent correspondence with the Department of Human Services requesting Medicare and Pharmaceutical Benefits Scheme (PBS) claims information for consenting participants of the "A cost and resource study: Midwifery Group Practice and Standard Hospital Care Study" for the periods stated on the data file.

Please find enclosed a disc containing Medicare and PBS claims information in response to your request. Originally you requested ACIR data, but as none of the participants were under the age of 7 years old at the time of data extraction, ACIR data was not extracted. Information has only been provided where a valid patient consent form was supplied.

This information is divulged to you under subsections 130(3)(c)[1] of the *Health Insurance Act 1973* (HIA) and/or 135A(3)(c)[1] of the *National Health Act 1953* (NHA) on the basis that I have formed the opinion that you are authorised to receive this information.

Please note that there exists a prohibition on further use and disclosure of this information. This means that you have a responsibility to treat this information in the same manner as a person who has been, or is, employed as an officer of the Department of Human Services and must not divulge that information to a third person unless you have that person or their legal representative's consent to do so. Penalties, including fines or imprisonment exist for breaches of the secrecy provisions contained in subsections 130(1)[2] of the HIA and 135A(1)[2] of the NHA.

Please do not hesitate to contact Rhonda Charlesworth on 1800 101 099 if you have any further questions in relation to this matter.

Yours sincerely

K Gerholt

Katrina Gerholt
Director
Health and Older Australians Gateway Section
Strategic Information Design and Governance Branch
Delegate of the Chief Executive Medicare, the Minister for Health and Ageing, and the Secretary of the Department of Health and Ageing

4 / 9 / 2012

Write: PO Box 7788 Canberra Mail Centre ACT 2610 **Phone:** 02 6124 6337 **Web:** **humanservices.gov.au**

IN CONFIDENCE

Appendix 3.20 Medicare Benefits Schedule Items – Cluster Code Summary: Prospective Arm

	Item Clusters	MBS Item Numbers	MBS Item Description
1	**Short or Standard Consultations (A & B)**	3; 23; 53	Short or standard consultations at consulting rooms
2	**Long / After Hours Consultations, (C & D) or Comprehensive Initial**	36; 44; 54; 57; 721; 597;599; 723; 732; 2501; 2504; 5020; 5023; 5040; 10900; 16591	Long, Urgent or After Hours Consultations or Comprehensive Initial Consultation
3	**Pathology: Blood Tests, General Biochemistry, Pregnancy Test; Histopathology**	65070; 65096; 65120;66512; 66542; 66548; 66596;66599; 66602; 66608; 66623;66650; 66695; 66701; 66716;66719; 69303;69306; 69312; 69316; 69317; 69321; 69333;69336; 69345; 69387; 69415;69474; 71097; 71099; 71121;72816; 73527; 73529; 73806	Pregnancy test B-HCG; Thyroid; Biochemistry - blood, urine faecal; antigens; iron studies; histopathology; prothrombin time Vitamin D
4	**PAP Smears, cervical screen; Intrauterine device**	10 994; 14203; 14206; 14221; 35503; 73053; 73055	PAP smear, cervical screening, intrauterine device, hormone or tissue implantation
5	**Mental Health Treatment Plan or Psychological Assessment**	2702; 2710; 2712; 2713; 2715; 2717; 80010; 80110	Psychological Assessment, GP Mental Health Treatment Plan, Mental Health Treatment

	Item Clusters	MBS Item Numbers	MBS Item Description
6	**Other Includes:**		
	Initiation Patient Episode;	73920; 73922; 73923; 7 924; 73926; 73927; 73928; 73929; 73936; 73938; 73939	Initiation Patient Episode
	Initial Specialist; further attendance;	104; 105; 110; 116; 133; 296; 306	Specialist attendance includes: physician and psychiatrist
	Consultations by other health professionals	10 907; 10912; 10913; 10918; 10953; 10960; 10993; 10996; 10997; 82135	Includes: Practice Nurse, Physiotherapist, Midwife, Aboriginal Health Worker, Immunisation services
	Other Tests	11 224; 11512; 11700; 11709; 11712; 12533;55036;55076; 55113; 55731; 55840; 55844; 56025; 56301; 57509; 57521; 57712; 57715; 57963; 58121; 58503; 58903	[X-Ray, ultrasound, EEG, radiography, Dental X-Ray]
	Miscellaneous [minor operation; oral / dental]	30 071; 30195; 30219; 31230; 31280; 85013; 85531	Minor ops (removal bcc, cyst removal), biopsy, abscess drainage Dental- minor; oral exam

Appendix 3.21 Pharmaceutical Benefits Schedule Prescription Items – Major Drug Groups

DRUG GROUP	PBS ITEM DESCRIPTION
ANTIBIOTIC	AMOXYCILLIN CAPSULES
	CEPHALEXIN CAPSULE
	CIPROFLOXACIN TABLETS
	CLINDAMYCIN CAPSULES
	DOXYCYCLINE CAPSULES
	ERYTHROMYCIN TABLETS
	FLUCLOXACILLIN CAPSULES
	METRONIDAZOLE TABLETS
	NYSTATIN ORAL SUSPENSION
	NYSTATIN TABLETS
	PHENOXYMETHYLPENICIL CAPSULES
	ROXITHROMYCIN TABLETS
	TRIAMCINOLONE-NEOMYCIN EAR OINTMENT
	TRIMETHOPRIM TABLET
CONTRACEPTIVE	LEVONORGESTREL TABLET 30 MICROGRA
	LEVONORGESTREL INTRAUTERINE 52MG
	ETONOGESTREL SUBCUTANEOUS IMPLANT
	MEDROXYPROGESTERONE INJECTION
ANALGESIC / ANTI-INFLAMMATORY	CODEINE PHOSPHATE TABLETS
	OXYCODONE HYDROCHLOR TABLET 5MG
	TRAMADOL HYDROCHLORIDE TABLET
	IBUPROFEN TABLETS
	MELOXICAM CAPSULES
	MEFENAMIC ACID CAPSULES
INHALERS	SALBUTAMOL SULFATE ORAL PRESS INHALER
	BUDESONIDE ¢ EFORMOT PDR ORAL INHALE
	FLUTICASONE PROPION- ORAL PRES INHALER
	SODIUM CROMOGLYCATE ORAL INHALER
ANTI-DEPRESSANTS	SERTRALINE TABLETS
	DESVENLAFAXINE SUCCI TABLETS
	CITALOPRAM HYDROBROM TABLETS
	ESCITALOPRAM ORAL SOLN
	FLUOXETINE CAPSULES
	PAROXETINE TABLETS
LACTATION	DOMPERIDONE TABLETS
IRON SUPPLEMENT	IRON POLYMALTOSE COM INJECTION
	FERROUS FUMARATE TABLETS
OTHER	HYDROXYCHLOROQUINE TABLETS

DRUG GROUP	PBS ITEM DESCRIPTION
(anti-hypertensive, anti-coagulants, anti – convulsing, anti-malarial, oral hypoglycaemic, milk suppression, thyroid, anti-reflux, antacids, eye drops, steroid cream)	HYDROCHLOROTHIAZIDE TABLETS
	ISOTRETINOIN CAPSULES
	PANTOPRAZOLE SODIUM TABLETS
	METFORMIN HYDROCHLORIDE TABLETS
	SODIUM VALPROATE TABLET
	BROMOCRIPTINE MESYLATE TABLET
	FLUDROCORTISONE ACETATE TABLET
	ALUM HYDROXIDE ¢ MAG ORAL SUSPENSION
	ESOMEPRAZOLE MAG TRI TABLET
	CARMELLOSE SODIUM EYE DROPS
	LANSOPRAZOLE TABLETS
	THYROXINE SODIUM TABLETS
	ENALAPRIL TABLETS
	ENOXAPARIN SODIUM INJECTION
	BETAMETHASONE DIPROP OINTMENT BETAMETHASONE VALERA CREAM HYDROCORTISONE ACETATE CREAM MOMETASONE FUROATE LOTION

Appendix 3.22 Statistical Tests and Models used in the Analyses (Referenced)

Method / Statistical Test	Description (reference)
Methods (research)	The steps, procedures and strategies for gathering and analysing data in a study to answer an explicit question (Shields & Watson 2013, p. 162)
Evaluation research	Research that enables assessment about the performance of a program, policy or practice (Rees 2011)
Quantitative analysis	The manipulation of numeric data through statistical procedures for the purpose of describing phenomena or assessing the magnitude and reliability of relationships among them (Polit & Beck 2012, p. 739)
statistical analysis	Organisation and analysis of quantitative data using statistical procedures (e.g. descriptive and inferential statistics), tests and software (Fisher & Schneider 2013)
statistical test	An analytic tool that estimates the probability that results obtained from a sample reflect true population values (Polit & Beck 2012, p. 743)
statistical significance	A term indicating that the results from an analyses of sample data are unlikely to have been caused by chance, at a specified level of probability (Polit & Beck 2012, p743)
Nonparametric tests	A class of statistical tests that do not involve assumptions about the distribution of critical variables; for example, when the population cannot be assumed to be normally distributed according to a bell curve, or what is known as Gaussian distribution (Polit & Beck 2012, p. 735)
Parametric tests	A class of statistical tests that involve assumptions about the distribution of the variables and the estimation of a parameter (Polit & Beck 2012, p. 737)
Null hypothesis	A hypothesis predicting no relationship between the variables under study. The null hypothesis is used in statistical testing as the hypothesis to be rejected (Polit and Beck, 2012, p. 735)
Variable	An attribute that varies, that is, takes on different values (Polit & Beck 2012 p. 745)
dependent variable	The variable hypothesized to depend on or be caused by another variable (the independent variable); the outcome variable of interest (Polit & Beck 2012, p. 725)
independent variable	The variable that is believed to cause or influence the dependent variable; in experimental research, the manipulated (treatment) variable (Polit and Beck 2012, p. 730)
confounding variables	Variables that may be unevenly distributed between comparison groups (Maltby, Day & Williams 2007)
power	The statistical power of a study is the probability of detecting a predefined clinical significance. Ideal power is considered to be 80% (Suresh & Chandrashekara 2012)
standard deviation	The most frequently used statistic for measuring the degree

	of variability in a set of scores" (Polit & Beck 2012, p. 743) i.e. how much variation or dispersion from the average exists; the average distance of each point from the mean (Plichta & Garzon 2009, p.414)
p value (alpha level)	In statistical testing, the probability of detecting a significant difference; the probability of a Type 1 error (Suresh & Chandrashekara 2012) [Type 1 error: rejecting the null hypothesis when it is true] The smaller the p value the more statistically significant
Confidence Interval	The range of values within which a population parameter is estimated to lie, at a specified probability, e.g. 95% CI (Maltby, Day & Williams 2007, p.257)
outliers	Values that lie outside the normal range of values for other cases in a data set (Polit & Beck 2012, p.736)
univariate statistics	Statistical analysis of a single variable for purposes of description (e.g. computing a mean) (Polit & Beck 2012, p. 745)
multivariate statistics	Statistical procedures that analyse relationships among three or more variables (e.g. multiple regression, logistic regression, multivariate analysis of variance and covariance) (Fisher and Schneider 2013, p. 258)
logistic regression	A regression procedure that analyses relationships between one or more independent variables and a categorical dependent variable; also called logit analyses (Hilbe 2009)
multiple regression analysis	"A statistical procedure for understanding the effects of two or more independent (predictor) variables on a dependent variable" (Polit & Beck 2012, p.734)
Mann – Whitney U Test	The Mann – Whitney U test is a nonparametric statistical hypothesis test used to evaluate whether the medians on a test variable differ significantly between two groups. It is used on ranked scores when the distribution of data is skewed / cannot be assumed to be normally distributed (Green & Salkind 2008)
Pearson chi square test	Is used to assess two types of comparison test: tests of goodness of fit and tests of independence Goodness of fit establishes whether or not an observed frequency distribution varies from a theoretical distribution. A test of independence assesses whether paired observations on two variables expressed in a contingency table are independent of each other. (Plichta & Garzon 2009, p. 408) The Pearson chi-square test is a non-parametric statistical test applied to sets of categorical data to evaluate how likely any observed difference between the groups arose by chance (Corder & Foreman 2014)
Odds Ratio (OR)	The ratio of one odds to another odds, for example, the ratio of the odds of an event in one group to the odds of an event in another group. (Webb & Bain 2011)
generalisability	The degree to which the research methods justify the inference that the findings are true for a broader group than study participants; usually, the inference that the findings can be generalized from the sample to the population (Polit & Beck 2012, p. 729)
external validity	The degree to which study results can be generalized to

	settings or samples other than the one studied (Polit & Beck 2012, p. 727)
Z score	A standard score, expressed in terms of standard deviations from the mean; raw scores are transformed such that the mean equals zero and the standard deviation equals 1 (Polit & Beck 2012 p. 746)
alpha level (α- level)	The specific level of the p-value that is defined as ‘statistically significant’ is called the alpha level. Common alpha levels used are .10, .05, and .01 An α-level of .05 means that the result cannot occur more than 5% of the time by chance, and an α-level of .01 means that it cannot occur more than 1% of the time by chance. (Plichta & Garzon 2009, p.85)
degrees of freedom	In statistics the number of degrees of freedom is the number of values in the final calculation of a statistic that are free to vary. Degree of freedom is calculated differently depending on the type of test you are performing, which is determined by the number of samples you have collected. (Plichta & Garzon 2009)
Type II Error	Accepting the null hypothesis when it is false (Munro 2005)
Negative binomial regression	Where count data is over dispersed the negative binomial regression model is considered a better fit (Hilbe 2011)
Poisson Regression	A regression model that is considered to be the benchmark for the analyses of count data (Lord 2006). This model is not appropriate where there is over dispersion as it may conflate levels of significance (Katz 2006)
Independent sample t test	Statistical test used when the population mean and standard deviation are unknown, and two separate groups, i.e. MGP and SHC, are being compared (Maltby, Day & Williams 2007)
Incidence Rate Ratio (IRR)	IRR is an epidemiologic measure used to compare the rates of events based on an association between a certain risk factor and an outcome (Hoffman et al. 2008)
Generalised linear model (GLM)	Use of GLM models enable statistical linear regression modelling of variables that are not normally distributed. They are commonly used to model binary or count data.(Tabachanick & Fidell 2013). This study applied the GLM Model (Gaussian family) with log link function to transform data for multiple variables that were not normally distributed.

Appendix 4.1 Women's country of birth

* SHC and MGP Distributions 2004 – 2010

Country of birth		SHC	% ** n=4015	MGP	%** n=886	Number n=13 462	% of women	%** n=4901
1100	Australia	6 062	na	2 499	na	8 561	63.5	Na
6104	India	518	12.9	81	9.1	599	4.5	12.2
2101 – 2107	UK & Ireland	253	6.3	157	18.0	410	3.1	8.4
5101	China	244	6.1	52	5.9	296	2.2	6.0
4110	Vietnam	407	10.1	47	5.3	454	3.3	9.3
4107	Philippines	180	4.5	30	3.4	210	1.6	4.3
1301	New Zealand	124	3.1	61	6.9	185	1.4	3.8
3207	Sudan	334	8.3	26	3.0	360	2.7	7.4
6101	Afghanistan	176	4.4	18	2.0	194	1.4	4.0
4102	Cambodia	83	2.1	11	1.2	94	0.7	2.0
4105	Malaysia	72	1.8	15	1.7	87	0.7	1.8
9220	South Africa	37	1.0	24	2.7	61	0.5	1.2
4109	Thailand	52	1.2	10	1.1	62	0.5	1.2
5105	South Korea	52	1.2	13	1.5	65	0.5	1.3
6108	Sri Lanka	16	0.4	7	0.8	23	0.1	0.4
7104	USA	22	0.6	20	2.3	42	0.3	0.9
4103	Indonesia	44	1.1	11	1.2	55	0.4	1.1
6107	Pakistan	39	0.9	12	1.4	51	0.4	1.0
3103	Iran	48	1.2	3	0.3	51	0.4	1.0
5103	Japan	24	0.6	24	2.7	48	0.3	0.9
7102	Canada	20	0.5	6	0.6	26	0.2	0.6
3104	Iraq	72	1.8	6	0.6	78	0.6	1.6
2504	Poland	37	1.0	9	1.0	46	0.3	0.9
2305	Germany	16	0.4	11	1.2	27	0.2	0.6
	All Other	1 145	28.5	232	26.1	1 377	10.2	28.1
Total		**10 077**	**100.0**	**3 385**	**100.0**	**13 462**	**100.0**	**100.0**

*Australian Bureau of Statistics Australian Standard Classification of Countries for Social Statistics (ASCCSS) Canberra ABS 1990 (Catalogue No.1269.0) ** Denotes % of migrant women

SHC, Standard Hospital Care; MGP, Midwifery Group Practice

Appendix 4.2 Maternal Occupations SHC and MGP 2004 – 2010

Maternal Occupation* SHC and MGP Distributions 2004 – 2010

ASCO Classification	Code	SHC	%	MGP	%	Total
Armed Forces		5	0.1	1	-	6
Managers / Administrators	1	385	3.8	239	7.1	624
Professionals	2	630	6.3	529	15.6	1159
Para Professionals	3	542	5.4	365	10.8	907
Tradespersons	4	354	3.5	127	3.8	481
Clerical	5	567	5.6	247	7.3	814
Sales Persons and personal service workers	6	1437	14.3	542	16.0	1979
Plant / machine operators / drivers	7	78	0.7	11	0.3	89
Laborers and related workers	8	250	2.5	52	1.5	302
Students, pensioners, home duties, unemployed	9	5829	57.8	1272	37.6	7101
TOTAL		**10 077**	**100.0**	**3 385**	**100.0**	**13 462**

*Australian Bureau of Statistics ASCO Second Edition. Occupation Definitions Canberra ABS 1997

Appendix 4.3 Paternal Occupations SHC and MGP 2004 – 2010

Paternal Occupation* SHC and MGP Distributions 2004–2010

ASCO Classification	Code	SHC	%	MGP	%	Total
Armed Forces		4	-	3	0.1	7
Managers / Administrators	1	806	8.0	450	13.3	1256
Professionals	2	987	9.8	730	21.6	1717
Para Professionals	3	388	3.9	201	5.9	589
Tradespersons	4	1613	16.0	548	16.2	2161
Clerical	5	164	1.6	73	2.1	237
Sales Persons and personal service workers	6	572	5.7	233	6.9	805
Plant / machine operators / drivers	7	701	7.0	176	5.2	877
Laborers and related workers	8	1273	12.6	319	9.4	1592
Students, pensioners, home duties, unemployed	9	3569	35.4	652	19.3	4221
TOTAL		**10 077**	**100.0**	**3 385**	**100.0**	**13 462**

*Australian Bureau of Statistics ASCO Second Edition. Occupation Definitions Canberra ABS 1997

Appendix 4.4 Average Australian Refined Diagnostic Related Group Cost and Revenue Stream Calculations (Integrated South Australian Activity Collection): Subanalyses – Combined Hospital Services 2004 – 2010 (Retrospective Study Arm)

To provide a context for comparison of hospital cost and revenue stream analysis in Midwifery Group Practice vs Standard Hospital Care in this study, a summary sub – analysis of cost and revenue stream for combined hospital services was undertaken. Results have been reported in Tables 4.1 (4.1.1 – 4.1.13), Tables 4.2 (4.2.1 – 4.2.6), Tables 4.3 and 4.4.

All four Tables and sub-Tables reported obstetric and neonatal Australian Refined Diagnostic Related Group cost data from the Integrated South Australian Activity Collection dataset. The results included the total number of separation episodes recorded for each Diagnostic Related Group code during the period 2004 – 2010 and the average aggregate public revenues and public costs generated for each code for whole of hospital across all service models. Tables reflect cumulative fiscal year averages. Figures for average difference were based on cost minus revenue calculations, with standard deviation noted in the Tables.

Tables 4.1.1 – 4.1.13 show the Obstetric Code revenue and cost trends. Tables 4.2.1 – 4.2.6 show the Neonatal Code revenue and cost trends. Table 5.3 highlights the Codes in which public costs exceeded public revenues. Table 4.4 highlights the Codes in which public revenues exceeded public costs.

Obstetric Australian Refined Diagnostic Related Group Average Cost and Revenue Trends 2004 – 2010 (Tables 4.1.1 – 4.1.13)

14 obstetric Australian Refined Diagnostic Related Group codes and descriptions were analysed. The Code with the highest volume of separations was O60B, Vaginal delivery without catastrophic or severe complication. Public revenue exceeded public costs (Table 4.1.4). Other high volume DRG codes reported included Antenatal and other obstetric admissions (Codes O66A and O66Z, Table 4.2.1) and Same Day Antenatal and other obstetric admissions (O66B, Table 4.1.2). These admission codes showed high resource consumption in which public costs exceeded public revenue. Each of the caesarean section DRG codes O01A, O01B, O01C (Tables 4.1.7, 4.1.8, 4.1.9) showed substantive public cost deficits individually and collectively. This was

greatest for code O01A (Caesarean section with catastrophic complications) with 1283 episodes and an average short fall of $1513.09 per episode, Table 4.1.7. Code O61Z (Postpartum admission without operating room procedure) was another high volume area with a large cost deficit for the public purse, Table 4.1.10.

Tables 4.1 Obstetric Australian Refined Diagnostic Related Group Average Revenue and Cost Trends [Combined Hospital Separation Data 2004 – 2010]*

*** Coding Changes from July 2009 with DRG Version 6 replacing AR DRG Versions 5 (1 &2)**

Cumulative Totals for 2004 – 2010 fiscal years are calculated. As noted some cover 2004 – 2009 only due to code changes introduced with DRG Version 6. See Appendix Table 3.8 for reference to Codes, Year, and Descriptor Changes.

Table 4.1.1 O66A– Antenatal and Other Obstetric Admission 2004 – 2010

Fiscal Year	DRG	DRG Description	Total Episodes	Avg Revenue*	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Avg Difference* Cost – Revenue	SD Avg Difference
2004/2005	O66A	Antenatal & Other Obstetric Admission	787	$1,312.56	$504.09	$1,683.42	$1,796.71	$370.86	$1,482.61
2005/2006	O66A	Antenatal & Other Obstetric Admission	716	$1,900.80	$1,153.28	$1,940.63	$2,913.01	$39.83	$2,051.76
2006/2007	O66A	Antenatal & Other Obstetric Admission	700	$2,101.55	$1,383.67	$2,407.08	$3,708.25	$305.53	$2,570.14
2007/2008	O66A	Antenatal & Other Obstetric Admission	665	$2,078.71	$1,182.25	$2,178.23	$2,649.06	$99.52	$1,994.37
2008/2009	O66A	Antenatal & Other Obstetric Admission	623	$2,279.38	$993.72	$2,535.08	$2,807.85	$255.70	$2,131.93
2009/2010	O66Z	Antenatal & Other Obstetric Admission	1115	$1,732.22	$1,230.70	$2,401.00	$3,408.82	$668.78	$2,530.97
Total 2004/2010	O66A	Antenatal & Other Obstetric Admission	4606	$1,866.88	$1,156.76	$2,193.73	$2,990.08	$326.84	$2,196.19

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Table 4.1.2 O66B– Antenatal and Other Obstetric Admission – Sameday 2004 – 2009

Fiscal Year	DRG	DRG Description	Total Episodes	Avg Revenue*	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Avg Difference* Cost – Revenue	SD Avg Difference
2004/2005	O66B	Antenatal & Other Admission-Sameday	1747	$453.86	$49.81	$378.91	$277.38	-$74.95	$275.61
2005/2006	O66B	Antenatal & Other Admission-Sameday	1488	$572.56	$81.18	$411.09	$291.80	-$161.47	$297.67
2006/2007	O66B	Antenatal & Other Admission-Sameday	551	$565.08	$62.14	$680.55	$714.84	$115.47	$718.41
2007/2008	O66B	Antenatal & Other Admission-Sameday	464	$501.21	$44.82	$714.66	$427.57	$213.45	$426.57
2008/2009	O66B	Antenatal & Other Admission-Sameday	337	$601.10	$51.74	$872.02	$569.01	$270.92	$567.89
Total 2004 /2009	O66B	Antenatal & Other Admission-Sameday	4587	$593.34	$85.26	$845.88	$252.54		

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Table 4.1.3 O60A– Vaginal Delivery with Catastrophic / Severe Complications 2004 – 2009

Fiscal Year	DRG	DRG Description	Total Episodes	Avg Revenue*	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Avg Difference* Cost – Revenue	SD Avg Difference
2004/2005	O60A	Vaginal Delivery W Cat / Severe CC	516	$4,224.00	$1,315.84	$4,926.62	$4,324.49	$702.62	$3,546.72
2005/2006	O60A	Vaginal Delivery W Cat / Severe CC	467	$5,037.11	$972.64	$4,707.88	$3,254.99	-$329.23	$2,926.22
2006/2007	O60A	Vaginal Delivery W Cat / Severe CC	460	$5,526.21	$1,874.26	$5,470.76	$5,444.78	-$55.45	$4,149.20
2007/2008	O60A	Vaginal Delivery W Cat / Severe CC	606	$5,296.61	$1,604.60	$5,100.34	$4,114.08	-$196.27	$3,174.22
2008/2009	O60A	Vaginal Delivery W Cat / Severe CC	509	$5,589.65	$1,159.37	$6,368.36	$3,937.50	$778.71	$3,573.62
Total 2004/2009	O60 A	Vaginal Delivery W Cat / Severe CC	2558	$5,501.87	$1,508.34	$5,745.49	$4,297.25	$243.62	$3,513.12

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Table 4.1.4 O60B– Vaginal Delivery without Catastrophic / Severe Complications 2004 – 2009

Fiscal Year	DRG	DRG Description	Total Episodes	Avg Revenue*	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Avg Difference* Cost – Revenue	SD Avg Difference
2004/2005	O60B	Vaginal Delivery W/O Cat /Severe CC	2018	$2,474.11	$131.99	$2,651.77	$1,336.64	$177.66	$1,341.54
2005/2006	O60B	Vaginal Delivery W/O Cat / Severe CC	1890	$2,928.46	$212.98	$2,799.39	$1,571.49	-$129.07	$1,535.81
2006/2007	O60B	Vaginal Delivery W/O Cat / Severe CC	2353	$3,130.48	$427.44	$2,759.87	$1,593.52	-$370.61	$1,467.93
2007/2008	O60B	Vaginal Delivery W/O Cat / Severe CC	2552	$3,016.12	$162.59	$2,829.86	$1,648.70	-$186.26	$1,640.33
2008/2009	O60B	Vaginal Delivery W/O Cat / Severe CC	2365	$3,129.35	$208.36	$3,383.33	$1,926.14	$253.98	$1,910.18
Total 2004/2009	O60B	Vaginal Delivery W/O Cat / Severe CC	11178	$2,951.48	$346.58	$2,894.93	$1,657.61	-$56.55	$1,618.46

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Table 4.1.5 O60C– Vaginal Delivery Single / Uncomplicated 2004 – 2009

Fiscal Year	DRG	DRG Description	Total Episodes	Avg Revenue*	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Avg Difference* Cost – Revenue	SD Avg Difference
2004/2005	O60C	Vaginal Delivery Single Uncomplicated	421	$1,776.30	$109.14	$1,635.08	$918.82	-$141.22	$921.15
2005/2006	O60C	Vaginal Delivery Single Uncomplicated	383	$2,065.42	$120.71	$1,756.67	$877.59	-$308.75	$888.87
2006/2007	O60C	Vaginal Delivery Single Uncomplicated	332	$2,274.87	$131.34	$1,539.88	$954.64	-$734.99	$957.87
2007/2008	O60C	Vaginal Delivery Single Uncomplicated	343	$2,066.27	$112.28	$1,515.89	$1,016.61	-$550.38	$1,019.41
2008/2009	O60C	Vaginal Delivery Single Uncomplicated	337	$2,115.52	$135.13	$1,771.75	$1,100.67	-$343.77	$1,101.34
Total 2004/2009	O60C	Vaginal Delivery Single Uncomplicated	1816	$2,046.14	$205.55	$1,646.17	$977.54	-$399.97	$997.55

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

*Table 4.1.6 O60Z– Vaginal Delivery 2009 – 2010***

Fiscal Year	DRG	DRG Description	Total Episodes	Avg Revenue*	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Avg Difference* Cost – Revenue	SD Avg Difference
2009/2010	O60Z	Vaginal Delivery	3191	$3,585.00	$908.70	$4,374.97	$3,305.27	$789.97	$2,861.28
Total 2009/2010	O60Z	Vaginal Delivery	3191	$3,585.00	$908.70	$4,374.97	$3,305.27	$789.97	$2,861.28

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

** A Single AR DRG Category O60Z for Vaginal Delivery was introduced in July 2009 with Version 6, resulting in national costing aberrations for the 2009 – 2010 fiscal year. This was caused by a coding change that no longer allowed for Operating Room Procedures or Complications with Vaginal Delivery. In 2010 National Coding reverted back to former coding conventions that discriminated between complicated and uncomplicated vaginal birth to account for the significant resource and cost imposts of these procedures and complications.

Table 4.1.7 O01A– Caesarean Delivery with Catastrophic Complications 2004 – 2010

Fiscal Year	DRG	DRG Description	Total	Avg	SD	Avg	SD	Avg	SD

			Episodes	Revenue*	Avg Revenue	Episode Cost^	Avg Cost	Difference* Cost – Revenue	Avg Difference
2004/2005	O01A	Caesarean Delivery W Catastrophic CC	176	$9,156.25	$2,874.47	$12,635.20	$10,474.49	$3,478.95	$8,345.41
2005/2006	O01A	Caesarean Delivery W Catastrophic CC	161	$12,076.00	$2,473.96	$11,235.43	$7,933.43	-$840.57	$7,025.32
2006/2007	O01A	Caesarean Delivery W Catastrophic CC	160	$12,797.40	$1,524.32	$13,459.77	$9,710.53	$662.37	$9,141.95
2007/2008	O01A	Caesarean Delivery W Catastrophic CC	164	$12,123.56	$2,706.63	$12,346.64	$9,253.42	$223.08	$7,811.28
2008/2009	O01A	Caesarean Delivery W Catastrophic CC	151	$13,522.93	$3,368.02	$14,599.89	$10,387.51	$1,076.96	$8,543.38
2009/2010	O01A	Caesarean Delivery W Catastrophic CC	471	$11,278.88	$2,286.29	$13,739.90	$8,462.84	$2,461.02	$7,260.49
Total 2004/2010	O01A	Caesarean Delivery W Catastrophic CC	1283	$11,278.88	$2,807.51	$13,162.27	$9,230.13	$1,513.09	$7,967.98

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Table 4.1.8 O01B– Caesarean Delivery with Severe Complications 2004 – 2010

Fiscal Year	DRG	DRG Description	Total Episodes	Avg Revenue*	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Avg Difference* Cost – Revenue	SD Avg Difference
2004/2005	O01B	Caesarean Delivery W Severe CC	358	$6,337.28	$6,337.28	$6,593.82	$6,593.82	$256.64	$256.54
2005/2006	O01B	Caesarean Delivery W Severe CC	323	$7,586.53	$852.11	$6,570.35	$3,390.04	-$1,016.18	$3,080.76
2006/2007	O01B	Caesarean Delivery W Severe CC	325	$7,789.58	$1,062.33	$7,933.83	$4,261.99	$144.25	$3,795.28
2007/2008	O01B	Caesarean Delivery W Severe CC	330	$7,620.69	$1,729.00	$8,385.98	$5,025.94	$765.29	$3,964.58
2008/2009	O01B	Caesarean Delivery W Severe CC	312	$8,256.20	$1,661.66	$9,664.46	$5,265.04	$1,408.26	$4,337.65
2009/2010	O01B	Caesarean Delivery W Severe CC	866	$7,635.28	$750.41	$8,447.19	$3,008.09	$811.91	$2,742.60
Total 2004/2010	O01B	Caesarean Delivery W Severe CC	2514	$7,539.27	$1,263.10	$8,018.80	$4,034.20	$479.53	$3,431.05

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Table 4.1.9 O01C– Caesarean Delivery without Severe Complications 2004 – 2009

Fiscal Year	DRG	DRG Description	Total Episodes	Avg Revenue*	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Avg Difference* Cost – Revenue	SD Avg Difference
2004/2005	O01C	Caesarean Delivery W/O Severe CC	744	$4,668.79	$414.26	$4,645.91	$1,464.82	-$22.89	$1,435.20
2005/2006	O01C	Caesarean Delivery W/O Severe CC	771	$5,469.93	$703.92	$4,801.14	$2,259.76	-$668.79	$1,910.97
2006/2007	O01C	Caesarean Delivery W/O Severe CC	848	$5,842.63	$616.44	$5,616.05	$1,740.53	-$226.58	$1,685.32
2007/2008	O01C	Caesarean Delivery W/O Severe CC	824	$5,754.51	$386.04	$5,991.96	$1,715.47	$237.46	$1,705.43
2008/2009	O01C	Caesarean Delivery W/O Severe CC	892	$6,202.13	$1,084.86	$7,053.43	$3,541.20	$851.30	$2,942.86
2004/2009	O01C	Caesarean Delivery W/O Severe CC	4079	$5,618.89	$865.09	$5,675.33	$2,468.27	$56.44	$2,096.66

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Table 4.1.10 O61Z– Postpartum Admission without Operating Room Procedure 2004 – 2010

Fiscal Year	DRG	DRG Description	Total Episodes	Avg Revenue*	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Avg Difference* Cost – Revenue	SD Avg Difference
2004/2005	O61Z	Postpartum W/O O.R. Procedure	684	$792.31	$140.87	$881.73	$1,147.47	$89.43	$1,148.53
2005/2006	O61Z	Postpartum W/O O.R. Procedure	643	$1,036.16	$148.41	$870.94	$1,017.60	-$165.22	$1,021.57
2006/2007	O61Z	Postpartum W/O O.R. Procedure	599	$1,159.54	$990.21	$1,153.02	$1,919.76	-$6.52	$1,560.81
2007/2008	O61Z	Postpartum W/O O.R. Procedure	509	$1,348.50	$991.26	$1,243.67	$1,283.03	-$104.83	$1,063.54
2008/2009	O61Z	Postpartum W/O O.R. Procedure	514	$1,032.98	$61.07	$1,529.36	$2,123.93	$496.38	$2,099.43
2009/2010	O61Z	Postpartum W/O O.R. Procedure	495	$1,394.52	$120.03	$1,758.82	$2,149.06	$364.30	$2,119.25
Total 2004/2010	O61Z	Postpartum W/O O.R. Procedure	3444	$1,106.38	$607.32	$1,203.11	$1,666.81	$96.73	$1,551.08

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Table 4.1.11 O04Z– Postpartum Admission with Operating Room Procedure 2004 – 2009

Fiscal Year	DRG	DRG Description	Total Episodes	Avg Revenue*	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Avg Difference* Cost – Revenue	SD Avg Difference
2004/2005	O04Z	Postpartum W O.R. Procedure	36	$1,864.00	$87.40	$2,415.99	$1,753.31	$552.00	$1,719.22
2005/2006	O04Z	Postpartum W O.R. Procedure	22	$2,514.36	$197.42	$3,310.95	$3,873.32	$796.59	$3,762.35
2006/2007	O04Z	Postpartum W O.R. Procedure	30	$3,129.48	$889.17	$3,934.04	$6,745.96	$804.56	$6,093.77
2007/2008	O04Z	Postpartum W O.R. Procedure	27	$2,802.12	$157.01	$2,297.67	$1,301.79	-$504.45	$1,268.15
2008/2009	O04Z	Postpartum W O.R. Procedure	22	$3,194.35	$4.55	$3,127.21	$2,746.38	-$67.14	$2,746.38
Total 2004/2009	O04Z	Postpartum W O.R. Procedure	137	$2,644.07	$673.80	$2,983.02	$3,888.85	$338.95	$3,601.28

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Table 4.1.12 O04A– Postpartum Admission with Procedure with Complications 2009 – 2010

Fiscal Year	DRG	DRG Description	Total Episodes	Avg Revenue*	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Avg Difference* Cost – Revenue	SD Avg Difference
2009/2010	O04A	Postpartum with Procedure With Comp	2	$14,008.31	0	$25,728.98	$16,446.46	$11,720.68	$16,446.46
Total 2009/2010	O04A	Postpartum with Procedure With Comp	2	$14,008.31	0	$25,728.98	$16,446.46	$11,720.68	$16,446.46

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Table 4.1.13 O04B– Postpartum Admission with Procedure without Complications 2009 – 2010

Fiscal Year	DR G	DRG Description	Total Episodes	Avg Revenue*	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Avg Difference* Cost – Revenue	SD Avg Difference
2009/2010	O04B	Postpartum with Procedure W/O Comp	18	$3,320.28	$1,071.78	$4,976.16	$3,845.23	$1,655.88	$3,139.42
Total 2009/2010	O04B	Postpartum with Procedure W/O Comp	18	$3,320.28	$1,071.78	$4,976.16	$3,845.23	$1,655.88	$3,139.42

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Neonatal Australian Refined Diagnostic Related Group Average Revenue and Cost Trends 2004 – 2010

Tables 4.2.1 – 4.2.6 highlight six Neonatal Australian Refined Diagnostic Related Group codes and descriptions, including total separation coding episodes of each DRG for the period 2004 – 2010. The DRG code with the highest volume of separations was P67D, a Neonate admitted with a weight > 2499 grams discharged from any ward. For this code average public cost exceeded average revenue by $193.08 per episode. However, there was an increased margin for cost deficit of $1, 468.68 per episode in relation to the same code (P67D) when a neonate of the same classification category was discharged from the Special Care Baby Unit. While these separations were of lower volume their resource use and cost is high. The same cost / revenue trends were not evident for Neonatal DRG codes P65D and P66D where substantive revenue was generated for the hospital from separations for babies of smaller birth weights (1550 – 1999 grams; 2000 – 2499 grams respectively) whether they were discharged from Special Care Baby Unit or any other ward. Neonatal DRG code P66D generated additional revenue of $ 443.24 for the hospital when the baby was admitted to Special Care Baby Unit, rather than roomed in with the mother at time of birth.

Tables 4.2 Neonatal Australian Refined Diagnostic Related Group Average Revenue and Cost Trends [Combined Hospital Separation Data 2004 – 2010]

Table 4.2.1 P65D – Neonate – Admit Weight 1500 – 1999 grams Without Significant Operating Room Procedure, Without Problems: Discharge from Any Ward 2004 – 2010

Fiscal Year	**DRG**	**DRG Description**	**Total Episodes**	**Avg Revenue**	**SD Avg Revenue**	Avg Episode Cost^	**SD Avg Cost**	**Avg Difference* Cost – Revenue**	**SD Avg Difference**
2004/2005	P65D	Neonate- AdmWt 1500–1999 g W/O Significant O.R. Procedure W/O Problem	10	$11,756.14	$3,401.12	$6,399.87	$2,776.55	-$5,356.27	$3,039.64
2005/2006	P65D		15	$8,838.85	$5,735.33	$8,005.55	$9,327.31	-$833.31	$7,595.07
2006/2007	P65D		14	$9,972.58	$2,880.90	$8,424.74	$5,247.46	-$1547.84	$4,587.88
2007/2008	P65D		12	$8,616.81	$4,655.00	$5,772.18	$3,822.23	-$2,844.63	$3,787.07
2008/2009	P65D		13	$14,131.87	$3,270.27	$8,024.10	$4,325.44	-$6,107.77	$4,633.22
2009/2010	P65D		14	$14,118.01	$1,108.21	$13,991.04	$5,806.71	-$126.97	$5,911.46
Total 2004/2010	P65D	Neonate- AdmWt 1500–1999 g W/O Significant O.R. Procedure W/O Problem	78	$11,211.90	$4,364.15	$8,608.75	$6,240.77	-$2,603.16	$5,593.30

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Table 4.2.2 P65D – Neonate – Admit Weight 1500 – 1999 grams Without Significant Operating Room Procedure, Without Problems: Discharge from Special Care Baby Unit 2004 – 2010

Fiscal Year	DRG	DRG Description	Total Episodes	Avg Revenue	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Avg Difference* Cost – Revenue	SD Avg Difference
2004/2005	P65D	Neonate- AdmWt 1500–1999 g W/O Significant O.R. Procedure W/O Problem	9	$11,630.17	$3,799.82	$6,840.33	$2,730.20	-$4,789.84	$2,817.77
2005/2006	P65D		13	$10,102.57	$5,039.93	$9,127.69	$9,550.70	-$974.87	$8,190.54
2006/2007	P65D		13	$9,885.40	$2,979.25	$8,506.59	$5,452.42	-$1,378.81	$4,729.63
2007/2008	P65D		10	$9,760.35	$4,215.02	$6,425.84	$3,869.76	-$3,334.51	$3,987.06
2008/2009	P65D		9	$15,235.53	$2,077.57	$9,200.78	$4,688.71	-$6,034.75	$5,309.01
2009/2010	P65D		12	$14,167.37	$1,197.01	$15,105.07	$5,510.98	$937.70	$5,811.03
Total 2004/2010	P65D	Neonate- AdmWt 1500–1999 g W/O Significant O.R. Procedure W/O Problem	66	$11,655.26	$3,959.70	$9,380.83	$6,402.38	-$2,274.42	$5,810.93

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Table 4.2.3 P66D – Neonate – Admit Weight 2000 – 2499 grams Without Significant Operating Room Procedure, Without Problems: Discharge from Any Ward 2004 – 2010

Fiscal Year	DRG	DRG Description	Total Episodes	Avg Revenue	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Avg Difference* Cost – Revenue	SD Avg Difference
2004/2005	P66D	Neonate- AdmWt 2000–2499 g W/O Significant O.R. Procedure W/O Problem	31	$2,065.66	$551.44	$1,742.46	$1,271.45	-$323.20	$1,200.06
2005/2006	P66D		44	$3,035.26	$724.86	$2,599.15	$1,477.26	-$436.11	$1,147.46
2006/2007	P66D		38	$2,496.85	$527.85	$2,513.38	$1,400.19	$16.53	$1,233.76
2007/2008	P66D		34	$2,487.45	$790.33	$2,827.83	$1,489.35	$340.38	$1,114.59
2008/2009	P66D		46	$3,469.83	$859.98	$3,501.30	$1,666.90	$31.47	$1,421.13
2009/2010	P66D		56	$3,634.58	$1,150.83	$3,630.18	$2,287.96	-$4.40	$1,906.92
Total 2004/2010	P66D	Neonate- AdmWt 2000–2499 g W/O Significant O.R. Procedure W/O Problem	249	$2,972.65	$997.88	$2,909.17	$1,794.78	-$63.48	$1,432.62

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Table 4.2.4 P66D – Neonate – Admit Weight 2000 – 2499 grams Without Significant Operating Room Procedure, Without Problems: Discharge from Special Care Baby Unit 2004 – 2010

Fiscal Year	DRG	DRG Description	Total Episodes	Avg Revenue	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Difference* Cost – Revenue	SD Avg Difference
2004/2005	P66D	Neonate- AdmWt 2000–2499 g W/O Significant O.R. Procedure W/O Problem	4	$2,208.12	0	$620.14	$307.31	-$1,587.98	$307.31
2005/2006	P66D		8	$3,497.74	$1,441.92	$3,868.46	$2,542.93	$370.72	$1,641.12
2006/2007	P66D		5	$2,607.92	$330.08	$1,990.95	$751.72	-$616.97	$692.73
2007/2008	P66D		5	$2,371.06	$983.19	$2,697.28	$1,937.18	$326.22	$1,505.89
2008/2009	P66D		5	$2,652.58	$1,593.35	$2,037.96	$1,411.33	-$614.62	$759.81
2009/2010	P66D		6	$3,552.06	$1,583.42	$2,083.93	$1,657.03	-$1,468.13	$1,413.57
Total 2004/2010	P66D	Neonate- AdmWt 2000–2499 g W/O Significant O.R. Procedure W/O Problem	33	$2,917.71	$1,262.35	$2,410.99	$1,911.87	-$506.72	$1,396.38

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Table 4.2.5 P67D – Neonate – Admit Weight > 2499 grams Without Significant Operating Room Procedure, Without Problems: Discharge from Any Ward 2004 – 2010

Fiscal Year	DRG	DRG Description	Total Episodes	Avg Revenue	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Difference* Cost – Revenue	SD Avg Difference
2004/2005	P67D	Neonate- AdmWt > 2499 g W/O Significant O.R. Procedure W/O Problem	495	$1,007.25	$214.95	$1,069.20	$1,285.44	$61.94	$1,206.19
2005/2006	P67D		484	$1,216.90	$254.70	$1,098.41	$1,275.21	-$118.50	$1,206.16
2006/2007	P67D		521	$1,377.12	$295.37	$1,396.41	$1,504.68	$19.28	$1,464.74
2007/2008	P67D		452	$1,454.22	$874.21	$1,625.84	$1,434.08	$171.62	$1,563.01
2008/2009	P67D		447	$1,503.95	$226.58	$2,069.74	$2,000.08	$565.80	$1,897.06
2009/2010	P67D		459	$1,910.37	$309.84	$2,428.82	$2,451.31	$518.46	$2,307.45
Total 2004/2010	P67D	Neonate- AdmWt > 2499 g W/O Significant O.R. Procedure W/O Problem	2858	$1,403.60	$505.34	$1,596.67	$1,768.92	$193.08	$1,659.14

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Table 4.2.6 P67D – Neonate – Admit Weight > 2499 grams Without Significant Operating Room Procedure, Without Problems: Discharge from Special Care Baby Unit Only 2004 – 2010

Fiscal Year	DRG	DRG Description	Total Episodes	Avg Revenue	SD Avg Revenue	Avg Episode Cost^	SD Avg Cost	Difference* Cost – Revenue	SD Avg Difference
2004/2005	P67D	Neonate- AdmWt > 2499 g W/O Significant O.R. Procedure W/O Problem	17	$1,310.44	$576.84	$2,286.68	$2,218.97	$976.24	$1,776.18
2005/2006	P67D		18	$1,495.86	$698.51	$2,687.62	$2,839.99	$1,191.77	$2,216.72
2006/2007	P67D		20	$1,474.59	$615.15	$3,218.35	$1,780.75	$1,743.76	$1,563.24
2007/2008	P67D		17	$1,323.70	$398.84	$2,131.08	$1,739.39	$807.38	$1,616.13
2008/2009	P67D		19	$2,023.34	$807.32	$4,726.97	$4,107.48	$2,703.62	$3,421.27
2009/2010	P67D		21	$2,175.40	$989.01	$4,465.86	$5,477.97	$2,290.45	$4,836.86
Total 2004/2010	P67D	Neonate- AdmWt > 2499 g W/O Significant O.R. Procedure W/O Problem	112	$1,654.68	$782.14	$3,316.44	$3,478.60	$1,661.76	$2,932.06

DRG, Diagnostic Related Group; Avg, Average; SD, Standard Deviation

Public Deficit Trends

The twelve Diagnostic Related Group codes summarised in Table 4.3 all generated average public deficit spending within ISAAC for the hospital during the period of this study.

Table 4.3 AR DRG Hospital Costs Exceed AR DRG Hospital Revenues 2004 – 2010 Obstetric & Neonatal Cost & Revenue Trend Averages – Combined Hospital Separations

Australian Refined Diagnostic Related Group Categories*	Average Hospital Costs > Average Hospital Revenue (SD)
Antenatal and Other Obstetric Admission O66A, O66Z	$ 326.84 ($ 2,196.19)
Same Day Antenatal and Other Obstetric Admission O66B	$ 252.54 ($ 428.16)
Vaginal Delivery with Catastrophic or Severe Complications O60A	$ 243.62 ($ 3, 513.12)
Vaginal Delivery O60Z**	$ 789.97 ($2, 861.28)
Caesarean Delivery with Catastrophic / Severe Complications O01A	$ 1, 513.09 ($7, 967.98)
Caesarean Delivery with Severe Complicating Diagnosis O01B	$ 479.53 ($3, 431.05)
Caesarean Delivery without Catastrophic / Severe Complication O01C	$ 56.44 ($2, 096.66)
Postpartum without Operating Room Procedure O61Z	$ 96.73 ($1, 551.08)
Postpartum with Operating Room Procedure O04Z	$ 338.95 ($3, 601.28)
Postpartum with Procedure and Complications O04A	$ 11, 720.68 ($16, 446.46)
Postpartum with Procedure and No Complication O04B	$ 1, 655.88 ($3, 139.42)
Neonate Admitted, Weight > 2499 gm without Significant Operative Procedure; without Problem Discharged from any Ward P67D	$ 193.08 ($1, 659.14)
Neonate Admitted, Weight > 2499 gm without Significant Operative Procedure; without problem Discharged from SCBU P67D	$ 1, 661.76 ($2, 932.06)

* Coding Changes from July 2009 with DRG Version 6 replacing AR DRG V5 (1 &2)

Cumulative Totals for 2004 – 2010 fiscal years are calculated. As noted some cover 2004 – 2009 only due to code changes introduced with DRG Version 6. See Appendix Table 3.8 for reference to Codes, Year, and Descriptor Changes.

** A Single AR DRG Category O60Z for Vaginal Delivery was introduced in July 2009 with Version 6, resulting in a costing aberration for the 2009 – 2010 fiscal year. This was caused by a coding change that no longer allowed for Operating Room Procedures or Complications with Vaginal Delivery. In 2010 National Coding reverted back to former coding conventions that discriminated between complicated and uncomplicated vaginal birth to account for the significant resource and cost imposts of these procedures and complications.

Table 4.3 shows that average public costs exceeded average revenue in all models of care for: antenatal and other obstetric admissions; same day admissions; vaginal delivery with catastrophic complications; vaginal delivery (one year only); caesarean delivery without complications; caesarean delivery with severe complications; caesarean delivery with catastrophic complications; all categories of postpartum admission whether with, or without an operating room procedure, and whether with or without further complication as a result of those procedures. Whereas the lowest average negative obstetric revenue / deficit margin was $ 56.44 for DRG O01C (caesarean delivery without severe or catastrophic complication), the highest was $ 11 720.68 for DRG O04A (postpartum admission with operating room procedure and severe or catastrophic complications).

The four highest frequency Diagnostic Related Groups for negative obstetric revenue / deficit included: antenatal and other obstetric admissions, same day admissions, caesarean delivery without severe or catastrophic complications, and postpartum admissions without an operating room procedure. These were followed by vaginal delivery with catastrophic or severe complications and caesarean delivery with severe complications. In relation to neonatal episodes of care, average episode costs exceeded average revenue for whole of hospital (all service models) across Diagnostic Related Group category P67D: neonate admitted with weight > 2499 grams without a significant operative procedure and without a problem. However, whereas a neonate in this DRG (P67D) discharged from any ward generated an average negative revenue / deficit of up to $ 193.08, a neonate in DRG P67D discharged from Special Care Baby Unit generated an average negative revenue / deficit of $ 1, 661.76, i.e. an average revenue deficit difference totalling $ 1 468.68. This finding was important when considering the numbers of babies who direct roomed in with their mother after birth, as compared to the numbers of babies who were admitted to SCBU. Differential admission rates for different service models translated to different cost and resource consumption.

Public Revenue Trends

The six Diagnostic Related Groups summarised in Table 4.4 generated public revenues for the hospital in this study. The obstetric codes that generated most revenue were high volume uncomplicated vaginal birth and neonates discharged without problems or requirement for additional medical procedures.

Table 4.4 AR DRG Hospital Revenues Exceed AR DRG Hospital Costs 2004 – 2010 Obstetric & Neonatal Cost & Revenue Trend Averages – Combined Hospital Separations

Australian Diagnostic Related Group Categories*	Average Hospital Revenues > Average Hospital Costs (SD)
Vaginal Delivery, No Catastrophic Complications O60B	$ 56.55 ($1, 618.46)
Vaginal Delivery, Single, Uncomplicated O60C	$ 399.97 ($ 997.55)
Neonate Admit Weight 1500 – 1999 g Without Significant Operating Room Procedure Without Problem Discharged from any Ward P65D	$ 2, 603.16 ($5, 593.30)
Neonate Admit Weight 1500 – 1999 g Without Significant Operating Room Procedure Without Problem Discharged from SCBU only P65D	$ 2, 274.42 ($5, 810.93)
Neonate Admit Weight 2000 – 2499 g Without Significant Operating Room Procedure Without Problem Discharge from any Ward P66D	$ 63.48 ($1, 432.62)
Neonate Admit Weight 2000 – 2499 g Without Significant Operating Room Procedure Without Problem Discharge from SCBU only P66D	$ 506.72 ($1, 396.38)

* Coding Changes from July 2009 with DRG Version 6 replacing AR DRG V5 (1 &2)

Cumulative Totals for 2004 – 2010 fiscal years are calculated. As noted some cover 2004 – 2009 only due to code changes introduced with DRG Version 6. See Appendix Table 3.8 for reference to Codes, Year, and Descriptor Changes

Some of the trends for whole of hospital (Tables 4.1 – 4.4) suggested that differences in negative revenue deficits for specific Diagnostic Related Groups may be correlated with patterns of clinical outcomes and resource use reported in this thesis (Chapter 4). To support this claim three additional summary tables follow. These tables were extracted from data provided in the National Cost Data Report (2010) (Tables 4.5a; 4.5b; 4.5c). They illustrate high volume high cost obstetric and neonatal Diagnostic Related Groups for public sector hospitals across Australia and were used to undertake comparative service benchmarking.

Three Summary Tables National Hospital Cost Data Report – 2010

AR – DRGs: Obstetrics and Neonates (Commonwealth Department of Health and Ageing 2010)

Table 4.5a Summary from 20 Highest Volume Public Sector AR – DRGs Version 5.2 (2008–2009)

National Hospital Cost Data Collection Report (DOHA, 2010) Round 13, p 29.

Rank	DRG Descriptor for National Average Cost per Separation	Cost & Average Length of Stay (ALOS) days
2	Vaginal Birth (O60)	$ 4 516 ALOS 2.69
3	Vaginal Delivery – CSCC (O60B)	$ 4 457 ALOS 2.67
6	Antenatal & Other Obstetric Admission (O66)	$ 1 361 ALOS 1.5
8	Caesarean Section (O01C)	$ 8 022 ALOS 4.03
10	Caesarean Section (O01)	$ 8 783 ALOS 4.62
11	Antenatal & Other Obstetric Admission, Same Day (O66B)	$ 525 ALOS 1.00
19	Antenatal & Other Obstetric Admission (O66A)	$ 2 532 ALOS 2.37

DRG, Diagnostic Related Group; ALOS, Average Length of Stay

Rank = indicates DRG volume and cost ranking; lower rank scores indicate higher volume

Table 4.5b Summary from 25 Highest Estimated Volume Public Sector AR – DRGs Version 5.2

Cost by Jurisdiction, National Hospital Cost Data Collection Report (DOHA, 2010)

Round 13, p 30; National AR DRG Ranking / SA State DRG Ranking, p 106).

Rank Nat /SA	DRG Descriptor for SA Average Cost per Separation	Cost & Average Length of Stay (ALOS) days
2/3	Vaginal Birth (O60B)	$3 894 ALOS 2.78
8/9	Caesarean Section (O01C)	$8 088 ALOS 4.34
11/24	Antenatal & Other Obstetric Admission, Same Day (O66B)	$ 812 ALOS 1.00
19/23	Antenatal & Obstetric Admission (O66A)	$ 2 536 ALOS 2.31

DRG, Diagnostic Related Group; ALOS, Average Length of Stay; Nat = National; SA = South Australia

Rank = indicates DRG volume and cost ranking; lower rank scores indicate higher volume

Table 4.5c Summary SA 25 highest cost by volume DRGs, Public Sector, Round 13 AR-DRG Version 5.2

National Hospital Cost Data Collection Report (DOHA, 2010) Round 13, p 108.

Rank	SA Highest Cost per Volume DRGs	Separations & Average Length of Stay (ALOS) days
2	O01 Caesarean Section = $ 38 809 540	4 345 seps; ALOS 5.10
3	O60 Vaginal Birth = $ 37 920 244	9 676 seps; ALOS 2.79
18	P67 Neonate, Admit wt > 2499gms – Sig OR Procedure = $ 14 325 840	3 030 seps; ALOS 4.88

DRG, Diagnostic Related Group; ALOS, Average Length of Stay; Seps = Separations

Rank = indicates DRG volume and cost ranking; lower rank scores indicate higher volume

Tables 4.5a, 4.5b and 4.5c were derived from the National Cost Data Report (2010). They illustrate high volume high cost obstetric and neonatal DRGs for public sector hospitals and are used to facilitate comparative benchmarking between public sector services where resource use is high. Standard deviation was not provided in the report.

Table 4.5a, summarises the seven obstetric codes included in the 20 Highest Volume Public Sector Diagnostic Related Groups nationally. These included: vaginal birth (with and without complications / complicating diagnosis); caesarean section (with and without complications / complicating diagnosis); antenatal and other obstetric admissions (same day stay and longer stay). Cross referencing these findings with Tables 4.1 and 4.3 shows these are all areas in which cost exceeded revenue for the hospital based on ISAAC separations.

Four of the seven Diagnostic Related Groups in Table 4.5a also appeared in the top 25 Highest Volume Diagnostic Related Group codes for South Australian public hospitals. These included: vaginal birth with complicating diagnosis (ranked third); caesarean section with complicating diagnosis (ranked ninth); antenatal and obstetric admission (ranked twenty – third); and same day antenatal and obstetric admission (ranked twenty – fourth) Table 4.5b.

Further, as shown in the summary in Table 4.5c South Australia's 25 Highest Cost by Volume Diagnostic Related Groups for public hospitals ranked caesarean section with complicating diagnosis the second most costly code overall; vaginal birth third; and P67, a neonate admitted with a weight of > 2499 grams eighteenth. Comparative bed stay days for each of these Diagnostic Related Groups illustrated in these appendices also shows they were areas of significant cost and resource consumption in public sector hospitals, National Cost Data Report (Commonwealth Department of Health and Ageing 2010).

Appendix 4.5 Total public hospital cost between two groups across DRG Separation Codes SHC vs MGP 2003/04–2010/11

DRG Code	DRG Group	Standard Hospital Care (n = 9,442)			Midwifery Group Practice (n = 2,964)			P Value
		n	Median	IQR	n	Median	IQR	
O01A	LSCS Catastrophic Complication	279	$9244.0	$6815.8–11970.4	52	$10554.0	$7927.2–12523.1	0.12
O01B	LSCS Severe Complex	926	$7641.2	$6139.6–9349.7	213	$7616.5	$6120.6–9302.6	0.63
O01C	LSCS Moderate Complex	1447	$5228.2	$4239.3–6453.9	357	$5685.0	$4657.8–6761.7	0.21
O01D	LSCS No Complication	69	$4317.9	$3604.9–5111.0	5	$3653.0	$2632.2–3721.6	0.10
O02A	Vaginal Catastrophic Complication	122	$6164.6	$4296.5–8848.4	36	$4925.5	$3279.4–7617.7	0.07
O02B	Vaginal Complex Operating Room	214	$4853.1	$3326.0–6835.5	64	$4020.3	$2693.3–6552.1	0.17
O60A	Vaginal Multiple Complication	742	$3901.8	$2752.8–5490.5	154	$3528.6	$2527.5–5083.1	0.12
O60B	Vaginal Some Complexity	3292	$2660.8	$1875.9–2892.3	1039	$2069.7	$1276.4–3234.4	<0.001
O60C	Vaginal Complicated	476	$1839.6	$1257.0–2495.9	308	$957.9	$514.1–1586.0	<0.001
O60D	Vaginal No Complexity	179	$2383.4	$1587.3–3251.3	58	$963.1	$461.3–1860.2	<0.001
O60Z	Vaginal Uncomplicated	1646	$4088.8	$2815.9–5788.8	630	$2536.1	$1427.2–4446.6	<0.001
O61Z	Postnatal Admission No OR/Theatre	41	$1579.1	$1199.3–2097.5	41	$1294.5	$650.5–1875.0	0.06
O66AZ	Same-Day Antenatal Admission	1	$2528.7	$2528.7–2528.7	3	$2965.2	$1206.7–5332.3	♯
O66B	Antenatal or Obstetric Admission	3	$208.2	$120.9–1851.3	2	$407.2	$384.9–429.5	♯
Other*	Other*	5	$4056.9	$3964.5–4668.7	2	$2430.4	$445.0–4415.9	♯

Note. P values are based on Mann-Whitney U test; ♯ sample size too small; LSCS = lower segment caesarean section; Predictor variables that had a significant difference on cost are highlighted in yellow

*Other includes: 168B;O02Z;O04B;O04Z;O63Z;O64A;O64B;O64Z;O65A;O65B;X60A (Appendix 4.6); $Australian Dollars

Appendix 4.6 Total public hospital revenue between two groups across AR DRG Separation Codes SHC vs MGP 2003/04–2010/11

DRG Code	DRG group	Standard Hospital Care (n=9,442)			Midwifery Group Practice (n=2,964)			P value
		n	Median	IQR	n	Median	IQR	
O01A	LSCS Catastrophic Complication	279	$10801.8	$10801.8–10987.6	52	$10838.4	$10801.8–11655.2	0.17
O01B	LSCS Severe Complex	926	$7544.1	$7408.1–7773.4	213	$7544.1	$7408.1–7773.4	0.83
O01C	LSCS Moderate Complex	1447	$5716.3	$5437.5–6096.8	357	$5716.3	$5437.5–5789.2	0.11
O01D	LSCS No Complication	69	$4404.7	$4404.7–4404.7	5	$4404.7	$4404.7–4404.7	⸗
O02A	Vaginal Catastrophic Complication	122	$6071.4	$5400.1–7163.6	36	$6071.4	$5985.3–7163.6	0.25
O02B	Vaginal Complex Operating Room	214	$4889.0	$4189.2–4889.0	64	$4189.2	$3938.2–4889.0	0.20
O60A	Vaginal Multiple Complication	742	$5206.3	$4287.1–5384.6	154	$5064.2	$4179.3–5384.6	0.44
O60B	Vaginal Some Complexity	3292	$2986.9	$2892.3–3092.0	1039	$3088.4	$2986.9–3092.0	0.03
O60C	Vaginal Complicated	476	$2045.0	$2040.8–2249.0	308	$2090.8	$2040.8–2249.0	0.01
O60D	Vaginal No Complexity	179	$1901.1	$1901.1–1901.1	58	$1901.1	$1901.1–1901.1	⸗
O60Z	Vaginal Uncomplicated	1646	$3468.1	$3468.1–3652.1	630	$3468.1	$3468.1–3652.1	0.12
O61Z	Postnatal Admission No OR/ Theatre	41	$1373.9	$806.9–2284.1	41	$1046.1	$1023.9–1373.9	0.20
O66AZ	Same-Day Antenatal Admission	1	$1850.7	$1850.7–1850.7	3	$1526.3	$1526.3–1718.3	♯
O66B	Antenatal or Obstetric Admission	3	$454.9	$454.9–498.3	2	$515.9	$454.9–577.0	♯
Other*	Other*	5	$3060.3	$3021.5–3105.3	2	$1695.6	$1547.0–1844.2	♯

Note. P values are based on Mann-Whitney U test; ♯ sample size too small; ⸗ median and IQR same both groups; LSCS = lower segment caesarean section; Predictor variables that had a significant difference on cost are highlighted in yellow

*Other includes: 168B;O02Z;O04B;O04Z;O63Z;O64A;O64B;O64Z;O65A;O65B;X60A (Appendix 4.6); $ = Australian Dollars

Appendix 4.7 Multivariate generalised linear model of total cost between SHC and MGP during 2003/04–2010/11

Care Type And Patients' Characteristics	Unadjusted			Adjusted		
	Coefficient (β)	95% CI	P Value	Coefficient (β)	95% CI	P Value
Care type						
SHC	Referent	-	-			
MGP	0.77	0.75–0.79	<0.001	0.79	0.76–0.82	<0.001
Year						
2003–2004	Referent	-	-	-	-	-
2004–2005	1.04	0.96–1.12	0.31	1.14	1.04–1.26	<0.01
2005–2006	1.01	0.94–1.10	0.72	1.13	1.03–1.25	<0.01
2006–2007	1.1	1.02–1.19	<0.01	1.26	1.15–1.39	<0.001
2007–2008	1.15	1.07–1.23	<0.001	1.26	1.15–1.39	<0.001
2008–2009	1.34	1.25–1.44	<0.001	1.44	1.31–1.58	<0.001
2009–2010	1.62	1.51–1.73	<0.001	1.84	1.68–2.01	<0.001
2010–2011	1.86	1.73–1.99	<0.001	1.89	1.72–2.07	<0.001
Age				1.01	0.01–1.02	<0.001
Gravida				1.01	1.00–1.02	0.18
Parity				0.89	0.87–0.91	<0.001
Previous caesarean section/s				1.39	0.37–1.42	<0.001
Race						
Caucasian				Referent	-	-
Aboriginal, Torres Strait Islander				1.02	0.93–1.12	0.65
Asian				1.02	0.91–1.13	0.77
Other (includes Middle East/Africa)				0.98	0.90–1.06	0.58
Country						
Oceania & Antarctica				Referent	-	-
Europe & USSR				1.05	0.99–1.11	0.08
Middle East & Nth Africa				1.16	1.05–1.28	< 0.003
South-East Asia				0.99	0.88–1.11	0.81

Care Type And Patients' Characteristics	Unadjusted			Adjusted		
	Coefficient (β)	95% CI	P Value	Coefficient (β)	95% CI	P Value
North-East Asia				1.06	0.93–1.20	0.38
Southern Asia				1.17	1.06–1.31	<0.003
Northern America				0.91	0.73–1.13	0.39
South/Central America/Caribbean				1.19	1.04–1.37	<0.01
Africa (excluding Nth Africa)				1.18	1.07–1.30	<0.001
Marital						
Married/de facto				Referent	-	-
Widowed/divorced, separated				0.95	0.88–1.03	0.24
Never married				1.02	0.97–1.06	0.47
Unknown				1.09	0.83–1.44	0.54
Postcode/SEIFA category						
CBD/Nth Adelaide (SEIFA 1)				Referent	-	-
Nth/Nth Eastern suburbs (SEIFA 6)				1	0.89–1.13	1
Western beach suburbs (SEIFA 4)				0.99	0.87–1.11	0.81
Southern suburbs (SEIFA 5)				0.99	0.87–1.12	0.89
Eastern suburbs (SEIFA 2)				1.02	0.90–1.16	0.76
Adelaide hills suburbs (SEIFA 3)				0.83	0.68–1.02	0.08
Maternal occupation						
Managers and Administrators				Referent	-	-
Professionals				0.94	0.87–1.02	0.16
Associate professionals				0.96	0.89–1.04	0.32
Tradespersons/related workers				0.92	0.83–1.02	0.13
Advanced clerical/service workers				1.02	0.94–1.11	0.7
Clerical, sales, service workers				1	0.93–1.07	0.97
Production/transport workers				1.01	0.85–1.19	0.92
Elementary clerical/sale/service				0.97	0.87–1.09	0.63
Labourers and related workers				0.98	0.91–1.04	0.49
Body Mass Index						

Care Type And Patients' Characteristics	Unadjusted			Adjusted		
	Coefficient (β)	95% CI	P Value	Coefficient (β)	95% CI	P Value
Normal 18–25				Referent	-	-
Low <18				0.99	0.86–1.14	0.87
Overweight 26–35				1.13	1.10–1.16	<0.001
Obese II 36–40				1.23	1.16–1.30	<0.001
Obese III ≥ 41				1.33	1.24–1.41	<0.001
Smoking status						
Non–smoker				Referent	-	-
Smoker				0.98	0.94–1.02	0.39
Quit in pregnancy before first visit				0.97	0.89–1.06	0.53
Unknown				3.16	2.73–3.65	<0.001
Nulliparous				1.44	1.36–1.52	<0.001
Plurality				1.49	1.36–1.62	<0.001
Clinical gestation of baby						
37–43 weeks				Referent	-	-
28–36 weeks				1.25	1.17–1.34	<0.001
20–27 weeks				0.37	0.24–0.57	<0.001
Birth weight of baby						
3000 grams +				Referent	-	-
<3000 grams				0.99	0.96–1.03	0.73
<2000 grams				1.20	1.05–1.38	<0.01
Congenital abnormality				1.25	1.16–1.36	<0.001
Outcome for baby						
Discharged < 28 days of birth				Referent	-	-
Fetal death or stillbirth				0.83	0.57–1.19	0.31
Neonatal death (within 28 days)				1.16	0.95–1.41	0.14
In hospital @ 28 days or transfer				3.23	2.86–3.66	<0.001

Note. SHC, Standard Hospital Care; MGP, Midwifery Group Practice; GLM Generalised linear model (Gaussian family) with log link function; Predictor variables that had a significant difference on cost are highlighted in yellow

Predicted Mean Cost Total across Years for SHC and MGP services 2003/04–2010/11

Mean cost	Standard Hospital Care			Midwifery Group Practice			P value
Years	$Margin	Std. Err	95% Confidence interval	$Margin	Std. Err	95% Confidence interval	
2003/04	$2853.24	$125.92	$2606.44–$3100.04	$2237.19	$105.00	$2031.39–$2442.99	<0.001
2004/05	$3253.85	$82.08	$3092.97–$3413.73	$2551.31	$77.47	$2399.47–$2703.14	<0.001
2005/06	$3231.67	$86.48	$3062.16–$3401.17	$2533.92	$79.76	$2377.58–$2690.25	<0.001
2006/07	$3599.22	$77.72	$3446.89–$3751.55	$2822.11	$73.11	$2678.82–$2965.40	<0.001
2007/08	$3597.58	$74.73	$3451.11–$3744.05	$2820.82	$72.26	$2679.20–$2962.45	<0.001
2008/09	$4093.95	$74.13	$3948.67–$4239.24	$3210.02	$75.35	$3062.345–$3357.70	<0.001
2009/10	$5210.23	$73.80	$5065.58–$5354.88	$4085.29	$80.60	$3927.31–$4243.26	<0.001
2010/11	$5355.17	$101.04	$51557.14–$5553.19	$4198.93	$101.24	$4000.51–$4397.35	<0.001

Note. GLM Generalised linear model (Gaussian family) with log link function; $Australian Dollars; Predictor variables that had a significant difference on cost are highlighted in yellow

Appendix 4.8 Multivariate generalised linear model of total revenue between SHC and MGP during 2003/04–2010/11

Care Type and Patients' Characteristics	Unadjusted			Adjusted		
	Coefficient (β)	95% CI	P Value	Coefficient (β)	95% CI	P Value
Care type						

Care Type and Patients' Characteristics	Unadjusted			Adjusted		
	Coefficient (β)	95% CI	P Value	Coefficient (β)	95% CI	P Value
SHC	Referent	-	-			
MGP	0.89	0.88–0.91	<0.001	0.9	0.88–0.92	<0.001
Year		-	-	-	-	-
2003–2004	Referent					
2004–2005	0.99	0.96–1.05	0.83	0.99	0.94–1.05	0.85
2005–2006	0.17	1.11–1.23	<0.001	1.18	1.12–1.25	<0.001
2006–2007	1.2	1.15–1.26	<0.001	1.25	1.18–1.32	<0.001
2007–2008	1.2	1.14–1.26	<0.001	1.2	0.14–1.27	<0.001
2008–2009	1.24	1.19–1.30	<0.001	1.27	1.20–1.34	<0.001
2009–2010	1.4	1.34–1.47	<0.001	1.46	1.39–1.54	<0.001
2010–2011	1.49	1.42–1.57	<0.001	1.5	1.42–1.58	<0.001
Age				1.01	1.01–1.01	<0.001
Gravida				1	0.10–1.01	0.39
Parity				0.91	0.90–0.92	<0.001
Previous caesarean sections/s				1.38	1.37–1.40	<0.001
Race						
Caucasian				Referent	-	-
Aboriginal, Torres Strait Islander				1.29	1.23–1.35	<0.001
Asian				0.99	0.93–1.06	0.79
Other (includes Middle East/Africa)				0.95	0.90–1.00	0.06
Country						
Oceania & Antarctica				Referent	-	-
Europe & USSR				1.01	0.98–1.05	0.45
Middle East & Nth Africa				1.09	1.02–1.16	0.01
South-East Asia				1.03	0.96–1.11	0.4
North-East Asia				1.02	0.94–1.10	0.68
Southern Asia				1.09	1.02–1.17	0.01

Care Type and Patients' Characteristics	Unadjusted			Adjusted		
	Coefficient (β)	95% CI	P Value	Coefficient (β)	95% CI	P Value
Northern America				0.98	0.87–1.11	0.8
South/Central America / Caribbean				1.12	1.02–1.23	0.01
Africa (excluding Nth Africa)				1.13	1.06–1.21	<0.001
Marital						
Married/de facto				Referent	-	-
Widowed/divorced, separated				0.97	0.93–1.02	0.25
Never married				0.1	0.97–1.02	0.81
Unknown				1.07	0.91–1.25	0.44
Postcode / SEIFA category						
CBD/Nth Adelaide (SEIFA 1)				Referent	-	-
Nth/Nth Eastern suburbs (SEIFA 6)				1.05	0.97–0.14	0.25
Western beach suburbs (SEIFA 4)				1.05	0.96–1.14	0.29
Southern suburbs (SEIFA 5)				1.03	0.95–1.13	0.45
Eastern suburbs (SEIFA 2)				1.06	0.97–1.16	0.17
Adelaide hills suburbs (SEIFA 3)				0.96	0.85–1.08	0.51
Maternal occupation						
Managers and Administrators				Referent	-	-
Professionals				1.02	0.97–1.07	0.53
Associate professionals				1.02	0.97–1.07	0.42
Tradespersons/related workers				1.04	0.98–1.11	0.23
Advanced clerical/service workers				1.04	0.99–1.10	0.15
Clerical, sales, service workers				1.02	0.97–1.07	0.40
Production/transport workers				1.06	0.96–1.18	0.25
Elementary clerical/sale/service				0.99	0.92–1.06	0.71
Labourers and related workers				1.01	0.97–1.06	0.63
Body Mass Index						
Normal 18–25				Referent	-	-
Low <18				0.94	0.86–1.03	0.19

Care Type and Patients' Characteristics	Unadjusted Coefficient (β)	Unadjusted 95% CI	Unadjusted P Value	Adjusted Coefficient (β)	Adjusted 95% CI	Adjusted P Value
Overweight 26–35				1.04	1.02–1.06	<0.001
Obese II 36–40				1.09	1.05–1.13	<0.001
Obese III ≥ 41				1.17	1.12–1.22	<0.001
Smoking status						
Non–smoker				Referent	-	-
Smoker				1.01	0.98–1.04	0.47
Quit in pregnancy before 1'st visit				0.98	0.93–1.04	0.56
Unknown				1.90	1.67–2.17	<0.001
Nulliparous				1.13	1.09–1.17	<0.001
Plurality				1.63	1.55–1.71	<0.001
Clinical gestation of baby						
37–43 weeks				Referent	-	-
28–36 weeks				1.07	1.02–1.12	<0.004
20–27 weeks				0.35	0.25–0.49	<0.001
Birth weight of baby						
3000 grams +				Referent	-	-
<3000 grams				1.01	0.98–1.03	0.5
<2000 grams				1.35	1.24–1.47	<0.001
Congenital abnormality				1.07	1.01–1.13	<0.03
Outcome for baby						
Discharged < 28 days of birth				Referent	-	-
Fetal death or stillbirth				0.52	0.38–0.70	<0.001
Neonatal death (within 28 days)				1.14	1.00–1.30	<0.05
In hospital @ 28 days or transfer				2.34	2.09–2.62	<0.001

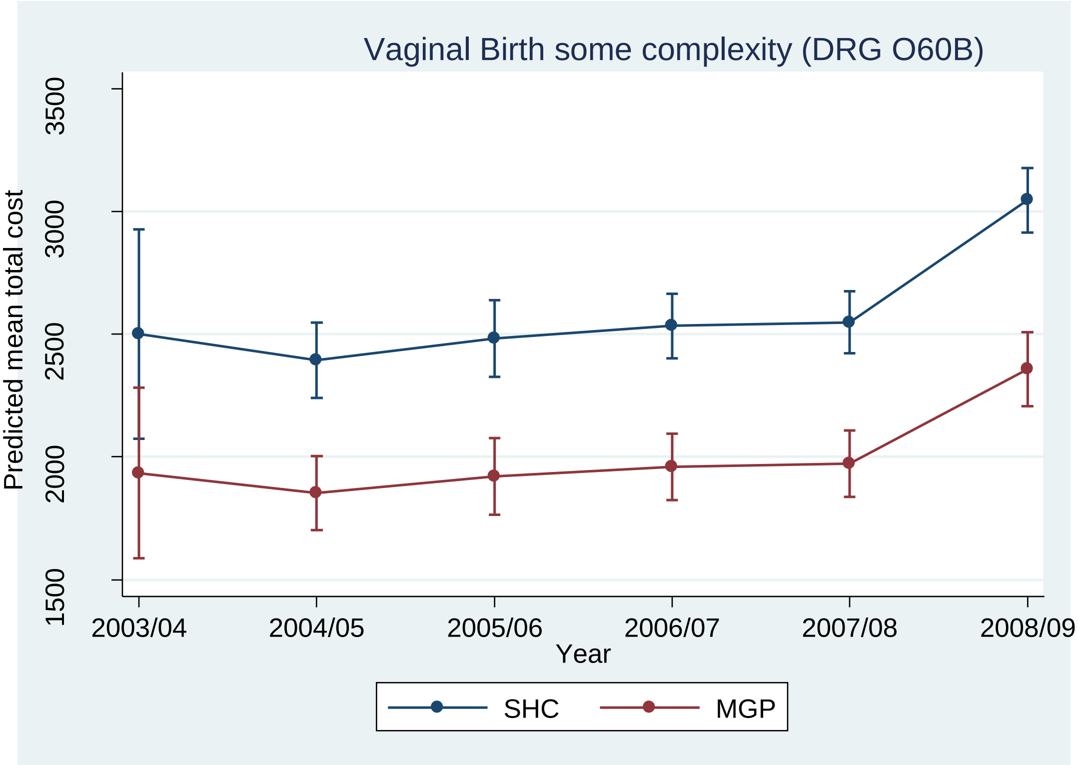
Note. SHC = Standard Hospital Care; MGP = Midwifery Group Practice; GLM = Generalised linear model (Gaussian family) with log link function; Predictor variables that had a significant difference on cost are highlighted in yellow

Predicted Mean Revenue Total across Years for SHC and MGP services 2003/04–2010/11

Mean revenue Years	Standard Hospital Care			Midwifery Group Practice			P value
	$Margin	Std. Err	95% Confidence interval	$Margin	Std. Err	95% Confidence interval	
2003/04	$3385.68	$83.21	$3222.58–$3548.78	$3042.38	$80.12	$2885.35–$3199.40	<0.001
2004/05	$3361.10	$54.23	$3254.81–$3467.39	$3020.29	$56.12	$2910.30–$3130.27	<0.001
2005/06	$3998.82	$56.76	$3887.57–$4110.06	$3593.34	$60.51	$3474.75–$3711.94	<0.001
2006/07	$4220.95	$50.81	$4121.38–$4320.53	$3792.95	$54.37	$3686.40–$3899.51	<0.001
2007/08	$4064.67	$48.89	$3968.84–$4160.49	$3652.52	$52.99	$3548.66–$3756.37	<0.001
2008/09	$4285.97	$48.06	$4191.78–$4380.15	$3851.37	$52.96	$3747.57–$3955.18	<0.001
2009/10	$4931.30	$47.29	$4838.60–$5023.99	$4431.27	$54.00	$4325.42–$4537.12	<0.001
2010/11	$5053.91	$64.80	$4926.90–$5180.91	$4541.45	$68.43	$4407.32–$4675.58	<0.001

Note. GLM = Generalised Linear Model (Gaussian family) with log link function; A$ = Australian Dollars; Predictor variables that had a significant difference on cost are highlighted in yellow

Appendix 4.9 Multivariate generalised linear model of total cost between SHC and MGP for AR DRGs with significant difference



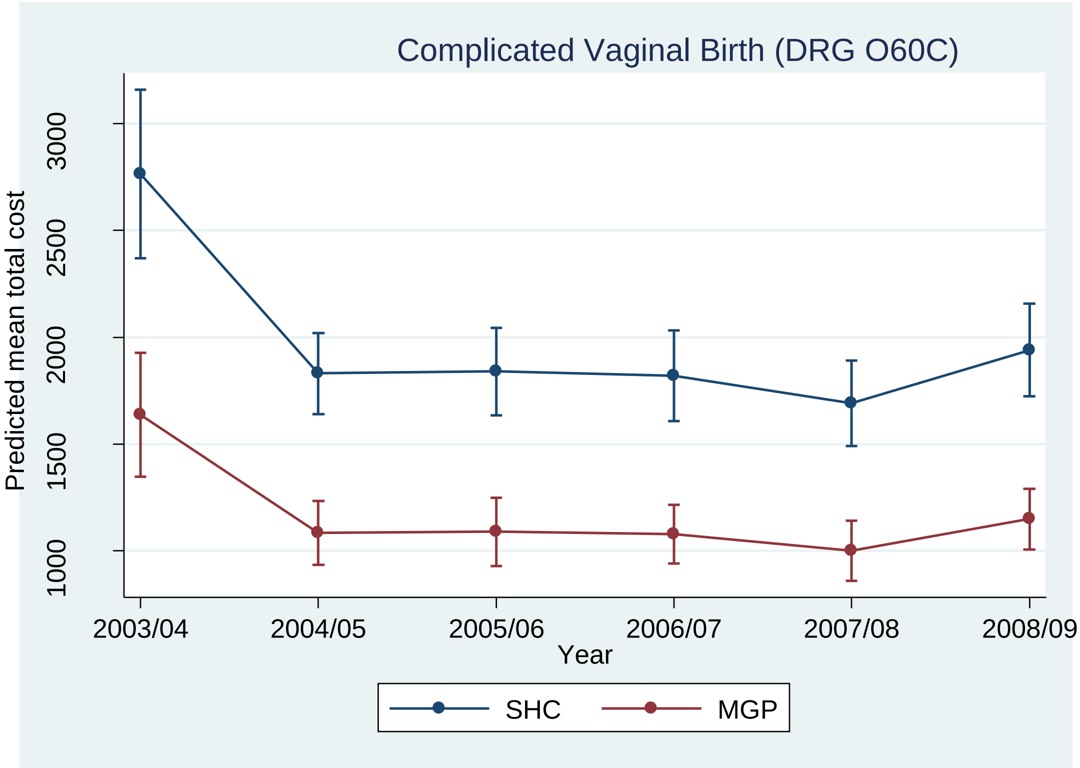
SHC = Standard Hospital Care; MGP = Midwifery Group Practice; Vertical bars = 95% CI

Figure 4.9a Vaginal Birth (some complexity) O60B – Cost Adjusted Model

Standard Hospital Care vs Midwifery Group Practice 2003/04 – 2008/09

(Generalised linear model [Gaussian family] with log link function) p<0.001

Mean total cost for Vaginal Birth with some complexity was higher in women who received Standard Hospital Care. Confounders that demonstrated a significant difference associated with Diagnostic Related Group O60B included age (p<0.001); nulliparity (p<0.001); number of previous caesarean sections (p<0.01); tobacco smokers (p<0.01); babies who had a congenital abnormality (p<0.01); and women from Africa, Middle East, South and Central America.



SHC = Standard Hospital Care; MGP = Midwifery Group Practice; Vertical bars = 95% CI

Figure 4.9b Complicated Vaginal Birth O60C – Cost Adjusted Model

Standard Hospital Care vs Midwifery Group Practice 2003/04 – 2008/09

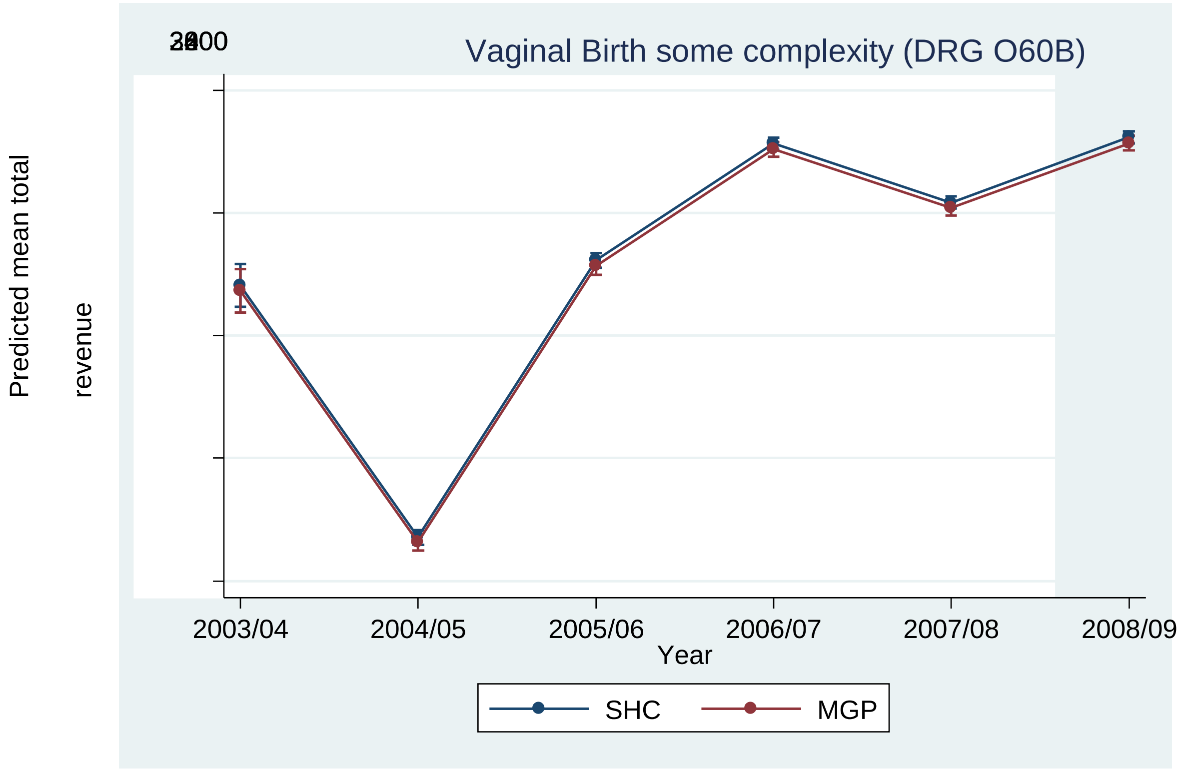
(Generalised linear model [Gaussian family] with log link function) p<0.001

Mean total cost for Complicated Vaginal Birth was higher in women who received Standard Hospital Care. Confounders that demonstrated a significant difference associated with Diagnostic Related Group O60C included nulliparity (p<0.001); women from North East Asia, Southern Asia and Africa; maternal occupation listed as production / transport workers (p<0.01); body mass index in the normal – overweight category (p<0.001), and babies with a congenital abnormality (p<0.02).

*National coding changes to Version 5.2 and Version 6 of Australian Refined Diagnostic Related Group obstetric code descriptions (Appendices 3.8 and 3.9) meant DRG O60Z was only relevant for the 2009/10 – 2010/11 fiscal year. Confounders demonstrating a significant difference associated with this DRG included nulliparity (p<0.001); plurality (p<0.001); clinical gestation of the baby (p<0.02), and whether the baby remained hospitalised at 28 days after birth or was transferred to another facility (p<0.001). Similarly, DRG O60D code was only relevant for the 2003/04 fiscal year due to coding changes that merged it with another code.

Appendix 4.10 Multivariate generalised linear model examples – AR DRGs without Significant Difference – Total Revenue

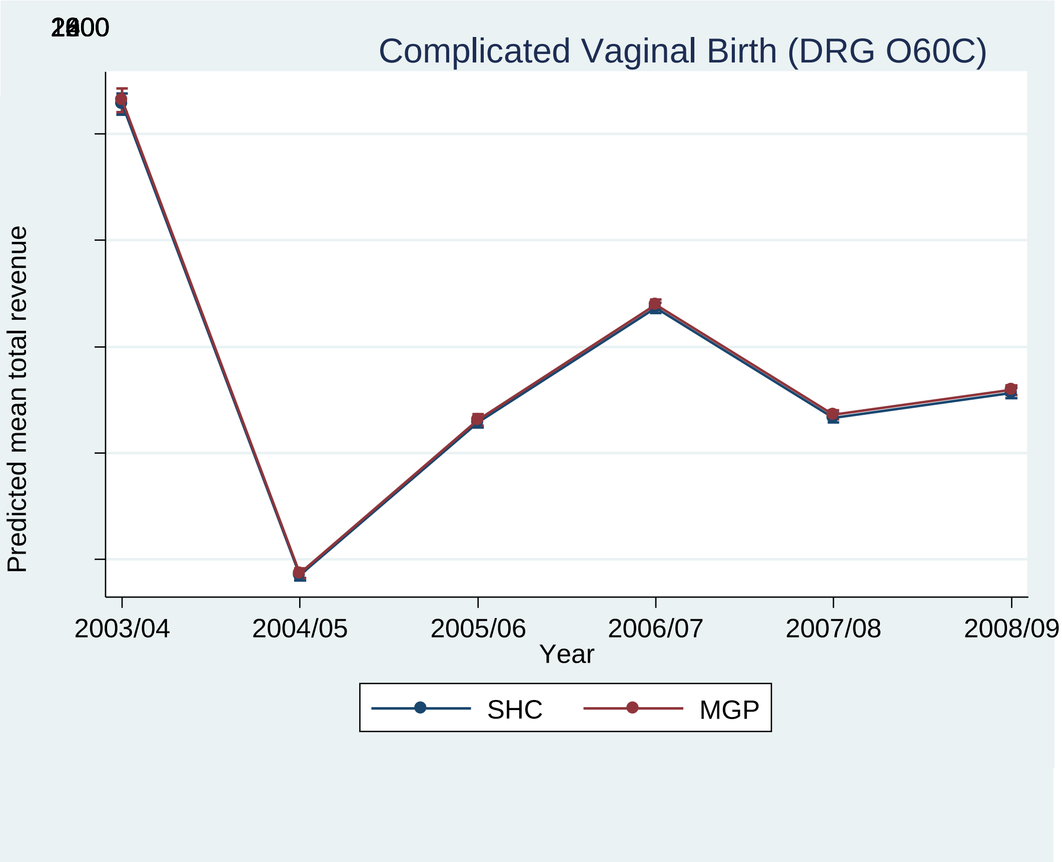
As shown in Figures 5.10a, 5.10b there was no significant association with care type for total revenu e when multivariate general linear modelling was applied for AR DRG Codes O60B (Vaginal Birth some complexity) and O60C (Complicated Vaginal Birth)



SHC = Standard Hospital Care; MGP = Midwifery Group Practice; Vertical bars = 95%CI

Figure 4.10a Vaginal Birth O60B (some complexity) – Revenue Adjusted Model Standard Hospital Care vs Midwifery Group Practice 2003/04 – 2008/09

(Generalised linear model [Gaussian family] with log link function) p = 0.10

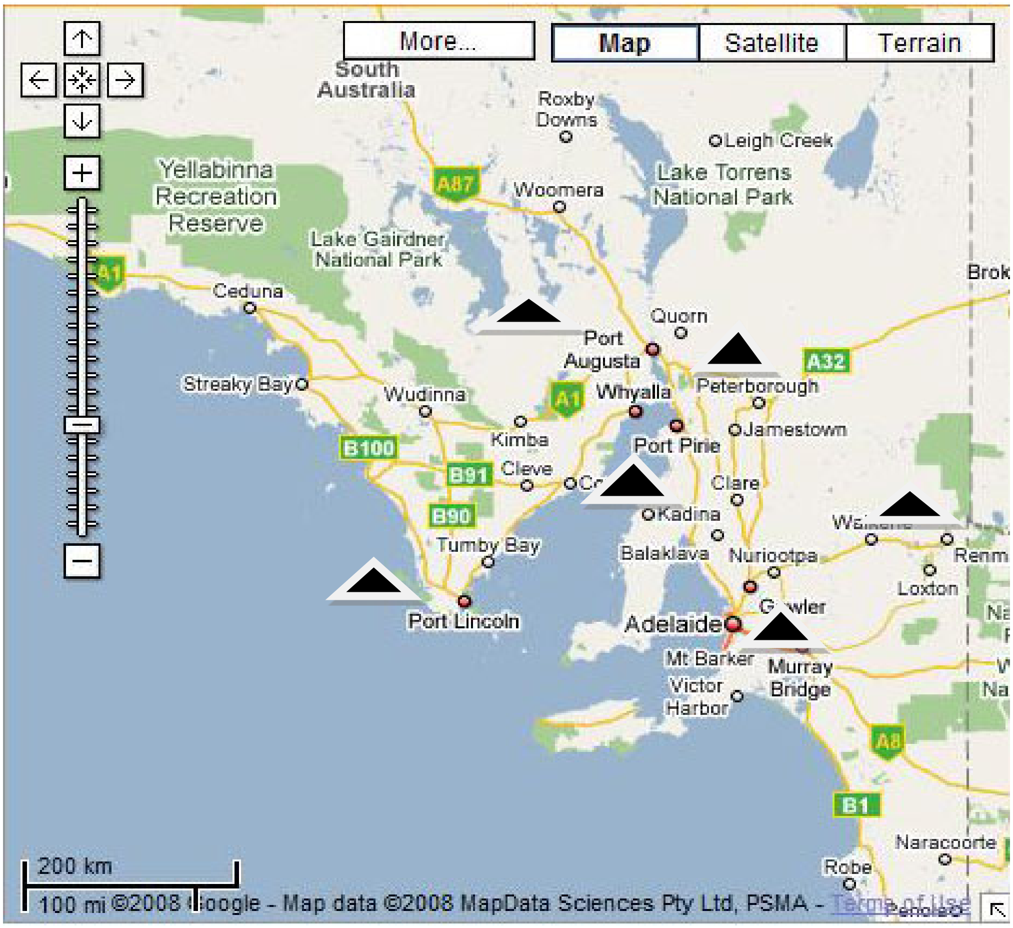


SHC = Standard Hospital Care; MGP = Midwifery Group Practice; Vertical bars = 95%CI

Figure 4.10b Complicated Vaginal Birth O60C – Revenue Adjusted Model Standard Hospital Care vs Midwifery Group Practice 2003/04 – 2008/09

(Generalised linear model [Gaussian family] with log link function) p = 0.18

Appendix 5.1 Map for six women who were outliers in rural and regional South Australia



Port Lincoln, Port Augusta, Peterborough, Renmark, Wallaroo, Murray Brid

Appendix 5.2 Standard Hospital Care Outliers with 10 or > Medicare Benefits Schedule Items / Visits in 4 Month Period after Giving Birth

Unique Identifier	No of MBS Items	No of MBS Visits	Pattern of Medicare Benefits Schedule Use	Age	G:P	Birth	Peri	Baby Sex	Baby Weight (grams)	DRI or SCBU	PC / SEIFA
21008	10	7	Treatment of a wound, Pap smear, Follow up Consultations Level B & C	31	1:1	SVB	intact	F	3660	DRI	5019 SEIFA4
21013	20	16	Spinal examinations, pelvic girdle, immunisation, USS foot, Preparation of a GP Management Plan, Follow up Consultations Level B & C, Physiotherapy Health Service x 4	40	1:1	SVB	1 tear	F	3380	DRI	5061 SEIFA5
21022	13	7	4 After Hours Attendances, blood studies including thyroid, Follow up Consultations Level B & C	28	1:1	SVB	3 tear	F	2780	SCBU	5093 SEIFA6
21034	11	6	Oral glucose challenge test, microbiology/culture, Pap smear Follow up Consultations Levels B & C	30	1:1	SVB	3 tear	M	3100	DRI	5097 SEIFA6
21042	10	6	Blood studies including iron, Vit D and thyroid, Pap smear, Follow up Consultations B, C & D	29	1:1	INST	episi	F	2880	DRI	5023 SEIFA4
21043	12	7	Blood studies, cervical cytology, Follow up Consultations Level B & C	24	1:1	SVB	episi	F	3340	DRI	5019 SEIFA4
21044	13	7	1 Urgent Attendance After Hours, blood studies, microbiology / culture, microbial antibodies, detection of Epstein Barr Virus antibodies, Home Visit / Consultation at Institution other than Hospital, Follow up Consultations Level B	21	1:1	SVB	2 tear	M	4350	SCBU	5087 SEIFA6
21046	52	20	Prothrombin time (including INR) x 17, Follow up Consultations Levels A & B	32	1:1	INST	episi	F	3480	DRI	5556 Rural
21047	11	7	Microbiology / culture post – operative wound, Pap smear, Home Visit / Consultation at Institution other than Hospital, Follow up Consultations A, B & C	30	2:1	INST	3 tear	F	3280	SCBU	5083 SEIFA6

Unique Identifier	No of MBS Items	No of MBS Visits	Pattern of Medicare Benefits Schedule Use	Age	G:P	Birth	Peri	Baby Sex	Baby Weight (grams)	DRI or SCBU	PC / SEIFA
21049	10	7	Urine examination, immunisation, Optometrical consultation, Follow up Consultations Level A, B & C	30	1:1	EM LSCS	-	M	4100	DRI	5097 SEIFA6
21050	17	10	Blood studies including Vit D and thyroid, Pap smear, Hormone Implant, Preparation GP Mental Health Treatment Plan, Follow up Consultations Levels A, B & C	40	1:1	EM LSCS	-	M	3950	DRI	5086 SEIFA6
21057	10	5	Blood studies, cervical cytology, Follow up Consultations Levels B & C	23	1:1	EL LSCS	-	F	3450	SCBU	5070 SEIFA2
21059	13	6	Blood studies, urine microbiology / culture, Pap smear, Hormone treatment, Follow up Consultations Levels B, C & D	27	1:1	SVB	intact	M	2630	SCBU	5606 Rural
21065	12	7	1 Urgent Attendance After Hours, blood studies including Vit D, antinuclear antibodies and tissue antigens, X-Ray hand, wrist, forearm, elbow / humerus Specialist Attendance, full quantitative computerised perimetry, Planning and Management of Pregnancy, Follow up Consultations Level B	33	1:1	SVB	1 tear	M	2700	DRI	5063 SEIFA5
22004	30	17	Blood studies including iron and thyroid, cervical cytology, pelvic USS, Multi Channel ECG Monitoring & Recording, M-Mode/2 Dimensional Echocardiographic Examination, Oral examination, adhesive restoration – tooth, Preparation GP Management Plan, GP Mental Health Treatment Plan, Consultant Physician Review, Consultant Psychiatrist Review, Physiotherapy Health Service x 4 Follow up Consultations Levels B & C	35	6:4	SVB	intact	F	3380	DRI	5422 Rural
22008	11	6	Basal cell carcinoma removal, histological specimen, immunisation, Pap smear, Hormone implant, Follow up Consultations Levels B & C	28	4:4	SVB	2 tear	M	4040	SCBU	5253 Rural
22015	11	8	Blood studies including iron, B12,folate & thyroid,	29	6:5	SVB	intact	M	3790	DRI	5042

Unique Identifier	No of MBS Items	No of MBS Visits	Pattern of Medicare Benefits Schedule Use	Age	G:P	Birth	Peri	Baby Sex	Baby Weight (grams)	DRI or SCBU	PC / SEIFA
			Consultant Physician Review, Follow up Consultations Levels B & C								SEIFA5
22016	12	11	Chest X – Ray, USS abdomen & urinary tract, Carbon – labelled urea breath test, Pap smear, Follow up Consultations Levels B & C	30	4:4	SVB	intact	F	3700	DRI	5012 SEIFA4
22021	10	6	Blood studies including iron, Vit D & thyroid, Follow up Consultations Level B & C	37	2:2	SVB	1 tear	F	3220	DRI	5012 SEIFA4
22030	16	11	Blood studies, Hormone implant, Follow up Consultations Level B	22	4:2	SVB	intact	M	2890	DRI	5700 Rural
22039	20	8	Blood studies, microbiology / culture urine x 2, Pap smear, tumour, cyst, ulcer / scar removal, histological specimen, USS both breasts, Specialist Review, Follow up Consultations Level B	37	4:4	SVB	intact	M	3910	DRI	5141 SEIFA3
22044	38	20	Blood studies including iron, Vitamin D, B12, folate, microbiology / culture urine, haematocrit / erythrocyte count x 2, thyroid function x 3, Exercise physiology health service, 2 Psychological Assessment Attendances 2 Review GP Management Plan / Review Team Care, Follow up Consultations Levels B & C	32	3:3	EL LSCS	-	M	3770	DRI	5073 SEIFA2

G:P (gravida: parity); SVB (spontaneous vaginal birth); INST (instrumental); LSCS (lower segment caesarean section); Peri (perineal status) – first, second, third degree tear, episiotomy; DRI (direct room in of baby with mother after birth); SCBU (special care baby unit); USS (ultrasound scan); PC (postcode); shaded indicates rural PC

SEIFA, Socioeconomic Index for Area Legend

SEIFA Code	Geographical Area	Colour
SEIFA 1	CBD / North Adelaide	
SEIFA 2	Eastern suburbs	
SEIFA 3	Adelaide Hills	
SEIFA 4	Western / Beach suburbs	
SEIFA 5	Southern suburbs	
SEIFA 6	North/ Nth East Suburbs	
Outliers	Rural/ Regional Code	

Appendix 5.3 Midwifery Group Practice Outliers with 10 or > Medicare Benefit Schedule Items / Visits in 4 Month Period after Giving Birth

Unique Identifier	No of MBS Items	No of MBS Visits	Pattern of Medicare Benefits Schedule Use	Age	G: P	Birth	Peri	Baby Sex	Baby Weight (grams)	DRI Or SCBU	PC / SEIFA

Unique Identifier	No of MBS Items	No of MBS Visits	Pattern of Medicare Benefits Schedule Use	Age	G: P	Birth	Peri	Baby Sex	Baby Weight (grams)	DRI Or SCBU	PC / SEIFA
11004	12	4	1 Urgent Attendance After Hours, blood studies, Pap smear, faecal culture, Follow Up Consultations Levels B & C	35	1:1	SVB	3 tear	F	3430	DRI	5033 SEIFA4
11019	11	7	Consultations Level B & C, immunisation, urine examination, Pap smear	37	1:1	INST	3 tear	F	3240	DRI	5031 SEIFA4
11023	11	8	1 After Hours Attendance, Blood tests, USS female pelvis, Follow Up Consultations Level B	40	1:1	SVB	2 tear	F	3440	SCBU	5031 SEIFA4
11038	17	9	1 After Hours Attendance, blood studies, microbiology, Pap smear, Follow up Consultations Level B & C	29	1:1	SVB	1 tear	F	3110	DRI	5086 SEIFA6
11045	19	15	1 Urgent Attendance A / Hours, urine examination, Pap smear, GP Mental Health Treatment Plan, 4 Psychological Assessment Attendances, Consultations Level A, B & C	35	1:1	SVB	intact	F	2630	DRI	5069 SEIFA2
11052	17	10	Microbiology / culture post-operative wound, Pap smear, Consultations Level B & C, Preparation of GP Management Plan, Development of Mental Health Treatment Plan, Review of GP Mental Health Treatment Plan x 2 Psychiatric Consultation	25	1:1	INST	2 tear	F	3430	DRI	5083 SEIFA6
11053	13	5	Urine examination, microbiology / culture, blood studies, IUCD introduction, Consultations Level B, Attendance for GP Mental Health Treatment x 2	26	2:1	SVB	1 tear	M	3560	DRI	5063 SEIFA5
12001	10	4	Blood studies, pregnancy test, microbiological serology, cervical cytology, Consultations Level B & C	40	3:2	SVB	intact	F	2920	DRI	5072 SEIFA2

Unique Identifier	No of MBS Items	No of MBS Visits	Pattern of Medicare Benefits Schedule Use	Age	G: P	Birth	Peri	Baby Sex	Baby Weight (grams)	DRI Or SCBU	PC / SEIFA
12033	10	8	1 After Hours Consultation, Pap smear, Optometric consultation, Consultations Level B	35	2:2	SVB	2 tear	F	3780	DRI	5006 SEIFA1

G:P (gravida: parity); SVB (spontaneous vaginal birth); INST (instrumental); LSCS (lower segment caesarean section); Peri (perineal status) – first, second, third degree tear, episiotomy; DRI (direct room in of baby with mother after birth); SCBU (special care baby unit); USS (ultrasound scan); PC (postcode)

Appendix 5.4 Medicare Benefits Schedule Items – Distribution of all items claimed by women: SHC vs MGP 2010 – 2012

	Item Clusters	MBS Item Numbers	MBS Item Description	Total Claims	% Claim	SHC	MGP
1	**Short or Standard Consultations (A & B)**	3; 23; 53	Short or standard consultations at consulting rooms	440	39.18	291	149
2	**Long / After Hours Consultations, (C & D) or Comprehensive Initial**	36; 44; 54; 57; 721; 597;599; 723; 732; 2501; 2504; 5020; 5023; 5040; 10900; 16591	Long, Urgent or After Hours Consultations or Comprehensive Initial Consultation	172	15.32	100	72
3	**Pathology: Blood Tests, General Biochemistry, Pregnancy Test; Histopathology**	65070; 65096; 65120;66512; 66542; 66548; 66596;66599; 66602; 66608; 66623;66650; 66695; 66701; 66716;66719; 69303;69306; 69312; 69316; 69317; 69321; 69333;69336; 69345; 69387; 69415;69474; 71097; 71099; 71121;72816; 73527; 73529; 73806	Pregnancy test B-HCG; Thyroid; Biochemistry - blood, urine faecal; antigens; iron studies; histopathology; prothrombin time Vitamin D	166	14.78	112	54
4	**PAP Smears, cervical screen; Intrauterine device**	10 994; 14203; 14206; 14221; 35503; 73053; 73055	PAP smear, cervical screening, intrauterine device, hormone or tissue implantation	79	7.03	45	34
5	**Mental Health Treatment Plan or Psychological Assessment**	2702; 2710; 2712; 2713; 2715; 2717; 80010; 80110	Psychological Assessment, GP Mental Health Treatment Plan, Mental Health Treatment	26	2.32	11	15
6	**Other Includes:** **Initiation Patient Episode;**	73920; 73922; 73923; 7 924; 73926; 73927; 73928; 73929; 73936; 73938; 73939	Initiation Patient Episode	147		93	54

	Item Clusters	MBS Item Numbers	MBS Item Description	Total Claims	% Claim	SHC	MGP
	Initial Specialist; further attendance;	104; 105; 110; 116; 133; 296; 306	Specialist attendance includes: physician and psychiatrist	19	21.37 [Whole Group]	12	7
	Consultations by other health professionals	10 907; 10912; 10913; 10918; 10953; 10960; 10993; 10996; 10997; 82135	Includes: Practice Nurse, Physiotherapist, Midwife, Aboriginal Health Worker, Immunisation	26		21	5
	Other Tests	11 224; 11512; 11700; 11709; 11712; 12533;55036;55076; 55113; 55731; 55840; 55844; 56025; 56301; 57509; 57521; 57712; 57715; 57963; 58121; 58503; 58903	[X-Ray, ultrasound, EEG, radiography, Dental X-Ray]	41		30	11
	Miscellaneous [minor ops – removal bcc, cysts, biopsy, abscess drainage, minor dental, oral exam]	30 071; 30195; 30219; 31230; 31280; 85013; 85531	Minor ops (removal bcc, cyst removal) Biopsy Abscess drainage Dental- minor Oral exam	7		5	2
	TOTAL			1123	100.00	720	403

Appendix 5.5 Pharmaceutical Benefits Schedule Prescription Items: Item Use between SHC and MGP groups

PBS ITEM DESCRIPTION	MGP SCRIPTS	SHC SCRIPTS	TOTAL SCRIPTS	DRUG GROUP
AMOXYCILLIN CAPSULES	2	10	12	ANTIBIOTIC 45 scripts
CEPHALEXIN CAPSULE	1	6	7	
CIPROFLOXACIN TABLETS	0	4	4	
CLINDAMYCIN CAPSULES	0	1	1	
DOXYCYCLINE CAPSULES	0	1	1	
ERYTHROMYCIN TABLETS	0	2	2	
FLUCLOXACILLIN CAPSULES	3	3	6	
METRONIDAZOLE TABLETS	0	2	2	
NYSTATIN ORAL SUSPENSION	0	1	1	
NYSTATIN TABLETS	0	1	1	
PHENOXYMETHYLPENICIL CAPSULES	0	1	1	
ROXITHROMYCIN TABLETS	0	4	4	
TRIAMCINOLONE-NEOMYCIN EAR OINTMENT	0	1	1	
TRIMETHOPRIM TABLET	0	2	2	
LEVONORGESTREL TABLET 30 MICROGRA	4	3	7	CONTRACEPTIVE 30 scripts
LEVONORGESTREL INTRAUTERINE 52MG	2	3	5	
ETONOGESTREL SUBCUTANEOUS IMPLANT	4	13	17	
MEDROXYPROGESTERONE INJECTION	0	1	1	
CODEINE PHOSPHATE TABLETS	1	11	12	ANALGESIC / ANTI-INFLAMMATORY 24 scripts
OXYCODONE HYDROCHLOR TABLET 5MG	0	2	2	
TRAMADOL HYDROCHLORIDE TABLET	0	2	2	
IBUPROFEN TABLETS	0	2	2	
MELOXICAM CAPSULES	0	4	4	
MEFENAMIC ACID CAPSULES	0	2	2	
SALBUTAMOL SULFATE ORAL PRESS INHALER	0	10	10	INHALERS 17 scripts
BUDESONIDE ¢ EFORMOT PDR ORAL INHALE	1	3	4	
FLUTICASONE PROPION- ORAL PRES INHALER	0	2	2	
SODIUM CROMOGLYCATE ORAL INHALER	0	1	1	
SERTRALINE TABLETS	0	3	3	ANTI-DEPRESSANTS 13 scripts
DESVENLAFAXINE SUCCI TABLETS	0	4	4	
CITALOPRAM HYDROBROM TABLETS	0	1	1	
ESCITALOPRAM ORAL SOLN	0	1	1	
FLUOXETINE CAPSULES	0	3	3	
PAROXETINE TABLETS	0	1	1	
DOMPERIDONE TABLETS	2	5	7	LACTATION (7)
IRON POLYMALTOSE COM	1	0	1	IRON

PBS ITEM DESCRIPTION	MGP SCRIPTS	SHC SCRIPTS	TOTAL SCRIPTS	DRUG GROUP
INJECTION				SUPPLEMENT (6)
FERROUS FUMARATE TABLETS	0	5	5	
HYDROXYCHLOROQUINE TABLETS	0	2	2	OTHER (anti-hypertensives, anti-coagulants, anti-convulsants, anti-malarial, oral hypoglycaemic, milk suppression, thyroid, anti-reflux, antacids, eye drops, steroid cream) 34 scripts
HYDROCHLOROTHIAZIDE TABLETS	0	1	1	
ISOTRETINOIN CAPSULES	0	1	1	
PANTOPRAZOLE SODIUM TABLETS	0	4	4	
METFORMIN HYDROCHLORIDE TABLETS	0	1	1	
SODIUM VALPROATE TABLET	0	1	1	
BROMOCRIPTINE MESYLATE TABLET	0	2	2	
FLUDROCORTISONE ACETATE TABLET	0	1	1	
ALUM HYDROXIDE ¢ MAG ORAL SUSPENSION	0	1	1	
ESOMEPRAZOLE MAG TRI TABLET	0	3	3	
CARMELLOSE SODIUM EYE DROPS	0	4	4	
LANSOPRAZOLE TABLETS	0	4	4	
THYROXINE SODIUM TABLETS	0	1	1	
ENALAPRIL TABLETS	3	0	3	
ENOXAPARIN SODIUM INJECTION	0	1	1	
BETAMETHASONE DIPROP OINTMENT	0	1	1	
BETAMETHASONE VALERA CREAM	0	1	1	
HYDROCORTISONE ACETATE CREAM	0	1	1	
MOMETASONE FUROATE LOTION	0	1	1	
TOTAL	**24**	**152**	**176**	

REFERENCES

Abenhaim, H, Kinch, R & Morin, L 2007, 'Effect of prepregnancy body mass index categories on obstetrical and neonatal outcomes', *Archives of Gynecology and Obstetrics*, vol. 275, pp. 39–43.

ACT Department of Health 1993, *Maternity Services Review*, ACT Department of Health, Canberra.

Agresti, A 2007, *An introduction to categorical data analysis,* 2nd edn., John Wiley & Sons, New Jersey.

Alvaro, C, Jackson, L, Kirk, S, McHugh, T, Hughes, J, Chircop, A & Lyons, R 2011, 'Moving governmental policies beyond a focus on individual lifestyle: some insights from complexity and critical theories', *Health Promotion International*, vol. 26, no. 1, pp. 91–9

Amnesty International 2010, *Deadly delivery: the maternal health care crisis in the USA*, Amnesty International Publications, London.

Anderson, R & Anderson, D 1999, 'The cost-effectiveness of home birth', *Journal of Nurse-Midwifery*, vol. 44, no. 1, pp. 30–5.

Angood, PB, Armstrong, EM, Ashton, D, Burstin, H, Corry, MP & Delbanco, SF 2010, 'Blueprint for action: steps toward a high-quality, high-value maternity care system', *Women's Health Issues*, vol. 20, no. 2010, pp. S18–S49.

Armitage, A & Keeble-Allen, D 2008, 'Undertaking a structured literature review or structuring a literature review: tales from the field', *The Electronic Journal of Business Research Methods*, vol. 6, pp. 103–14.

Armstrong, B, Gillespie, J, Leeder, S, Rubin, G & Russell, L 2007, ‘Challenges in health and health care for Australia’*, Medical Journal of Australia*, vol. 187, no. 9, pp. 485–9.

Austin, M, Kildea, S & Sullivan 2007, 'Maternal mortality and psychiatric morbidity in the perinatal period: challenges and opportunities for prevention in the Australian setting', *Medical Journal of Australia*, vol. 186, no. 7, pp. 364–7.

Australian Bureau of Statistics 2008, *Census of Population and Housing: Socioeconomic Indexes for areas (SEIFA), Australia–Data only 2006 (cat.no. 2033.0.55.001) and Information paper: An Introduction to Socio-economic Indexes for areas (SEIFA), 2006 (cat. no. 2039.0)* Australian Bureau of Statistics, Canberra.

Australian College of Midwives 2005, *Solving maternity workforce shortages through getting the skill mix right – ACM submission to the Productivity Commission Inquiry into the Health Workforce*, The Productivity Commission, Canberra, Government of Australia.

Australian College of Midwives 2013, *National Midwifery Guidelines for Consultation and Referral,* 3rd edn, Australian College of Midwives, Canberra.

Australian College of Midwives 2015, *Implementing visiting access for Medicare eligible midwives, a guide for hospitals and health services*, Australian College of Midwives, Canberra, viewed, 11 November 2015, <http://midwives.rentsoft.biz/lib/pdf/documents/National/PDF%20ACM%20Eligible%20Midwives_%20Implementing%20visiting%20access%2020150619.pdf>.

Australian College of Midwives: SA Branch 2014, *Submission to SA Health transforming health discussion paper,* Australian College of Midwives: SA Branch, 19 November 2014, Australian College of Midwives: SA Branch, Adelaide.

Australian Government 2008, *Close the gap: indigenous health equality summit: statement of intent*, Canberra, March 20, viewed 21 April 2012, <https://www.humanrights.gov.au/publications/close-gap-indigenous-health-equality-summit-statement-intent>.

Australian Government 2008, *Improving maternity services in Australia: a discussion paper from the Australian Government*, Australian Government, Department of Health & Ageing, Commonwealth of Australia, Canberra.

Australian Government 2009, *Improving maternity services in Australia: the report of the Maternity Services Review*, Department of Health & Ageing, Commonwealth of Australia, viewed February 2010, <https://www.health.gov.au/internet/main/publishing.nsf/content/624EF4BED503DB5BCA257BF0001DC83C/$File/Improving%20Maternity%20Services%20in%20Australia%20-%20The%20Report%20of%20the%20Maternity%20Services%20Review.pdf>.

Australian Government Department of Health and Ageing 2006, *Australian refined diagnosis related groups version 5.2*, Canberra.

Australian Government Department of Health and Ageing 2010, *Australian hospital patient costing standards version 1.1 –, 22 September 2010*, Commonwealth of Australia, Canberra, viewed 7 January 2012, <http://www.health.gov.au/internet/ihpa/publishing.nsf/Content/EC0666091A19EBB1CA257B9B0083827A/$File/Australian%20Hospital%20Patient%20Costing%20Standards%20v1_1.pdf>.

Australian Government Department of Health and Ageing 2012, *Clinical practice guidelines: antenatal care – module 1*, Australian Health Minister's Advisory Council, Australian Government Department of Health & Ageing, Canberra, viewed 4 December 2012, <https://www.health.gov.au/internet/main/publishing.nsf/content/015FBFDD266795DBCA257BF0001A0547/$File/ANC_Guidelines_Mod1_v32.pdf>.

Australian Government Department of Human Services 2014, *Medicare Online*, viewed 30 October 2014, <https://www.medicareaustralia.gov.au/provider/business/online/medicare-online.jsp>.

Australian Health Minister's Conference (AHMC) 2009, *Australian National Breastfeeding Strategy 2010-2015*, Australian Government Department of Health and Ageing, Canberra.

Australian Health Ministers Advisory Council 2008a, *Primary maternity services in Australia – a framework for implementation*, AHMAC Canberra.

Australian Health Ministers Advisory Council 2008b, *Aboriginal and Torres Strait Islander health performance framework 2008 Summary*, Australian Government, Canberra, viewed 7 April 2009, <http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=6442458630>.

Australian Health Workforce Advisory Committee 2002, *The midwifery workforce in Australia 2002–2012*, Australian Health Workforce Advisory Committee, Sydney.

Australian Health Workforce Advisory Committee 2004, *The specialist obstetrics and gynaecology workforce in Australia: an update 2002–2013*, Australian Government, Sydney.

Australian Institute of Health & Welfare 2015, *Maternal deaths in Australia 2008–2012*, Australian Government, Canberra, viewed 20 July 2015 <http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=60129551117>.

Australian Institute of Health and Welfare 2008a, *Australia's mothers and babies 2006,* Perinatal statistics series no. 22, Cat. no. PER 46, AIHW, Canberra.

Australian Institute of Health and Welfare 2008b, *Maternal deaths in Australia 2003–2005*, AIHW, Canberra.

Australian Institute of Health and Welfare 2008c, *Rural, regional and remote health-indicators of health,* Series 9 AIHW cat. no. PHE97, AIHW, Canberra.

Australian Institute of Health and Welfare 2009, *A picture of Australia's children 2009*, AIHW, Canberra, viewed 7 July 2010, <http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=6442459928>.

Australian Institute of Health and Welfare 2011, *Nursing and midwifery workforce 2011*, AIHW, Canberra.

Australian Institute of Health and Welfare: Leeds KL, Gourley M, Laws PJ, Zhang J, Al-Yaman F & Sullivan EA 2007. *Indigenous mothers and their babies, Australia 2001–2004*. AIHW cat. no. PER 38. Perinatal statistics series no. 19, AIHW, Canberra.

Australian Medical Association 2013, *Maternal decision-making, position statement*, AMA, viewed 5 December 2013, <https://ama.com.au/position-statement/maternal-decision-making-2013>.

Australian Nursing & Midwifery Federation 2014, 'Influencing the future of public health in SA', *In Touch – News from ANMF SA Branch*, August, p. 3.

Bacchi, C, Eveline, J, Binns, J, Mackenzie, C & Harwood, S 2010, 'Gender Analysis and Social Change: Testing the Water', in C Bacchi & J Eveline (eds), *Mainstreaming politics: gendering practices and feminist theory*, Adelaide University Press, Adelaide, pp. 61–85.

Baerlocher, MO, Allan, S & Detsky, MD 2009, 'Professional monopolies in medicine', *The Journal of the American Medical Association*, vol. 301, no. 8, pp. 858–60.

Baghurst, P 2013, 'The case for retaining severe perineal tears as an indicator of the quality of obstetric care', *Australian and New Zealand Journal of Obstetrics and Gynaecology*, vol. 53, no. 1, pp. 3–8.

Banks, G 2009, 'Evidence-based policy-making: what is it? How do we get it?', in *ANZSOG/ANU Public Lecture Series 2009 4 February: Challenges of evidence-based policy making*, Canberra, pp. 1–27.

Banscott Health Consulting 2007, *Maternity Services Review in the Northern Territory*. Department of Health and Community Services. Available <http://www.health.nt.gov.au/Publications/Corporate_Publications/Maternity_Services_Model/index.aspx#ProposalsforanIntegratedMaternityServices>

Barclay, L & Tracy, SK 2010, 'Legally binding midwives to doctors is not collaboration', *Woman and Birth*, vol. 23, no. 1, pp. 1–2.

Barclay, L 2008, 'A feminist history of Australian midwifery from colonisation until the 1980s', *Women and Birth*, vol. 21, no. 1, pp. 3–8.

Barclay, L, Brodie, P, Lane, K, Leap, N, Reiger, K & Tracy, S 2003, *The Australian Midwifery Action Project Report*, Volume 1 and 2, University of Technology, Sydney.

Barclay, L, Farrington, C, Kildea, S & Kruske, S 2008, *Improving maternity services in Australia: Charles Darwin University Graduate School of Health Practice Response*, Charles Darwin University, Darwin.

Barclay, L, Tracy, S & Kildea, S 2008, *Maternity health reform has harmed women (but not obstetricians)*, viewed 19 November 2008, <http://www.crikey.com.au/2008/11/19/maternity-health-reform-has-harmed-women-but-not-obstetricians/>.

Bartholomew, K, Morton, S, Atatoa Carr, P, Bandara, D & Grant, C 2015, 'Provider engagement and choice in the Lead Maternity Carer System: evidence from Growing Up in New Zealand', *Australian and New Zealand Journal of Obstetrics and Gynaecology*, vol. 55, pp. 323–30.

Bartic, M & Reinhold, A 2010, 'The burden of suboptimal breastfeeding in the United States: a pediatric cost analysis', *Pediatrics*, vol. 125, no. 5, pp. e 1048–e56.

Bar-Zeev, S, Barclay, L, Farrington, C & Kildea, S 2012, 'From hospital to home: the quality and safety of a postnatal discharge system used for remote dwelling Aboriginal mothers and infants in the top end of Australia', *Midwifery*, vol. 28, no. 3, pp. 366–73.

Bar-Zeev, S, Barclay, L, Kruske, S & Kildea, S 2014, 'Factors affecting the quality of antenatal care provided to remote dwelling Aboriginal women in northern Australia', *Midwifery*, vol. 30, no. 3, pp. 289–96.

Bar-Zeev, S, Barclay, L, Kruske, S, Bar-Zeev, N, Gao, Y & Kildea, S 2013, 'Maternal health service use among remote dwelling Aboriginal women in northern Australia and their disease burden', *Birth*, vol. 40 no. 3 pp. 172–81.

Baum, C 2013, *Generalized linear models, EC 823: Applied Econometrics* (.ppt), viewed 3 January 2014, <http://fmwww.bc.edu/EC-C/S2013/823/EC823.S2013.nn06.slides.pdf>.

Baum, F 2008, 'Healthy economic policies', in *The new public health,* 3rd edn, Oxford University Press, Melbourne, pp. 371–88.

Baumgartner, S & Quaas, M 2010, 'What is sustainability economics?', *Ecological Economics*, vol. 69, no. 3, pp. 445–50.

Beck, U 2000, ‘Risk society revisited: Theory, politics and research programmes’, in Adam, B, Beck, U & Van Loon, J (eds), *The risk society and beyond: Critical issues for social theory*, Sage, London.

Begley, C, Devane, D, Clarke, M, McCann, C, Hughes, P, Reilly, M, Maguire, R, Higgins, S, Finan, A, Gormally, S & Doyle, M 2011, 'Comparison of midwife-led and consultant-led care of healthy women at low risk of childbirth complications in the Republic of Ireland: a randomised trial.', *BMC Pregnancy and Childbirth*, E publication Online, viewed 6 January 2013, <http://www.biomedcentral.com/1471–2393/11/85>.

Bellanger, M & Or, Z 2008, 'What can we learn from a cross-country comparison of of the costs of child delivery?', *Health Economics*, vol. 17 (Suppl. 1), pp. S47–S57.

Benoit, C, Zadoroznyj, M, Hallgrimsdottir, H, Treloar, A & Taylor, K 2010, 'Medical dominance and neoliberalisation in maternal care provision: the evidence from Canada and Australia', *Social Science & Medicine*, vol. 71, no. 3, pp. 475–81.

Bernitz, S, Aas, E & Oian, P 2012, 'Economic evaluation of birth care in low-risk women. A comparison between a midwife-led birth unit and a standard obstetric unit within the same hospital in Norway. A randomised controlled trial', *Midwifery*, vol. 28, pp. 591–9.

Bertilone, C & McEvoy, S 2015, 'Success in closing the gap: favourable neonatal outcomes in a metropolitan Aboriginal Maternity Group Practice Program', *Medical Journal of Australia*, vol. 203, no. 6, pp. 262.e1–.e7.

Bewley, S & Cockburn, J 2002a, 'Commentary I. The unethics of “request” caesarean section', *British Journal of Obstetrics and Gynaecology*, vol. 109, pp. 593–6.

Binstock, M & Wolde- Tsadik, G 1995, ‘Alternative prenatal care. Impact of reduced visit frequency, focused visits and continuity of care’,*Journal of Reproductive Medicine*, vol. 40, pp. 507–12.

Biro, M, Waldenstrom, U & Pannifex, J 2000, 'Team midwifery care in a tertiary level obstetric service: A randomised controlled trial.', *Birth*, vol. 27, no. 3, pp. 168–73.

Birthplace in England Collaborative Group, B, P, Hardy, P, Hollowell, J, Linsell L, Macfarlane A, McCourt C, Marlow N, Miller A, Newburn M, Petrou S, Puddicombe D, Redshaw M, Rowe R, Sandall J, Silverton L, Stewart M 2011, 'Perinatal and maternal outcomes by planned place of birth for healthy women with low risk pregnancies: the Birthplace in England national prospective cohort study', *British Medical Journal*, vol. 343, Nov 23;343:d7400. doi: 10.1136/bmj.d7400.

Boote, D & Beile, P 2005, 'Scholars before researchers: on the centrality of the dissertation literature review in research preparation', *Educational Researcher*, vol. 34, no. 6, pp. 3–15.

Booth, A, Papaioannou, D & Sutton, A 2012, *Systematic approaches to a successful literature review*, Sage, Thousand Oaks, CA.

Bowling, A 2007, *Handbook of health research methods*, McGraw Hill International (UK) Ltd, Maidenhead.

Boxall, A & Flitcroft, K 2007, 'From little things, big things grow: a local approach to system-wide maternity services reform in the absence of definitive evidence', *Australia & New Zealand Health Policy*, vol. 4, p. 18, E Publication online, <http://www.anzhealthpolicy.com/content/pdf/1743–8462–4–18.pdf>.

Boxall, A & Leeder, SR 2006, 'The health system: what should our priorities be?' *Health Promotion Journal of Australia*, vol. 17, no. 3, pp. 200–5.

Brayford, D, Chambers, R, Boath, E & Rogers, D 2008, *Evidence-based care for midwives: clinical effectiveness made easy*, 2nd edn, Radcliffe Publishing Ltd, Oxford, UK.

Brew, B, Kull, I, Garden, F & Almqvist, C 2012, 'Breastfeeding, asthma, and allergy: a tale of two cities', *Paediatric Allergy and Immunology*, vol. 23, no. 1, pp. 75–82.

Brinkman, S, McDermott, R & Lynch, J 2010, 'Better understanding trajectories of child development: opportunities for data linkage with the Australian Early Development Index (AEDI)', *Public Health Bulletin SA*, vol. 7, no. 3, pp. 7–10.

Brodie, P & Barclay, L 2001, 'Contemporary issues in Australian midwifery regulation', *Australian Health Review*, vol. 24(4), pp. 103–18.

Brodie, P 1998, 'Australian midwifery in transition – the agony and the ecstasy', paper presented to New Models of Maternity Service Provision: Australian Midwifery Perspectives conference, 5–6 November, Adelaide.

Brooks, P & Ellis, N 2007, 'Health workforce reform: rising to the challenge', *Centre For Policy Development*, pp. 1–8, viewed 30 June 2010, <http://cpd.org.au/article/health-workforce-reform-rising-to-the-challenge>

Brown, M & Dietsch, E 2013, 'The feasibility of caseload midwifery in rural Australia: a literature review', *Women and Birth*, vol. 26, vol. 1, pp. e1–e4, <http://www.sciencedirect.com/science/article/pii/S1871519212000637>.

Brown, S, Yelland, J, Sutherland, G, Baghurst, P & Robinson, J 2011, 'Stressful life events, social health issues, and low birthweight in an Australian population-based birth cohort: challenges and opportunities in antenatal care ', *BMC Public Health,* vol. 11, 196, online E publication, <http://www.biomedcentral.com/1471–2458/11/196>.

Bryant, J, Porter, M, Tracy, SK & Sullivan, E 2007, 'Caesarean birth: consumption, safety, order, and good mothering', *Social Science and Medicine*, vol. 65, pp. 1192–201.

Bryers, H & van Teijlingen, E 2010, 'Risk, theory, social and medical models: a critical analysis of the concept of risk in maternity care', *Midwifery*, vol. 26, no. 5, pp. 488–96.

Buckett, K & Maddock, A 2009, 'Public health law and private interests: a brief history of the politics of state regulation', *Public Health Bulletin SA*, vol. 6, no. 3, pp. 27–31.

Buist, AE, Austin, MP, Hayes, BA, Speelman, C, Bilszta, JL & Gemmill, AW 2008, 'Postnatal mental health of women giving birth in Australia 2002–2004: findings from the beyondblue National Postnatal Depression Program', *Australian New Zealand Journal of Psychiatry*, vol. 42, no. 1, pp. 66–73.

Burns, N & Grove, SK 2005, *The practice of nursing research: Conduct, critique, and utilization,* 5th edn, Saunders, Elsevier, St Louis, MO.

Buttery, L 2015, 'Ten years of Midwifery Group Practice (MGP) at the Women's and Children's Hospital (WCH), Adelaide', *Women and Birth*, vol. 28, no. Supp 1, p. S 42.

Buttner, P & Muller, R 2011, *Epidemiology*, Oxford University Press, Melbourne.

Byrne, J, Crowther, C & Moss, J 2000, 'A randomised controlled trial comparing birthing centre care with delivery suite care in Adelaide, Australia.', *The Australian and New Zealand Journal of Obstetrics and Gynaecology*, vol. 40, no. 3, pp. 268–74.

Caines, J 2004, 'President's report', *Birth Matters, Journal of the Maternity Coalition*, vol. 8.4, p. 3.

Caird, J, Rees, R, Kavanagh, J, Sutcliffe, K, Oliver, K, Dickson, K, Woodman, J, Barnett-Page, E & Thomas, J 2010, *The socioeconomic value of nursing and midwifery: A rapid systematic review of reviews*, EPPI Centre, Social Science Research Unit, Institute of Education, University of London, London, viewed 8 December 2010, <https://eppi.ioe.ac.uk/cms/LinkClick.aspx?fileticket=1QwTmUVUPWs%3D&tabid=2469&language=en-US>.

Callahan, J 2014, 'Writing literature reviews: a reprise and update', *Human Resource Development Review*, vol. 13, no. 3, pp. 271–5.

Campbell, R & Garcia, J 1997, *The organization of maternity care: a guide to evaluation*, 1st edn, Hochland & Hochland Ltd, Cheshire, England.

Campo-Englestein, L, Howland, L, Parker, W & Burcher, P 2015, 'Scheduling the stork: media portrayals of women's and physicians' reasons for elective cesarean delivery', *Birth*, vol. 42, no. 2, pp.181–8.

Cancer Council Australia 2014, viewed online 18 August 2014, <http://www.cancer.org.au/>.

Cardwell, CR, Stene, LC, Joner, G, Cinek, O, Svensson, J, Goldacre, MJ, Parslow, RC, Pozzilli, P, Brigis, G, Stoyanov, D, Urbonaite, B, Sipetic, S, Schober, E, Ionescu-Tirgoviste, C, Devoti, G, De Beaufort, CE, Buschard, K & Patterson, CC 2008, 'Caesarean section is associated with an increased risk of childhood-onset type 1 diabetes mellitus: a meta-analysis of observational studies', *Diabetologia*, vol. 51, no. 5, pp. 726–35.

Carter, E, Lumley, J, Wilson, G & Bell, S 2004, ''Alukura . . . for my daughters and their daughters and their daughters'. A review of Congress Alukura', *Australian and New Zealand Journal of Public Health*, vol. 28, pp. 229–34.

Carter, MC, Corry, M, Delbanco, S, Foster, TCS, Friedland, R, Gabel, R, Gipson, J, Joliveit, R, Main, E, Sakala, C, Simpkin, P & Simpson, KR 2010, '2020 Vision for a high-quality, high-value maternity care system', *Women's Health Issues*, vol. 20, no. 1 pp. Supplement S7–S17.

Challis, D 2008, 'Submission to National Health and Hospitals Reform Commission: Reducing inefficiencies generated by cost-shifting, blame-shifting and buck passing / Providing a well qualified and sustainable health workforce', *National Inquiry: The National Health & Hospital Reform Commission*, Sydney, June 5.

Cherniak, D & Fisher, J 2008, 'Explaining obstetric interventionism: technical skills, common conceptualisations, or collective countertransference?', *Women's Studies International Forum*, vol. 31, no. 4, pp. 270–7.

Clark, L, Mugford, M & Paterson, C 1991, 'How does mode of delivery affect the cost of maternity care?', *BJOG*, vol. 98, pp. 519–23.

Cluett, ER & Bluff, R 2006, *Principles and practice of research in midwifery,* 2nd edn, Churchill Livingstone Elsevier, Edinburgh, UK.

Coelli, TJ, Rao, DSP, O'Donnell, CJ & Battese, GE 2005, *An introduction to efficiency and productivity analysis*, 2nd edn, Springer Science, New York.

Commission on Social Determinants of Health 2007, *Achieving health equity: from root causes to fair outcomes*, Commission on Social Determinants of Health, World Health Organization, Geneva.

Commonwealth Department of Health and Ageing 2010, *National Hospital Cost Data Collection*, Canberra.

Commonwealth of Australia 2011, *National maternity services plan*, The Australian Health Ministers' Conference, Government of Australia, Canberra, online, viewed 8 December 2013, <http://www.health.gov.au/internet/publications/publishing.nsf/Content/pacd-maternityservicesplan-toc>.

Commonwealth of Australia 2014, *Australian early development census – 2012 Summary report*, Government of Australia, Canberra.

Community Midwifery Western Australia 2006, *Annual Report 2005–2006*, Community Midwifery WA Inc., Fremantle.

Corder, G & Foreman, D 2014, *Nonparametric statistics: a step-by-step approach*, Wiley, New York.

Cornwell, C, Donnellan-Fernandez, R & Nixon, A 2008, 'Chapter 6: Planning and implementing mainstream midwifery group practices in a tertiary setting', in C Homer, P Brodie & N Leap (eds), *Midwifery continuity of care: a practical guide*, Elsevier Australia, Chatswood, NSW, pp. 107–26.

Coyle, KL, Hauck, Y, Percival, P & Kristjanson, LJ 2001a, 'Normality and collaboration: mothers' perceptions of birth centre versus hospital care ', *Midwifery*, vol. 17, no. 3, pp. 182–93.

Coyle, KL, Hauck, Y, Percival, P & Kristjanson, LJ 2001b, 'Ongoing relationships with a personal focus: mothers' perceptions of birth centre versus hospital care', *Midwifery*, vol. 17, no. 3, pp. 171–81.

Craswell, G 2005, *Writing for academic success: a postgraduate guide*, Sage Publications, London.

Creedy, DK, Shochet, IM & Horsfall, J 2000, 'Childbirth and the development of acute trauma symptoms: Incidence and contributing factors', *Birth*, vol. 27(2), pp. 104–11.

Crettenden, I, McCarty, M, Fenech, B, Heywood, T, Taitz, M & Tudman, S 2014, 'How evidence-based workforce planning in Australia is informing policy development in the retention and distribution of the health workforce', *Human Resources for Health,* vol. 12, no. 7, pp. 1–13,< http://www.human-resources-health.com/content/12/1/7 pp 1–13>.

Dahlen, H, Jackson, M & Stevens, J 2011a, 'Homebirth, freebirth and doulas: casualty and consequences of a broken maternity system', *Women and Birth*, vol. 24, no. 1, pp. 47–50.

Dahlen, H, Jackson, M, Schmied, V, Tracy, S & Priddis, H 2011b, 'Birth centres and the national maternity services review: Response to consumer demand or compromise?', *Women and Birth*, vol. 24, no. 4, pp. 165–72.

Dahlen, H, Schmied, V, Tracy, SK, Jackson, M, Cummings, J & Priddis, H 2011c, 'Home birth and the National Australian Maternity Services Review: too hot to handle?', *Women and Birth*, vol. 24, no. 4, pp. 148–55.

Dahlen, H, Tracy, S, Tracy, M, Bisits, A, Brown, C & Thornton, C 2012, 'Rates of obstetric intervention among low-risk women giving birth in private and public hospitals in NSW: a population-based descriptive study', *British Medical Journal Open 2012 2*, pp. e001723.10.1136/bmjopen-2012-.

Davies, L, Daellenbach, R & Kensington, M 2011, *Sustainability, midwifery and birth*, Routledge, New York.

Davis, D, Baddock, S, Pairman, S, Hunter, M, Benn, C, Wilson, D, Dixon, L & Herbison, P 2011, 'Planned place of birth in New Zealand: does it affect mode of birth and intervention rates among low-risk women?', *Birth*, vol. 38, no. 2, pp. 111–9.

Davis-Floyd, R, Barclay, L, Daviss, B & Tritten, J 2009, *Birth models that work*, California Press, Ltd, Berkeley, CA.

Davis-Floyd, R, Pascal- Bonaro, D, Davies, R & Gomez Ponce de Leon, R 2010, 'The International MotherBaby Childbirth Initiative: a human rights approach to optimal maternity care', *Midwifery Today*, vol. 94, no. Summer 2010, <http://www.midwiferytoday.com/articles/imbci.asp>.

Davison, C, Hauck, Y, Bayes, S, Kuliukas, L & Wood, J 2015, 'The relationship is everything: women's reasons for choosing a privately practising midwife to provide maternity care in Western Australia', *Midwifery*, vol. 31, no. 8, pp. 772–8.

Dawson, K, Newton, M, Forster, D & McLachlan, H 2015, 'Caseload midwifery in Australia: what access do women have?', *Women and Birth*, vol. 28, no. Supp 1, p. S 12.

de Jonge, A, van der Goes, B, Ravelli, A, Amelink-Verburg, M, Mol, B, Nijhuis, J, Gravenhorst, J & Buitendijk, S 2009, 'Perinatal mortality and morbidity in a nationwide cohort of 529 688 low-risk planned home and hospital births', *BJOG*, vol. 116, no. 9, pp. 1177–84.

Deeble, J 2002, 'Funding the essentials: the Australian health care agreements 2003–2008', *Australian Health Review*, vol. 25, no. 6, pp. 1–7.

Deeble, J 2009, 'Reflections of a retiring health economist, Annual Chalmers Oration, Flinders Medical Centre, 23 July 2009', Flinders University, South Australia.

Department of Health and Ageing 2012, *ANAO Audit Report No.35 2011–12 Indigenous early childhood development new directions: mothers and babies services,* Department of Health and Ageing, Canbera.

Department of Health NSW 1989, *Maternity services in New South Wales. Final report of the Ministerial Taskforce on Obstetric Services in New South Wales (Shearman Report)*, Department of Health NSW.

Department of Health NSW 2000, *NSW Framework for Maternity Services 2000-2005*, Department of Health NSW, Sydney.

Department of Health Services 2004, *Future directions for Victoria's maternity services*, Department of Human Services, Victoria.

Department of Health Services 2004, *Future Directions for Victoria's Maternity Services*, Department of Human Services Victoria.

Department of Health UK 2002, *DOH New NHS – 2001 reference costs*, archived document online, viewed 2012 <http://webarchive.nationalarchives.gov.uk/+/www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4007056?PageOperation=email>.

Department of Human Services 2003, *Better choices, better health. Final report of the South Australian Generational Health Review (Menadue Report)*, Government of South Australia, Adelaide.

Deputy State Coroner Anthony Ernest Schapel 2012, *Finding of Inquest – Spencer-Koch, Tate and Hobbs, Jahli Jean and Kavanagh, Tully Oliver* 17/2010 (0984/2007, 0703/2009) & 45/2011 (1628/2011), South Australian Coroner's Court, South Australia, pp. 1–106, viewed online, <http://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjG_dbqu6DKAhWBE6YKHVQtA-QQFggbMAA&url=http%3A%2F%2Fwww.courts.sa.gov.au%2FCoronersFindings%2FLists%2FCoroners%2520Findings%2FAttachments%2F531%2FHome%2520Birthing%2520-%2520SPENCER-KOCH%2520Tate%2520and%2520HOBBS%2520Jahli%2520Jean%2520and%2520KAVANAGH%2520Tully%2520Oliver.docx&usg=AFQjCNEA4IXtKeMdBo2CvUIssUOeuOKArw>.

Devane, D, Brennan, M, Begley, C, Clarke, M, Walsh, D, Sandall, J, Ryan, P, Revill, P & Normand, C 2010, *Socioeconomic value of the midwife: a systematic review, meta-analysis, meta-synthesis and economic analysis of midwife-led models of care*, Royal College of Midwives, London, pp. 1–93, online, <https://www.rcm.org.uk/sites/default/files/Socioeconomic%20A4%20Report%2005%20FINAL%20040511.pdf>.

Dietsch, E, Davies, C, Shackleton, P, Alston, M & McCleod, M 2008, *'Luckily we had a torch': Contemporary birthing experiences of women living in rural and remote NSW*, School of Nursing & Midwifery, Faculty of Science, Charles Sturt University, NSW, pp. 1–131, online, <http://bahsl.com.au/old/pdf/birthing-in-rural-remote-NSW.pdf>.

Dodd, J, Grivell, R, Nguyen, A, Chan, A & Robinson, J 2011, 'Maternal and perinatal health outcomes by body mass index category', *Australian and New Zealand Journal of Obstetrics and Gynaecology*, vol. 51, no. 2, pp. 136–40.

Donabedian, A 1966, 'Evaluating the Quality of Medical Care', *The Milbank Memorial Fund Quarterly*, vol. 44, no. 3, pp. 166–203.

Donabedian, A 1980, *Explorations in quality assessment and monitoring vol. 1. The definition of quality and approaches to its assessment,* Health Administration Press, Ann Arbor, MI.

Donabedian, A 1982, *Explorations in quality assessment and monitoring: The definition of quality and approaches to its assessment. Vol II. The criteria and standards of quality,* Health Administration Press, Ann Arbor, MI.

Donabedian, A 1983, ‘Quality, cost, and clinical decisions’, *The Annals of the American Academy of Political and Social Science*, July, vol. 468, pp. 196-204.

Donabedian, A 1985, Explorations in quality assessment and monitoring: The definition of quality and approaches to its assessment. Vol III. The methods and findings of quality assesment measurement and monitoring, Health Administration Press, Ann Arbor, MI.

Donabedian, A 1990, 'The seven pillars of quality', *Archives of Pathology and Laboratory Medicine*, vol. 114, no. 11, pp. 1115–8.

Donabedian, A 2003, *An introduction to quality assurance in health care*, Oxford University Press, New York.

Donabedian, A 2005, 'Evaluating the quality of medical care (Reprinted from The Milbank Memorial Fund Quarterly, vol. 44, no. 3, Pt. 2, 1966, pp. 166–203)', *The Milbank Quarterly*, vol. 83, no. 4, pp. 691–729.

Donabedian, A, Wheeler, J & Wyszewianski, L 1982, 'Quality, cost, and health: an integrative model', *Medical Care*, vol. 20, no. 10, pp. 975-92.

Donnellan-Fernandez, R & Eastaugh, M 2003, 'Midwifery regulation in Australia: a century of invisibility', paper presented to Innovations In Regulation, 6th International Conference on the Regulation of Nursing and Midwifery, 26–28 October, Melbourne, Australia, online, <http://hdl.handle.net/2328/26652>.

Donnellan-Fernandez, R 2011a, 'Having a baby in Australia: women's business, risky business, or big business?', *Outskirts: feminisms along the edge*, vol. 24 online, <http://www.outskirts.arts.uwa.edu.au/volumes/volume-24/donnellan-fernandez#top>.

Donnellan-Fernandez, R 2013, 'Midwifery Group Practice v Standard Hospital Care: a cost and resource study', *Australian Midwifery News*, vol. 13, no. 4, pp. 9—11, online, <http://hdl.handle.net/2328/35035>.

Donnellan-Fernandez, R, Newman, L, Reiger, K & Tracy, S 2008, 'Maternity funding & workforce reform: strategies for better design, better value, better health & equity', paper presented to Casemix Evolution: extending the boundaries, Adelaide, 15 November, online, <http://hdl.handle.net/2328/26687>.

Donnellan-Fernandez, R, Newman, L, Reiger, K & Tracy, SK 2013, 'Identifying better systems design in Australian maternity care: a Boundary Critique analysis', *Health Systems*, vol. 2, no. 3, pp. 213–25, online, <http://hdl.handle.net/2328/2689>.

Drummond, MF 2003, *Costing constitutional change: estimates of savings in health,* Presentation to Australian Health Care Summit, August 2003, Canberra.

Drummond, MF, O'Brien, B, Stoddart, GL & Torrance, GW 1997, *Methods for the economic evaluation of health care programmes*, 2nd edn, Oxford University Press, Oxford.

Drummond, MF, Sculpher, MJ, Torrance, GW, O'Brien, BJ & Stoddart, GL 2005, *Methods for the economic evaluation of health care programmes,* 3rd edn, Oxford University Press, Oxford, UK.

Duckett, S & Jackson, T 2000, 'The new health insurance rebate: an inefficient way of assisting public hospitals', *MJA: The Medical Journal of Australia*, vol. 172, pp. 439–42.

Duckett, S & Willcox, S 2011, *The Australian health care system,* 4th edn, Oxford University Press, Melbourne.

Duckett, S, Breadon, P, Romanes, D, Fennessy, P & J, N 2015, *Questionable care: stopping ineffective treatments,* Grattan Institute, Melbourne, Australia, online, viewed 8 October 2015, <http://grattan.edu.au/wp-content/uploads/2015/08/828-Questionable-Care3.pdf>.

Duckett, SJ 2007, *The Australian healthcare system,* 3rd edn, Oxford University Press, Oxford.

Dugdale, P 2008, *Doing health policy in Australia*, Allen & Unwin, Sydney.

Dyson, L, McCormick, F & Renfrew, M 2007, 'Interventions for promoting the initiation of breastfeeding', *Cochrane Datbase of Systematic Reviews*, vol. 4:CD001688, online, viewed 8 December 2015, <http://apps.who.int/rhl/reviews/CD001688sp.pdf>.

Eckermann, S & Coelli, TJ 2008, 'Including quality attributes in a model of health care efficiency: A net benefit approach', *Centre for Efficiency and Productivity Analysis Working Paper Series*, vol. No. WP03/2008, pp. 1–35, viewed June 30 2010, <http://www.uq.edu.au/economics/cepa/docs/WP/WP032008.pdf>.

Eckermann, S & Coelli, TJ 2013, 'Including quality attributes in efficiency measures consistejnt with net benefit: creating incentives for evidence based medicine in practice', *Social Science & Medicine*, 76, pp. 159–68.

Eckermann, S 2004, 'Hospital performance including quality: creating economic incentives consistent with evidence-based medicine', PhD thesis, University of New South Wales, Sydney.

Eckermann, S 2007, *Measuring hospital efficiency consistent with maximising net benefit*, Flinders Centre for Clinical Change and Health Care Research, Flinders University, Adelaide, South Australia, online, viewed 7 July 2009, <https://www.flinders.edu.au/centres-files/fccchcr/documents/Working%20Paper%20No%202007_01.pdf>.

Eckermann, S 2009a, *Measuring health system efficiency and funding for net benefit maximisation: the health economics of quality of care*, Flinders University, Adelaide, South Australia, online, viewed 4 April 2010, <http://www.pc.gov.au/inquiries/completed/hospitals/submissions/sub010-attachment1.pdf>.

Eckermann, S 2009b, *Funding to maximise quality of care within a budget: bringing net benefit to casemix funding*, Flinders University, Adelaide, South Australia, online, viewed 8 March 2010, <https://www.flinders.edu.au/centres-files/fccchcr/documents/Working%20Paper%20No%202009_09.pdf>.

Elshaug, AG, Hiller, JE, Tunis, SR & Moss, JR 2007, 'Challenges in Australian policy processes for disinvestment from existing, ineffective health care practices', *Australian & New Zealand Health Policy*, vol. 4, no. 23. Available online at: <http://www.anzhealthpolicy.com/content/4/1/23>.

Fahy, K 2007, 'An Australian history of the subordination of midwifery', *Women and Birth*, vol. 20, no. 1, pp. 25–9.

Fenwick, J, Gamble, J, Nathan, E, Bayes, S & Hauck, Y 2009, 'Pre- and postpartum levels of childbirth fear and the relationship to birth outcomes in a cohort of Australian women', *Journal of Clinical Nursing*, vol. 18, no. 5 pp. 667–77.

Fereday, J & Oster, C 2008, 'Managing a work–life balance: the experiences of midwives working in a group practice setting', *Midwifery*, vol. 26, no. 3, pp. 311–8, doi: 10.1016/j.midw.2008.06.004. Epub 2008 Aug 23.

Fereday, J, Collins, C, Turnbull, D, Pincombe, J & Oster, C 2009, 'An evaluation of Midwifery Group Practice Part II: Women's satisfaction', *Women and Birth*, vol. 22, no. 1, pp. 11–6.

Fitzgerald J 2015, *Options for finance in primary care in Australia*. *Deeble Institute Health Policy Issues Brief* No 11, 6 July, viewed online 8 October 2015, <http://ahha.asn.au/system/files/docs/publications/deeble_institute_issues_brief_no._11_fitzgerald.pdf>.

Flint, C, Poulengeris, P & Grant, A 1989, 'The 'Know your midwife' scheme – a randomised trial of continuity of care by a team of midwives ', *Midwifery*, vol. 5, no. 1, pp. 11–6.

Folland, S, Goodman, AC & Stano, M 2007, *The economics of health and health care*, 5th edn, Pearson, Prentice Hall, Upper Saddle River, NJ.

Gao, Y, Gold, L, Josif, C, Bar-Zeev, S, Steenkamp, M, Barclay, L, Zhao, Y, Tracy, S & Kildea, S 2014, 'A cost-consequences analysis of a Midwifery Group Practice for Aboriginal mothers and infants in the Top End of the Northern Territory, Australia', *Midwifery*, vol. 30, no. 4, pp. 447–55.

Garrard, J 2007, *Health sciences literature review made easy: the matrix method,* 2nd edn, Jones and Bartlett, Sudbury, MA.

Gelman, A & Hill, J 2006, 'Chapter 25 Missing-data imputation', in *Data analysis using regression and multilevel/hierarchical models*, Cambridge University Press, Cambridge, UK, pp. 529–43.

Gibbons, L, Belizan, J, Lauer, J, Betran, A, Merialdi, M & Althabe, F 2010, *The global numbers and costs of additionally needed and unnecessary caesarean sections performed per year: overuse as a barrier to universal coverage*, World Health Organization, Geneva, pp. 1–32, online, <http://www.who.int/healthsystems/topics/financing/healthreport/30C-sectioncosts.pdf>.

Giles, W, Collins, J, Ong, F & Macdonald, R 1992, 'Antenatal care of low risk obstetric patients by midwives A randomised controlled trial', *Medical Journal of Australia*, vol. 157, pp. 158–61.

Gillespie, B & Chaboyer, W 2013, 'Chapter 12 Assessing measuring instruments', in Z Schneider, D Whitehead, G LoBiondo-Wood & J Haber (eds), *Nursing and Midwifery Research methods and appraisal for evidence-based practice,* 4th edn, Elsevier, Sydney, pp. 218–36.

Glickman, S, Baggett, K, Krubert, C, Peterson, E & Schulman, K 2007, 'Promoting quality: the health-care organization from a management perspective', *International Journal for Quality in Health Care*, vol. 19, no. 6, pp. 341–8.

Glover, J, Hetzel, D, Glover, L, Tennant, S & Page, A 2006, *A social health atlas of South Australia, Third Edition,*, Public Health Information Development Unit, The University of Adelaide, Adelaide.

Government of NSW 2006, *NSW Aboriginal maternal and infant health strategy evaluation: final report 2005*, NSW Health, NSW Health, Sydney.

Government of South Australia 2005a, *Children Youth and Women's Health Service Strategic Plan*, Government of South Australia, CYWHS, Adelaide.

Government of South Australia 2005b, *South Australian Women's Health Policy*, Department of Health, Adelaide.

Government of South Australia 2009, *Hospital code of conduct for research*, Government of South Australia, Children Youth & Women's Health Service.

Government of South Australia 2015, *Transforming health*, Government of South Australia, Adelaide.

Government of South Australia Health Department 2007, *South Australian Health Care Plan*, Government of South Australia, Adelaide.

Government of Western Australia 2007, *Improving maternity services: working together across Western Australia – a policy framework*, Department of Health, Government of Western Australia, Perth, Western Australia.

Graham, H 2009, 'Health inequalities, social determinants and public health policy', paper presented to Inaugural Southgate Oration: Flinders University, Southgate Institute for Health, Society and Equity, Flinders University, Adelaide, 17 March.

Gray Jamieson, G 2012, 'Chapter 6: Women's reproductive rights: confronting power', in *Reaching for health – The Australian women's health movement and public policy*, ANU E Press, Canberra, pp. 179–214.

Grbich, C 2004, *Health in Australia: sociological concepts and issues,*3rd edn, Longman, Sydney, NSW.

Green, S & Salkind, N 2008, *Using SPSS for Windows and Macintosh: analyzing and understanding data,* 5th edn, Pearson Prentice Hall, Upper Saddle River, NJ.

Greenhalgh, T & Peacock, R 2005, 'Effectiveness and efficiency of search methods in systematic reviews of complex evidence: audit of primary sources', *British Medical Journal*, vol. 331, no. 7524, pp.1064–1065.

Grove, SK 2007, *Statistics for health care research: a practical workbook*, Saunders, Elsevier, St Louis, MO.

Guilliland, K & Tracy, S 2015, 'Chapter 1: Australian and New Zealand midwifery and maternity services', in S Pairman, Pincombe, J, Thorogood, C, Tracy, S (eds.), *Midwifery preparation for practice,* Elsevier, Sydney, pp. 3–38.

Hambly, M 1997, *Alternative birthing services program in the ACT: community midwives pilot project evaluation*, Australian Capital Territory Government, Canberra.

Hancock, H 2006, *Aboriginal women's perinatal needs, experiences and maternity services: A literature review to enable considerations to be made about quality indicators*, Ngaannyatjarra Health Service (Aboriginal Corporation), Alice Springs.

Hancock, H 2007, 'Low birth weight in Aboriginal babies – a need for rethinking Aboriginal women's pregnancies and birthing', *Women and Birth*, vol. 20, no. 2, pp. 77–80.

Hardin, J & Hilbe, J 2012, *Generalized linear models and extensions,* 3rd edn, Stata Press, Texas.

Harris, M & Taylor, G 2004, *Medical statistics made easy*, Taylor & Francis, London.

Hartz, D, Foureur, M & Tracy, S, K. 2012, 'Australian caseload midwifery: the exception or the rule', *Women and Birth*, vol. 25, no. 1, pp. 39–46.

Hartz, D, White, J, Lainchbury, KA, Gunn, H, Jarman, H, Welsh, AW, Challis, D & Tracy, SK 2012, 'Australian maternity reform through clinical redesign', *Australian Health Review*, vol. 36, no. 2, pp. 169–75.

Harvey, S, Jarrell, J, Brant, R, Stainton, C & Rach, D 1996, ‘A randomized, controlled trial of nurse-midwifery care’, *Birth*, vol. 23, no. 3, pp. 128-135.

Health and Hospital Reform Commission 2009, *A healthier future for all Australians – Final report of the National Health and Hospitals Reform Commission (HHRC)*, Commonwealth of Australia, Canberra.

Health Department of WA 1990, *Report of the Ministerial Task Force to Review Obstetric, Neonatal and Gynaecological Services in Western Australia,* Western Australia Ministerial Taskforce to Review Obstetric Neonatal and Gynaecological Services in Western Australia.

Health Department Victoria 1990, *Having a baby in Victoria: Final Report of the Ministerial Review of Birthing Services in Victoria*, Health Department of Victoria.

Health Workforce Australia 2012, *Health Workforce 2025 – doctors, nurses and midwives – Volume 1*, Health Workforce Australia, Government of Australia, Canberra.

Hellerstein, J 2008, *Quantitative data cleaning for large databases* (pdf), EECS Computer Science Division: 3, viewed 27 March 2015, <http://db.cs.berkeley.edu/jmh/papers/cleaning-unece.pdf>.

Hemingway, P & Brereton, N 2009, *What is a systematic review?* 2nd edn, Hayward Medical Communications, Oxford, UK, viewed 8 July 2015, <http://www.medicine.ox.ac.uk/bandolier/painres/download/whatis/syst-review.pdf>.

Henderson, J & Mugford, M 1997, Chapter 10 'An economic evaluation of home births', in G Chamberlain, A Wraight & P Crowley (eds), *Homebirths: the report of the 1994 confidential enquiry by the National Birthday Trust Fund*, Parthenon, London, pp. 191–212

Henderson, J & Petrou, S 2008, 'Economic Implications of home births and birth centers: a structured review', *Birth*, vol. 35, pp. 136–46.

Henderson, J 2005, *Appendix D: What evidence do we have about the cost-effectiveness of different models of maternity care?* National Perinatal Epidemiology Unit (NPEU), University of Oxford, Oxford, UK, pp. 63–76.

Henderson, J, McCandlish, R, Kumiega, L & Petrou, S 2001, 'Systematic review of economic aspects of alternative modes of delivery', *British Journal of Obstetrics and Gynaecology*, vol. 108, pp. 149–57.

Henderson, J, Roberts, T, Sikorski, J, Wilson, J & Clement, S 2000, 'An economic evaluation comparing two schedules of antenatal visits', *Journal of Health Services Research and Policy*, vol. 5, no. 2, pp. 69–75.

Hendrix, M, Evers, S, Basten, M, Nijhuis, J & Severens, J 2009a, 'Cost analysis of the Dutch Obstetric System: low-risk nulliparous women preferring home or short-stay hospital birth: a prospective non-randomised controlled study', *BMC Health Services Research*, vol. 9, 211, E publication online, viewed 7 July 2010, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2784768/pdf/1472–6963–9–211.pdf>.

Hendrix, M, Van Horck, M, Moreta, D, Nieman, F, Nieuwenhuijze, M & Severens, J 2009b, 'Why women do not accept randomisation for place of birth: feasibility of a RCT in the Netherlands', *BJOG*, vol. 116, no. 4, pp. 537–44.

Heshmati, A 2003, 'Productivity, growth, efficiency and outsourcing in manufacturing and service industries', *Journal of Economic Surveys*, vol. 17, no. 1, pp. 1–112.

Hilbe, J 2007, *Negative binomial regression. (An addendum – Brief overview on interpreting count model risk ratios 2008)*, Cambridge University Press, Cambridge, UK

Hilbe, J 2009, *Logistic regression models*, Chapman & Hall/CRC, Taylor Francis Group, Boca Raton, FL.

Hilbe, J 2011, *Negative binomial regression*, 2nd edn, Cambridge University Press, Cambridge, UK.

Hilder, L, Zhichao, Z, Parker, M, Jahan, S & Chambers, G 2014, *Australia's mothers and babies 2012. Perinatal statistics series* no. 30. Cat. no. PER 69., AIHW, Canberra.

Hirst, C 2005, *Re-Birthing: Report of the review of Maternity Services in Queensland*, Queensland Health, Brisbane.

Hitzler, P & Janowicz, K 2013, 'Linked data, big data, and the 4'th paradigm', *Semantic Web*, May, pp. 1–3, online, <http://www.semantic-web-journal.net/system/files/swj488.pdf>.

Hodnett, ED 2004, *Continuity of caregivers for care during pregnancy and childbirth*, John Wiley and Sons, Chichester, UK.

Hoffman, K, Pischon, T, Schulz, M, Schulze, M, Ray, J & Boeing, H 2008, 'A statistical test for the equality of differently adjusted incidence rate ratios', *Americal Journal of Epidemiology*, vol. 167, no. 5, pp. 517–22.

Holman, D 2012, *Introductory analysis of linked health data: principles and hands-on applications (Version 2.5)*, Statistical Society of Australia Inc. (SSAI) / Flinders Centre for Epidemiology and Biostatistics (FCEB).

Homer, C 2002, 'Private health insurance uptake and the impact on normal birth and costs: a hypothetical model', *Australian Health Review*, vol. 25, no. 2, pp. 32–7.

Homer, C, Biggs, J, Vaughan, G & Sullivan, E 2011, 'Mapping maternity services in Australia: Location, classification and services', *Australian Health Review*, vol. 35, no. 2, pp. 222–9.

Homer, C, Brodie, P & Leap, N 2001, *Establishing models of continuity of midwifery care in Australia: A resource guide for midwives and managers*, University of Technology, Sydney.

Homer, C, Brodie, P & Leap, N 2008, *Midwifery continuity of care: a practical guide*, Churchill Livingstone Elsevier, Chatswood, NSW.

Homer, C, Davis, G, Brodie, P, Sheehan, A, Barclay, L, Wills, J & Chapman, G 2001, 'Collaboration in maternity care: a randomised controlled trial comparing community-based continuity of care with standard hospital care', *BJOG: An International Journal of Obstetrics & Gynaecology*, vol. 108, pp. 16–22.

Homer, C, Friberg, IK, Dias, MAB, ten Hoope-Bender, P, Sandall, J, Speciale, AM & Bartlett, LA 2014, 'The projected effect of scaling up midwifery', *The Lancet*, vol. 384, no. 9948, pp. 1146–57.

Homer, C, Matha, D Jordan, L, Wills, J, Davis, G 2001, Community-based continuity of midwifery care versus standard hospital care: a cost analysis, *Australian Health Review*, vol. 24, no. 1, pp. 85–93.

House of Representatives Standing Committee on Health and Ageing 2006, *The Blame Game Report on the inquiry into health funding*, Parliament of the Commonwealth of Australia, Canberra.

House of Representatives Standing Committee on Health and Ageing 2007, *The Best Start: Report on the inquiry into the health benefits of breastfeeding*, House of Representatives Standing Committee on Health and Ageing, Canberra.

Hundley, V, Cruickshank, F, Lang, G, Glazener, C, Milne, J, Turner, M, Blythe, D, Mollison, J & Donaldson, C 1994, ‘Midwife managed delivery unit: A randomised controlled comparison with consultant led care’, *British Medical Journal*, 309, pp. 1400-04.

Hundley, V, Donaldson, C, Lang, G, Cruickshank, F, Glazener, C, Milne, J & Mollison, J 1995, 'Costs of intrapartum care in a midwife-managed delivery unit and a consultant-led labour ward', *Midwifery*, vol. 11, no. 3, pp. 103–9.

Hutchinson, K & Holtman, M 2005, 'Analysis of count data using Poisson regression', *Research in Nursing & Health*, vol. 28, no. 5, pp. 408– – 18.

Hyde, M, Mostyn, A, Modi, N & Kemp, P 2012, 'The health implications of birth by caesarean section', *Biological Reviews*, vol. 87, no. 1, pp. 229–43.

Hyndman, J, Holman, C & Hockey, R 1995, 'Misclassification of social disadvantage based on geographic areas: comparison of postcode and collector's district analyses', *International Journal of Epidemiology*, vol. 24, no. 1, pp. 165–76.

Illich, I 1976, *Limits to medicine – medical nemesis: the expropriation of health*, Marion Boyers, London.

Independent Hospital Pricing Authority (IHPA) 2013, <http://www.ihpa.gov.au/internet/ihpa/publishing.nsf>.

International Confederation of Midwives 2011, 'International definition of a midwife updated,' 28th Triennial Congress, *Midwifery: A worldwide commitment to women and the newborn*, Glasgow, Scotland, 2–6 June.

Jadad, AR & Enkin, MW 2007, *Randomized controlled trials: questions, answers and musings,* 2nd edn, Blackwell BMJ Books, Oxford.

Jan, S, Conaty, S, Hecker, R, Bartlett, M, Delaney, S & Capon, T 2004, 'An holistic economic evaluation of an Aboriginal community-controlled midwifery program in Western Sydney', *Journal of Health Services Research & Policy*, vol. 9, no. 1, pp. 14–21.

Jefferson, T, Demicheli, V & Mugford, M 1996, *Elementary economic evaluation in health care*, BMJ Publishing Group, London.

Jongen, C, McCalman, J, Bainbridge, R & Tsey, K 2014, 'Aboriginal and Torres Strait Islander maternal and child health and wellbeing: a systematic search of programs and services in Australian primary health care settings', *BMC Pregnancy and Childbirth*, vol. 14, p. 251, E publication online, viewed 8 December 2014, <http://www.biomedcentral.com/1471–2393/14/251>.

Kant, I 1787/1965, *Critique of pure reason* (2nd ed), trans N.K. Smith, New York, St Martin's Press, New York.

Katz, M 2006, *Multivariable analysis: a practical guide for clinicians,* 2nd edn, Cambridge University Press, New York.

Keleher, H & McDougall, C 2015, *Understanding health*, Oxford University Press, Melbourne, VIC.

Kelman, C, Bass, A & Holman, C 2002, 'Research use of linked health data – a 'best practice' protocol', *ANZ Jounal of Public Health*, vol. 26, no. 3 pp. 251–5.

Kennedy, M 2007, 'Defining a literature', *Educational Researcher*, vol. 36, no. 3 pp. 139–47.

Kenny, P, Brodie, P, Eckermann, S & Hall, J 1994, *Westmead Hospital team midwifery project evaluation final report*, Centre for Health Economics Research and Evaluation, University of Sydney, Sydney.

Kilbourne, AM, Keyser, D & Pincus, HA 2010, ‘Challenges and Opportunities in Measuring the Quality of Mental Health Care’, *Canadian Journal of Psychiatry*, vol. 55, no. 9, pp. 549-557.

Kildea, S & Van Wagner, V 2012, *'Birthing on country,' Maternity service delivery models: a review of the literature*, Sax Institute, Sydney, pp. 1–68, online, <http://www.qcmb.org.au/media/pdf/Final%20BoC%20Lit%20review.pdf>.

Kildea, S & Wardaguga, M 2009, 'Childbirth in Australia: Aboriginal and Torres Strait Islander Women', in H Selin & PK Stone (eds), *Childbirth across cultures: ideas and practices of pregnancy, childbirth and the postpartum,* Springer Verlag, New York, pp. 275–87.

Kildea, S 1999, *And the women said . . . reporting on birthing services for Aboriginal women from remote top end communities*, Women's Health Strategy Unit, Territory Health Services, Darwin.

Kildea, S, Kruske, S, Barclay, L & Tracy, S 2010, ''Closing the Gap': How maternity services can contribute to reducing poor maternal infant health outcomes for Aboriginal and Torres Strait Islander Women', *Rural and Remote Health*, vol. 10, no. 1383.

Kildea, S, McGhie, A, Gao, Y, Rumbold, A & Rolfe, M 2015, 'Babies born before arrival to hospital and maternity unit closures in Queensland and Australia', *Women and Birth*, vol. 28, no. 3, pp. 236–45.

Kildea, S, Pollock, W & Barclay, L 2008, 'Making pregnancy safer in Australia: the importance of maternal death review.', *Australian and New Zealand Journal of Obstetrics and Gynaecology*, vol. 48, no. 2, pp. 130–6.

Kirby, S, Greaves, L & Reid, C 2006, 'Searching the literature', in *Experience research social change: methods beyond the mainstream*, Broadview Press, Peterborough, ON, pp. 101–17.

Kitzinger, S 2006, *Birth crisis*, Routledge, New York.

Kitzinger, S, Green, JM, Chalmers, B, Keirse, M, Lindstrom, K & Hemminki, E 2006, 'Why do women go along with this stuff?, Roundtable Discussion: Part 1', *Birth*, vol. 33, no. 2, pp. 154–8.

Klein, MC, Sakala, C, Simkin, P, Davis-Floyd, R, Rooks, J & Pincus, J 2006, 'Why do women go along with this stuff?, Roundtable Discussion: Part 2', *Birth*, vol. 33, no. 3, pp. 245–50.

Knight, M, Callaghan, W & Berg, C 2009, 'Trends in postpartum hemorrhage in high resource countries: a review and recommendations from the International Postpartum Hemorrhage Collaborative Group', *BMC Pregnancy Childbirth*, vol. 9, 55, E publication online, viewed 8 January 2010, <http://download.springer.com/static/pdf/362/art%253A10.1186%252F1471–2393–9–55.pdf?originUrl=http%3A%2F%2Fbmcpregnancychildbirth.biomedcentral.com%2Farticle%2F10.1186%2F1471–2393–9–55&token2=exp=145248000>.

Kosiak, M 2014, 'Chapter 7: Midwifery practices and Aboriginal and Torres Strait Islander women: urban and regional perspectives', in O Best & B Fredericks (eds), *Yatdjuligin Aboriginal and Torres Strait Islander Nursing & Midwifery Care*, Cambridge University Press, Port Melbourne, pp. 120–44.

Kotaska, A 2011, 'Guideline-centred care: A two-edged sword', *Birth*, vol. 38, no. 2, pp. 97–8.

Kozuki, N, Lee, A, Silveira, M, Sania, A, Vogel, J, Adair, L & Barros, F 2013, 'The associations of parity and maternal age with small-for-gestational-age, preterm, and neonatal and infant mortality: a meta-analysis', *BMC Public Health 2013*, 13 (Suppl 3):S2, online, viewed 8July 2014, <http://download.springer.com/static/pdf/518/art%253A10.1186%252F1471–2458–13-S3-S2.pdf?originUrl=http%3A%2F%2Fbmcpublichealth.biomedcentral.com%2Farticle%2F10.1186%2F1471–2458–13-S3-S2&token2=exp=145248035>.

Lane, K 2011, ''When is collaboration not collaboration? When it's' militarized.', *Women and Birth*, vol. 25, no. 1, pp. 29–38.

Langer, A, Horton, R & Challamilla, G 2013, 'A manifesto for maternal health post-2015', *The Lancet*, vol. 381, no. 9867, pp. 601–2.

Laws, PJ, Abeywardena, SA, Walker, J & Sullivan, EA 2007, *Australia's mothers and babies 2005*, National Perinatal Statistics Unit, Australian Government, Sydney.

Lord, D 2006, 'Modelling motor vehicle crashes using Poisson-gamma models: examining the effects of low sample mean values and small sample sizes on the estimation of the fixed dispersion parameter', *Accident Analysis and Prevention*, vol. 38, pp. 751–66.

Loughlin, M 2008, 'Reason, reality and objectivity – shared dogmas and distortions in the way both 'scientistic' and 'postmodern' commentators frame the EBM debate', *Journal of Evaluation in Clinical Practice*, vol. 14, no. 5, pp. 665–71.

Lynch, J 2011, 'Why are economists interested in early childhood health and development?' in *Seventh Annual Healthy Development Adelaide Oration,* Adelaide, 25 August.

MacVicar, J, Dobbie, G, Owen-Johnstone, L, Jagger, C, Hopkins, M & Kennedy, J 1993, ‘Simulated home delivery in hospital: A randomised controlled trial’, *BJOG*, vol. 100, no. 4, pp. 316-23.

Majoko, F, Munjanja, S, Lindmark, G, Nystrom, L & Mason, E 1997, ‘A study of two antenatal care models in a rural setting in Zimbabwe’, *Acta Obstetricia et Gynecologica Scandinavica*, vol 76:87, pp. 1–146.

Maltby, J, Day, L & Williams, G 2007, *Introduction to statistics for nurses*, Pearson Education Ltd, New York.

Maternity Coalition 2002, 'National maternity action plan', *Birth Matters*, vol. 6, no. 3, pp 1–26.

Maternity Coalition 2008, *Funding primary maternity care: a proposal to address cost shifting as an obstacle to public, primary maternity services,* submission to Commonwealth Review of Medicare, May, Canberra.

McAuley, I & Lyons, M 2015, *Govern-omics can we afford small government?*, Melbourne University Press, Melbourne.

McAuley, I & Menadue, J 2007, 'A health policy for Australia: reclaiming universal health care', *Centre For Policy Development: Rethink Paper Number 1*, pp. May, pp. 1–23.

McAuley, I 2008, 'More than one health insurer is too many: the case for a single insurer', *Centre For Policy Development*, June, pp. 1–16.

McAuley, I, Menadue, J, Carney, N & Lyons, M 2006, *'Reclaiming our common wealth: policies for a fair and sustainable future*', Common Sense Paper, no. 1, June, Centre For Policy Development, Centre for Policy Development, Australia, viewed online 10 December 2008, <http://cpd.org.au//wp-content/uploads/2006/06/OurCommonWealthCPD.pdf>.

McCrum-Gardner, E 2007, 'Which is the correct statistical test to use?', *British Journal of Oral and Maxillofacial Surgery*, vol. 46, pp. 38–41.

McDuffie, R, Bischoff, K, Beck, A & Orleans, M 1997, ‘Does reducing the number of prenatal office visits for low-risk women result in increased use of other medical services?’ *Obstetrics and Gynecology*, vol. 90, pp. 68–70.

McHugh, M 2009, 'The odds ratio: calculation, usage, and interpretation.', *Biochemia Medica*, vol. 19, no. 2, pp. 120–6.

McIntyre, MJ 2012, 'Safety of non-medically led primary maternity care models: a critical review of the international literature', *Australian Health Review*, vol. 36, pp. 140–7.

McIntyre, MJ, Chapman, Y & Francis 2011, 'Hidden costs associated with the universal application of risk management in maternity care', *Australian Health Review*, vol. 35, no. 2 pp. 211–5.

McIntyre, MJ, Francis, K & Chapman, Y 2012, 'Primary maternity care reform: Whose influence is driving the change?', *Midwifery*, vol. 28, no. 5, pp. e705–e11.

McLachlan, H, Forster, D, Davey, MA, Farrell, T, Flood, M, Shafiei, T & Waldenstrom, U 2015, 'The effect of primary midwife-led care on women's experience of childbirth: results from the COSMOS randomised controlled trial', *BJOG, Online,* 26 October 2015, doi: 10.1111/1471–0528.13713.

McLachlan, H, Forster, D, Davey, MA, Lumley, J, Farrell, T, Oats, J, Gold, L, Waldenstrom, U, Albers, L & Biro, MA 2008, 'COSMOS: Comparing Standard maternity care with One-to-one midwifery Support: a randomised controlled trial', *BMC Pregnancy and Childbirth*, vol. 8, no. 35, pp. http://www.biomedcentral.com/1471–2393/8/35.

McLachlan, H, Forster, DA, Davey, MA, Farrell, T, Gold, L, Biro, M, Albers, L, Flood, M, Oats, J & Waldenstrom, U 2012, 'Effects of continuity of care by a primary midwife (caseload midwifery) on caesarean section rates in women of low obstetric risk: the COSMOS randomised controlled trial', *British Journal of Obstetrics & Gynaecology*, vol. 119, no. 12, pp. 1483–92.

McLaren, G 2002, *Submission to the Dawson review of the competition provisions of the Trade Practices Act (1974) (Cth)*, Brisbane, November 2002.

Menadue, J 2007, 'Private health insurance: a threat to Medicare', *Australian Nursing Journal*, vol. 15, no. 4, p. 26.

Menadue, J 2008, 'The hospital tail wags the health dog', *Centre For Policy Development*, April, pp. 1–5.

Menadue, J 2011, 'Beating the hospital obsession: the key to rural health reform is in primary care', paper presented to 11th National Rural Health Conference, Perth, viewed August 30 2015, http://www.nrha.org.au/11nrhc/papers/11th_Menadue_John_KN14.pdf

Menke, J, Fenwick, J, Gamble, J, Brittain, H, Creedy, D 2014, ‘Midwifery group practice for socially disadvantaged and vulnerable women: Midwives’ perceptions of organisational structures and processes influencing care’, *Midwifery*, vol. 30, no. 10, pp. 1096-103.

Meysamie A, Taee F, Mohammadi-Vajari M-A, Yoosefi-Khanghah S, Emamzadeh-Fard S & Abbassi M. 2014, 'Sample size calculation on web, can we rely on the results?', *Journal of Medical Statistics and Informatics*, vol. 2, no. 3, viewed online 7 August 2015,<http://dx.doi.org/10.7243/2053–7662–2–3>.

Miettinen, O 1985, *Theoretical epidemiology. principles of occurrence research in medicine*, John Wiley & Sons, New York.

Miles, A, Grey, JE, Polychronis, A, Price, N & Melchiorri, C 2004, 'Developments in the evidence-based health care debate – 2004', *Journal of Evaluation in Clinical Practice*, vol. 10, no. 2, pp. 129–42.

Ministry of Health 2007, *Report on maternity: maternal and newborn information 2004*. Wellington: Ministry of Health, viewed 20 August 2010, <http://www.health.govt.nz/publication/report-maternity-maternal-and-newborn-information-2004>.

Moher, D, Liberati, A, Tetzlaff, J, Altman, D & The PRISMA Group 2009, 'Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement', *PLoS Med*, vol. 6, no. 6, E publication online, viewed 4 September 2013, e1000097, <http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1000097>.

Monk, A, Tracy, M, Foureur, M, Grigg, C & Tracy, S 2014, 'Evaluating Midwifery Units (EMU): a prospective cohort study of freestanding midwifery units in NSW, Australia', *BMJ Open*, vol. 2014, no. 4, viewed May 22 2015, <http://bmjopen.bmj.com/content/4/10/e006252.full>.

Mooney, GH, Russell, EM & Weir, RD 1986, *Choices for health care: a practical introduction to the economics of health provision,* 2nd edn, The Macmillan Press, London.

Mooney, S, Russell, M, Prairie, B, Savage, C & Weeks, W 2008, 'Group prenatal care: an analysis of cost', *Journal of Health Care Finance*, vol. 34, no. 4, pp. 31–41.

Moore, E, Anderson, G, Bergman, N & Dowswell, T 2012, Early skin-to-skin contact for mothers and their healthy newborn infants, *Cochrane Database of Systematic Reviews*, May 16, 5, <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD003519.pub3/pdf>

Morell, A, Kiem, S, Millsteed, M & Pollice, A 2014, 'Attraction, recruitment and distribution of health professionals in rural and remote Australia: early results of the Rural Health Professionals Program', *Human Resources for Health, Biomed Central*, vol. 12, no. 1, article 15, <http://link.springer.com/article/10.1186/1478–4491–12–15/fulltext.html>.

Morrell, C, Spiby, H, Stewart, P, Walters, S & Morgan, A 2000, 'Costs and effectiveness of community postnatal support workers: randomised controlled trial', *British Medical Journal*, vol. 321, no. 7261, pp. 593–8.

Moster, D, Lie, T & Markestad, T 2008, ‘Long-term medical and social consequences of preterm birth’, *New Englang Journal of Medicine*, vol. 359, no. 3, pp. 262-73.

Munjanja, S, Lindmark, G & Nystrom, L 1996, ‘Randomised controlled trial of a reduced-visits programme of antenatal care in Harare, Zimbabwe.’, *The Lancet*, vol. 348, pp. 364–9.

Munro, B 2005, *Statistical methods for health care research,* 5th edn, Lippincott Williams & Wilkins, Philadelphia, PA.

National Aboriginal and Torres Strait Islander Health Council for the Australian Health Ministers' Conference 2003, *National strategic framework for Aboriginal and Torres Strait Islander health: Context*, NATSHIHC, Canberra, viewed 6 June 2010, <http://www.naccho.org.au/download/naccho-historical/nsfatsihcont.pdf>.

National Health and Medical Research Council 1996, *Options for effective care in childbirth*, NHMRC, Australian Government Publishing Service, Canberra.

National Health and Medical Research Council 1998, *Review of services offered by midwives*, NHMRC, Australian Government Publishing Service, Canberra.

National Health and Medical Research Council 2000, *How to review the evidence: systematic identification and review of the scientific literature*, NHMRC, AGPS, Canberra.

National Health and Medical Research Council 2001, *How to compare the costs and benefits: evaluation of the economic evidence*, NHMRC, Australian Government Publishing Service.

National Health and Medical Research Council 2007a, *Australian code for the responsible conduct of research*, by National Health and Medical Research Council, Australian Research Council & Universities Austalia, Australian Government, Canberra.

National Health and Medical Research Council 2007b, *National statement on ethical conduct in human research*, NHMRC, Australian Research Council & Australian Vice-Chancellors' Committee, Australian Government, Canberra.

National Health and Medical Research Council 2008, *NHMRC additional levels of evidence and grades for recommendations for developers of guidelines,* NHMRC, Canberra.

National Health and Medical Research Council 2010, *National guidance on collaborative maternity care*, Department of Health and Ageing, Canberra, viewed 7 April 2011, <https://www.nhmrc.gov.au/guidelines-publications/cp124>.

National Health Performance Authority 2013, *Hospital performance: length of stay in public hospitals in 2011–2012*, NHPA, Sydney, viewed 6 October 2015, <http://www.myhospitals.gov.au/our-reports/length-of-stay/november-2013/report>.

National Health Performance Authority 2014, *Healthy communities: child and maternal health in 2009–2012*, NHPA, Sydney, viewed 6 October 2015, <http://www.myhealthycommunities.gov.au/our-reports/child-and-maternal-health/july-2014>.

National Health Performance Authority 2015, *Hospital performance: costs of acute admitted patients in public hospitals in 2011–2012*, NHPA, Sydney, viewed 6 October 2015, <http://www.myhospitals.gov.au/our-reports/cost-of-acute-admitted-patients/april-2015/report>.

Newman, L & Hancock, H 2009, 'How natural can major surgery really be? A critique of "the natural caesarean" technique', *Birth*, vol. 36, no. 2, pp. 168–70.

Newman, L 2008a, 'How parenthood experiences influence desire for more children in Australia: a qualitative study', *Journal of Population Research*, vol. 25, no. 1, pp. 1–27, online, <http://www.jpr.org.au/upload/JPR%2025–1Newman.pdf>.

Newman, L 2008b, 'The health care system as a social determinant of health: qualitative insights from South Australian maternity consumers', *Australian Health Review*, vol. 33, no. 1, pp. 62–71, online, <http://www.aushealthreview.com.au/publications/articles/>.

Newman, L, Reiger, K & Campo, M 2011, 'Maternity coalition: Australia’s national maternity consumer advocacy organization', in A O’Reilly (ed.), *The 21st century motherhood movement*, Demeter Press, New York, pp. 80–92.

Newnham, E 2010, ‘Midwifery directions: the Australian maternity services review’, *Health Sociology Review*, vol.19, no.2, pp. 245–59.

Newnham, E 2014, 'Birth control: power/knowledge in the politics of birth', *Health Sociology Review*, vol. 23, no. 3, pp. 254–68.

Newnham, E, McKellar, L & Pincombe, J 2015, 'Documenting risk: a comparison of policy and information pamphlets for using epidural or water in labour', *Women and Birth*, vol. 28, no. 3, pp. 221–7.

Newton, M, McLachlan, H, Willis, K & Forster, D 2014, 'Comparing satisfaction and burnout between caseload and standard care midwives: findings from two cross-sectional surveys conducted in Victoria, Australia', *BMC Pregnancy and Childbirth*, vol. 14, 426, <http://bmcpregnancychildbirth.biomedcentral.com/articles /10.1186/s12884–014–0426–7>.

Nixon, A, Byrne, J & Church, A 2003, *The community midwives project: an evaluation of the set up of the northern women's community midwives project*, Northern Community Metropolitan Health Service, Adelaide.

North Staffordshire Changing Childbirth Research Team 2000, 'A randomised study of midwifery caseload care and traditional 'shared-care', *Midwifery*, vol. 16, no.4, pp. 295–302.

Northern Territory Government 2008, *Developing an integrated maternity services model*, Northern Territory Department of Health and Community Services, Darwin.

NSW Health Department 1998, *New South Wales Alternative Birthing Services Program - Evaluation of Phase 2 - Aboriginal Strategy*, Sydney.

NSW Ministry of Health, 2012, *Midwifery continuity of carer model tool-kit*. The Nursing & Midwifery Office NSW Ministry of Health, Government of NSW, Sydney.

O'Brien, B, Harvey, S, Sommerfeldt, S, Beischel, S, Newburn-Cook, C & Schopflocher, D 2010, 'Comparison of costs and associated outcomes between women choosing newly integrated autonomous midwifery care and matched controls: a pilot study', *Journal Obstetrics & Gynaecology Canada*, vol. 32, no. 7, pp. 650–6.

Office of the Status of Women 1993, *Women – shaping and sharing the future. the new agenda for women, 1993–2000, June*. Department of Prime Minister and Cabinet, Australian Government Publishing Service, Canberra, ACT.

Organisation for Economic Co-operation and Development 2007, *Health at a glance 2007: OECD indicators*, OECD Publishing, Paris, viewed 8 October 2008, <http://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-2007_health_glance-2007-en>.

Ovretveit, J 2009, *Does improving quality save money? A review of evidence of which improvements to quality reduce costs to health services providers*, The Health Foundation, London.

Pairman, S & Donnellan-Fernandez, R 2015, 'Chapter 12: Professional frameworks for practice in Australia and New Zealand', in S Pairman, J Pincombe, C Thorogood & S Tracy (eds), *Midwifery preparation for practice,* 3rd edn, Elsevier, Sydney, pp. 267–303.

Pairman, S, Pincombe, J, Thorogood, C & Tracy, S 2015, *Midwifery preparation for practice,*3rd edn, Churchill Livingstone, Elsevier Australia, Sydney.

Parliament of South Australia 2015, *International Day of the Midwife, Member for Elder, Parliament of SA, 26 March 2015*, Parliament of South Australia, Adelaide, viewed 30 March 2015, <https://hansardpublic.parliament.sa.gov.au>.

Parliament of the Commonwealth of Australia 2009, House of Representatives (2009) *Health Legislation Amendment (Midwives and Nurse Practitioners) Bill,* Parliament of the Commonwealth of Australia, Canberra, viewed: 8 June 2010, <http://www.aph.gov.au/Parliamentary_Business/Bills_Legislation/Bills_Search_Results/Result?bId=r4151>.

Paxton Partners Pty Ltd 2008, *SA metropolitan hospital efficiency and performance review report: February 2008*, Government of South Australia, Department of Health, Adelaide.

Pelkas, C 2009, 'State interference with liberty: utilitarian justifications for public health interventions', *Public Health Bulletin SA*, vol. 6, no. 3, pp. 32–4.

Pelletier, D & Diers, D 2004, 'Developing data for practice and management: an Australian educational initiative', *CIN: Computers, Informatics, Nursing*, vol. 22, pp. 197–202.

Petrou, S & Glazener, C 2002, 'The economic costs of alternative modes of delivery during the first two months postpartum: results from a Scottish observational study', *British Journal of Obstetrics & Gynaecology*, vol. 109, no. 2, pp. 214–7.

Petrou, S & McIntosh, E 2011, 'Commentary: using stated preference discrete choice experiments to elicit women's preferences for aspects of maternity care', *Birth*, vol. 38, no. 1, pp. 47–8.

Petrou, S, Boulvain, M, Simon, J, Maricot, P, Borst, F & Perneger, T 2004, 'Home-based care after a shortened hospital stay versus hospital-based care postpartum: an economic evaluation', *British Journal of Obstetrics & Gynaecology*, vol. 111, no. 8, pp. 800–6.

Petrou, S, Cooper, P, Murray, L & Davidson, LL 2002, 'Economic costs of postnatal depression in a high-risk British cohort', *British Journal of Psychiatry*, vol. 181, pp. 500–12.

Petrou, S, Henderson, J & Glazener, C 2001, 'Economic aspects of caesarean section and alternative modes of delivery', *Bailliere's Best Practice and Research in Clinical Obstetrics and Gynaecology*, vol. 15, no. 1, pp. 145–63.

Pilcher, J, Kruske, S & Barclay, L 2014, 'A review of rural and remote health service indexes: are they relevant for the development of an Australian rural birth index?', *BMC Health Services Research*, vol. 2014, no. 14, pp. 548, viewed March 13 2015, <http://www.biomedcentral.com/1472–6963/14/548>.

Pittrof, R, Campbell, OMR & Filippi, VGA 2002, 'What is quality in maternity care? An international perspective', *Acta Obstetricia et Gynecologica Scandinavica*, vol. 81, no. 4, pp. 277–83.

Plante, L 2009, 'Mommy, what did you do in the industrial revolution? Meditations on the rising cesarean rate', *The International Journal of Feminist Approaches to Bioethics. 2009 Spring*, vol. 2, no. 1, pp. 140–7.

Plichta, S & Garzon, L 2009, *Statistics for nursing and allied health*, Wolters Kluwer Health/Lippincott Williams & Wilkins, Philadelphia.

Podger, A 2006, 'Reconceiving federal-state-regional arrangements in health, in federalism and regionalism in Australia', in AJ Brown & JA Bellamy (eds), *New approaches, new institutions?*, ANU ePress, vol. 9, pp. 135–54.

Pogge, T 2007, 'Chapter 4 Responsibilities for Poverty-Related Ill Health', in R.E Ashcroft, A. Dawson, H Draper and JR McMillan (eds), *Principles of health care ethics,* 2nd edn, John Wiley & Sons, Oxford.

Polit, DF & Beck, CT 2006, 'Chapter 9 Scrutinizing quantitative research design', in DF Polit & CT Beck (eds), *Essentials of nursing research: methods, appraisals and utilization* 6th edn, Lippincott,Williams & Wilkins, pp. 177–208.

Polit, DF & Beck, CT 2012, *Nursing research: generating and assessing evidence for nursing practice,* 9th edn, Lippincott Williams & Wilkins, Philadelphia.

Power, C, Nixon, A & O'Donnell, K 2008, *Evaluation of the Southern Aboriginal maternity care project*, Government of South Australia, Adelaide.

Pregnancy Outcome Unit Epidemiology Branch SA Health 2008, *Pregnancy Outcome in South Australia 2007*, Government of South Australia, SA Health, Adelaide.

Productivity Commission 2005, *The health workforce: issues paper*, Productivity Commission, Government of Australia, Canberra.

Queensland Health 2008, *Midwifery models of care: implementation guide,* Queensland Health, Brisbane.

Queensland Health 2012, *Delivering continuity of midwifery care to Queensland women: a guide to implementation*, Queensland Health, Brisbane.

Raisler, J & Kennedy, H 2005, 'Midwifery care of poor and vulnerable women, 1925–2003', *Journal of Midwifery & Women's Health*, vol. 50, no. 2, pp. 113–21.

Raith, L, Jones, J & Porter, M 2015, *Mothers at the margins – stories of challenge, resistance and love*, Cambridge Scholars Publishing, Newcastle upon Tyne, UK.

Ramsamy, N 2014, 'Chapter 6 Indigenous birthing in remote locations: Grandmothers' Law and government medicine', in O Best & B Fredericks (eds), *Yatdjuligan Aboriginal and Torres Strait Islander Nursing & Midwifery Care*, Cambridge University Press, Port Melbourne, pp. 102–19.

Ratcliffe, J 2003, 'The economic implications of the Edgeware birth centre', in M Kirkham (ed), *Birth Centres*, Books for Midwives Press, Cheshire, UK, pp. 131–9.

Ratcliffe, J, Ryan, M & Tucker, J 1996, 'The costs of alternative types of routine antenatal care for low-risk women: shared care vs care by general practitioners and community midwives', *Journal of Health Services Research Policy*, vol. 1, no. 3, pp. 135–40.

Rayment-Jones, H, Murrells, T & Sandall, J 2015, 'An investigation of the relationship between the caseload model of midwifery for socially disadvantaged women and childbirth outcomes using routine data – a retrospective, observational study', *Midwifery,* vol. 31, no. 4, pp. 409–17, <http://dx.doi.org/10.1016/j.midw.2015.01.003i>.

Rees, C 2011, *An introduction to research for midwives,* 3rd edn, Churchill Livingstone/Elsevier, Edinburgh.

Reiger, K & Morton, C 2012, 'Standardizing or individualizing? A critical analysis of the "discursive imaginaries" shaping maternity care reform', *International Journal of Childbirth*, vol. 2, no. 3, pp. 173–86.

Reiger, K 2001, *Our bodies, our babies: the forgotten women's movement*, Melbourne University Press, Carlton, Victoria.

Reiger, K 2006, 'A neoliberal quickstep: contradictions in Australian maternity policy', *Health Sociology Review*, vol. 15, no. 4, pp. 330–40.

Reiger, K 2011, 'Knights or knaves? Public policy, professional power and reforming matenity services', *Healthcare for Women International*, vol. 32, no. 1, pp. 2–22.

Reinharz, D, Blais, R, Fraser, WD & Contandriopoulos, AP 2000, 'Cost-effectiveness of midwifery services versus medical services in Quebec', *Canadian Journal of Public Health*, vol. 91, no. 1, pp. 12–5.

Renfrew, M, McCormick, F, Wade, A, Quinn, B & Dowswell, T 2012, Support for healthy breastfeeding mothers with healthy term babies, *Cochrane Database of Systematic Reviews May 16;5:CD001141,* E publication online, viewed 5 July 2015, <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD001141.pub4/full>.

Renfrew, MJ, Homer, C, Downe, S, McFadden, A, Muir, N, Prentice, T & Ten Hoope-Bender, P 2014, 'Midwifery, an executive summary for the Lancet's series', *The Lancet*, vol. June 2014, pp. 1–8.

Renfrew, MJ, McFadden, A, Bastos, MH, Campbell, J, Channon, AA, Cheung, NF, Silva, DRAD, Downe, S, Kennedy, HP, Malata, A, McCormick, F, Wick, L & Declercq, E 2014, 'Midwifery and quality care: findings from a new evidence-informed framework for maternal and newborn care', *The Lancet*, vol. 384, no. 9948, pp. 1129–45.

Reynolds, C 2009, 'Public health law: guest editorial', *Public Health Bulletin SA*, vol. 6, no. 3, pp. 1–4.

Rigg, E, Schmied, V, Peters, K & Dahlen, H 2015, ''Not addressing the root cause: An analysis of submissions made to the South Australian Government on a proposal to protect midwifery practice'', *Women and Birth*, vol. 28, no. 2, pp. 121–8.

Risnes, K, Vatten, L, Baker, J, Jameson, K, Sovio, U & al, e 2011, 'Birthweight and mortality in adulthood: a systematic review and meta-analysis', *International Journal of Epidemiology*, vol. 40, no. 3, pp. 647–61.

Roberts, CL, Tracy, SK & Peat, B 2000, 'Rates for obstetric intervention among private and public patients in Australia: population-based descriptive study', *British Medical Journal*, vol. 321, pp. 137–41.

Rocco, T & Plakhotnik, M 2009, 'Literature reviews, conceptual frameworks, and theoretical frameworks: terms, functions, and distinctions', *Human Resource Development Review*, vol. 8, pp. 120–30.

Rowley, M, Hensley, M, Brinsmead, M & Wlodarczyk, J 1995, 'Continuity of care by a midwife team versus routine care during pregnancy and birth: a randomised trial.', *Medical Journal of Australia*, vol. 163, no. 6, pp. 289–193.

Ruggeri, J 2006, *Health care spending, fiscal sustainability and public investment: Public Policy Paper Seies 42*, Institute of Public Policy, Saskatchewan.

Rural Doctors Association of Australia RDAA2007, *Joint media release re maternity services and work force*. viewed December 30 2009, <http://www.health.gov.au/internet/nhhrc/publishing.nsf/Content/155/$FILE/155%20Rural%20Doctors%20Association%20of%20Australia,%20Rural%20Maternity%20Services%20Joint%20Submission.pdf>.

Rural Health Workforce Australia, Royal Australia College of General Practitioners, Rural Doctors Association of Australia, Australian College of Midwives, Australian College of Rural and Remote Medicine & Gynaecologists, RAaNZCoOa 2007, *National Consensus Framework for Rural Maternity Services,* viewed 10 May 2009, <http://www.health.gov.au/internet/nhhrc/publishing.nsf/Content/155/$FILE/155%20Rural%20Doctors%20Association%20of%20Australia,%20Rural%20Maternity%20Services%20Joint%20Submission.pdf>.

Russell, L 2008a, 'Our baby boom is blowing the Medicare budget', *The Canberra Times*, 19 January.

Russell, L 2008b, *The increasing cost of private maternity services*, The Menzies Centre for Health Policy, Sydney.

Ryan, P, Revill, P, Devane, D & Normand, C 2013, 'An assessment of the cost-effectiveness of midwife-led care in the United Kingdom', *Midwifery*, vol. 29, no.4, pp. 368–76.

SA Health 2012, *Hospital budget performance and remediation review – summary of recommendations*, SA Health, Adelaide.

SA Health 2013, *Integrated South Australian activity collection (ISAAC)*, SA Health, viewed 6 May 2013, <http://www.health.sa.gov.au/isaac/>.

SA Health 2015, *SA Perinatal Practice Guidelines*, SA Government, viewed 20 August 2015, <http://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/clinical+resources/clinical+topics/perinatal+practice+guidelines/perinatal+practice+guidelines>.

SA Health 2015, *Transforming health,* SA Health, Adelaide.

Sackett, DL, Rosenberg, WM & Muir Gray, JA 1996, 'Evidence based medicine: what it is and what it isn't', *British Medical Journal*, vol. 312, pp. 71–2.

Sakala, C & Corry, MP 2008, *Evidence-based maternity care: what it is and what it can achieve*, Milbank Memorial Fund, New York.

Sandall, J, Soltani, H, Gates, S, Shennan, A & Devane, D 2013, Midwife-led continuity models versus other models of care for childbearing women, *Cochrane Database of Sytematic Reviews*, Issue 8. Art. No.: CD004667. <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD004667.pub3/full>.

Sandall, J, Soltani, H, Gates, S, Shennan, A & Devane, D 2015, Midwife-led continuity models versus other models of care for childbearing women (Review), *Cochrane Database of Sytematic Reviews,*, Issue 9, <http://www.cochrane.org/CD004667/PREG_midwife-led-continuity-models-versus-other-models-care-childbearing-women>.Sax, S 1984, *A strife of interests: medical power and politics in Australia*, Allen & Unwin, Sydney.

Sayers, S & Boyle, J 2010, 'Indigenous perinatal and neonatal outcomes: a time for preventive strategies', *Journal of Paediatrics and Child Health*, vol. 46, no. 9, pp. 475–8.

Scheil, W, Scott, J, Catcheside, B, Sage, L & Kennare, R 2013, *Pregnancy outcome in South Australia 2011*, Pregnancy Outcome Unit, SA Health, Government of South Australia, Adelaide.

Scheil, W, Scott, J, Sage, L, Fisher, M, Thompson, J, Jolly, K & Kennare, R 2014, *Pregnancy outcome in South Australia 2012*, Pregnancy Outcome Unit, SA Health, Adekaide, South Australia.

Scherman, S, Smith, J & Davidson, M 2008, 'The first year of a midwifery-led model of care in Far North Queensland', *Medical Journal of Australia*, vol. 188, no. 2, pp. 85–8.

Schlinzig, T, Johansson, S, Gunnar, A, Ekstrom, T & Norman, M 2009, 'Epigenetic modulation at birth-altered DNA-methylation in white blood cells after Caesarean section', *Acta Paediatrica 2009*, vol. 98, pp. 1096–9.

Schram, SF & Caterino, B 2006, *Making political science matter: debating knowledge, research, and method*, New York University Press, New York and London.

Schroeder, E, Petrou, S, Patel, N, Hollowell, J, Puddicombe, D, Redshaw, M & Brocklehurst, P 2012, 'Cost effectiveness of alternative planned places of birth in woman at low risk of complications: evidence from the Birthplace in England national prospective cohort study', *British Medical Journal*, vol. 344:e2292, pp. 1–13.

Scotton, D 1999, 'The contribution of research evidence to health policy', *Healthcover*, vol. 9, no. 4, pp. 21–4.

Segal, L 2009, 'Prevention in the health care system: an economic perspective', *Public Health Bulletin South Australia*, vol. 6, no. 1, pp. 22–6.

Senate Community Affairs Reference Committee 1999, *Rocking the cradle: a report into childbirth procedures*, Senate Community Affairs Reference Committee, Pregnancy Outcome Unit, SA Health, Government of South Australia, Adelaide.

Senate Community Affairs Reference Committee 2009, *Health Legislation Amendment (Midwives and Nurse Practitioners) Bill 2009 and two related Bills, Inquiry One*, Parliament of Australia,Canberra.

Senate Community Affairs Reference Committee 2010, *Health Legislation Amendment (Midwives and Nurse Practitioners) Bill and two related Bills: Inquiry Two*, Parliament of Australia, Canberra.

Shah, P 2010, 'Parity and low birth weight and preterm birth: a systematic review and meta-analyses', *Acta Obstetricia et Gynecologica Scandinavica 2010*, vol. 89, no. 7, pp. 862–75.

Shields, L & Watson, R 2013, 'Chapter 9 Common quantitative methods', in Z Schneider, D Whitehead, G LoBiondo-Wood & J Haber (eds), *Nursing and Midwifery Research methods and appraisal for evidence-based practice*, 4th edn, Elsevier, Sydney, pp. 161–83.

Shields, N, Reid, M, Cheyne, H, Holmes, A, McGinley, M, Turnbull, D & Smith, LN 1997, 'Impact of midwife-managed care in the postnatal period: an exploration of psychosocial outcomes', *Journal of Reproductive and Infant Psychology*, vol. 15, pp. 91–108.

Shorten, A & Shorten, B 2007, 'What happens when a private hospital comes to town? The impact of the 'public' to 'private' hospital shift on regional birthing outcomes.', *Women and Birth*, vol. 20, no. 2, pp. 49–55.

Shorten, B & Shorten, A 2000, 'Women's choice? The impact of private health insurance on episiotomy rates in Australian hospitals', *Midwifery*, vol. 16, pp. 204–12.

Smith, J, Plaat, F & Fisk, N 2008, 'The natural caesarean: a woman-centred technique', *BJOG*, vol. 115, pp. 1037–42.

Smith, PC 2009, *Measuring value for money in healthcare: concepts and tools*, The Health Foundation, London.

South Australian Health Commission 1995, *Report of the South Australian Models of Maternity Care Working Party*, South Australian Health Commission, Adelaide.

Sowada, B 2003, *A call to be whole: the fundamentals of health care reform*, Greenwood Publishing Group, Westport, CT.

Standards Australia 2016, *Net Benefit – What is Net Benefit?* viewed 3 January 2016 <http://www.standards.org.au/StandardsDevelopment/What_is_a_Standard/Pages/Net-Benefit.aspx>.

Starrs, AM 2006, 'Safe motherhood initiative: 20 years and counting', *The Lancet*, vol. 2006, no. 368, pp. 1130–2.

StataCorp 2013, *Stata statistical software: Release 13*, StataCorp LP, College Station, TX.

Stevens, G, Thompson, R, Kruske, S, Watson, B & Miller, Y 2014, 'What are women told about models of maternity care in Australia? A retrospective study of women's reports.', *Patient Education and Counseling*, vol. 97, no. 1, pp. 114–21.

Stewart, M, McCandlish, R, Henderson, J & Brocklehurst, P 2005, *Report of a structured review of birth centre outcomes: review of evidence about psychosocial and economic outcomes for women with straightforward pregnancies who plan to give birth in a midwife-led birth centre, and outcomes for their babies*, National Perinatal Epidemiology Unit, Oxford, UK.

Stone, P & Walker, P 1995, 'Cost-effectiveness analysis: birth center vs hospital care', *Nurse Economics*, vol. 13, no. 5, pp. 299–308.

Stone, P, Zwansiger, J, Walker, PH & Buenting, J 2000, 'Economic analysis of two models of low-risk maternity care: a freestanding birth centre compared to traditional care', *Research in Nursing & Health*, vol. 23, no. 4, pp. 279–89.

Summers, A 1998, 'The lost voice of midwifery', *Collegian*, vol. 5, no. 3, pp. 16–22.

Suresh, K & Chandrashekara, S 2012, 'Sample size estimation and power analysis for clinical research studies', *Journal of Human Reproductive Sciences*, vol. 5, no. 1, pp. 7–13.

Sutcliffe, K, Caird, J, Kavanagh, J, Rees, R, Oliver, K, Dickson, K, Woodman, J, Barnett-Page, E & Thomas, J 2012, 'Comparing midwife-led and doctor-led maternity care: a systematic review of reviews', *Journal of Advanced Nursing*, vol. 68, no. 11, pp. 2376–86.

Sutherland, G, Yelland, J & Brown, S 2012, 'Social inequalities in the organization of pregnancy care in a universally funded public health care system', *Maternal Child Health Journal*, vol. 16, no. 2, pp. 288–96.

Szumilas, M 2010, 'Explaining odds ratios', *Journal of Canadian Academy of Child Adolescent Psychiatry*, vol. 19, no. 3, pp. 227–9.

Tabachnick, BG & Fidell, LS 2013, *Using multivariate statistics,* 6th edn, Pearson, New York.

Teakle, B 2014, *Primary maternity reform: consumer action pack*, Maternity Choices Australia, viewed June 20 2015, <http://www.maternitychoices.org.au/uploads/1/5/1/4/15149676/craction pack.pdf>.

ten Hoope-Bender, P, de Bernis, L, Campbell, J, Downe, S, Fauveau, V, Fogstad, H, Homer, CSE, Kennedy, HP, Matthews, Z, McFadden, A, Renfrew, MJ & Van Lerberghe, W 2014, 'Improvement of maternal and newborn health through midwifery', *The Lancet*, vol. 384, no. 9949, pp. 1226–35.

Thorogood, C & Thiele, B 1998, 'Homebirth in the public health system – what are the issues?', paper presented to New Models of Maternity Service Provision: Australian Midwifery Perspectives Conference, 5–6 November 1998, Adelaide.

Toohill, J, Gamble, J & Creedy, D 2013, 'A critical review of vaginal birth rates after a primary caesarean in Queensland hospitals', *Australian Health Review*, vol. 37, no. 5, pp. 642 – 8.

Toohill, J, Turkstra, E, Gamble, J & Scuffham, P 2011, 'A non-randomised trial investigating the cost-effectiveness of Midwifery Group Practice compared with standard maternity care arrangements in one Australian hospital', *Midwifery, vol. 28, no. 6, e874–9,* <https://www.researchgate.net/profile/Jocelyn_Toohill/publication/51882746_A_non-randomised_trial_investigating_the_cost-effectiveness_of_Midwifery_Group_Practice_compared_with_standard_maternity_care_arrangements_in_one_Australian_hospital/links/0c96051df4a58055c9000000.pdf>.

Torraco, R 2005, 'Writing integrative literature reviews: guidelines and examples', *Human Resource Development Review*, vol. 4, pp. 356–67.

Tracy, S & Hartz, D 2006, *The quality review of Ryde Midwifery Group Practice, September 2004 to October 2005: final report*, Northern Sydney and Central Coast Health, Sydney.

Tracy, S & Tracy, M 2003, 'Costing the cascade: estimating the cost of increased obstetric intervention in childbirth using population data', *BJOG: An International Journal of Obstetrics & Gynaecology*, vol. 110, pp. 717–24.

Tracy, S 2011, 'Chapter 3, Costing birth as commodity or sustainable public good.', in L Davies, Dallenbach & M Kensington (eds), *Sustainability, midwifery and birth*, Taylor & Francis Inc., New York, pp. 32–44.

Tracy, S 2015, 'Chapter 6 Ways of looking at evidence and measurement', in S Pairman, J Pincombe, C Thorogood & S Tracy (eds), *Midwifery preparation for practice,* 3rd edn, Elsevier, Sydney, pp. 103–31.

Tracy, S, Barclay, L & Brodie, P 2000, 'Contemporary issues in the workforce and education of Australian midwives', *Australian Health Review*, vol. 23, no. 4, pp. 78–88.

Tracy, S, Dahlen, H, Caplice, S, Laws, P, Wang, YA, Tracy, MB & Sullivan, E 2007, 'Birth centers in Australia: a national population -based study of perinatal mortality associated with giving birth in a birth center', *Birth: Issues in Perinatal Care*, vol. 34, no. 3, pp. 194–201.

Tracy, S, Hartz, D, Hall, B, Allen, J, Forti, A, Lainchbury, A, White, J, Welsh, A, Tracy, M & Kildea, S 2011, 'A randomised controlled trial of caseload midwifery care: M@NGO (Midwives @ New Group practice Options).', *BMC Pregnancy Childbirth*, 11:82, viewed 6 July 2012, <http://www.biomedcentral.com/1471–2393/11/82>.

Tracy, S, Hartz, D, Nicholl, M, McCann, Y & Latta, D 2005, 'An integrated service network in maternity – the implementation of a midwifery-led unit.', *Australian Health Review*, vol. 29, no. 3, pp. 332–9.

Tracy, S, Hartz, D, Tracy, M, Allen, J, Forti, A, Hall, B, White, J, Lainchbury, A, Stapleton, H, Beckmann, M, Bisits, A, Homer, C, Foureur, M, Welsh, A & Kildea, S 2013, 'Caseload midwifery care versus standard maternity care for women of any risk: M@NGO, a randomised controlled trial', *The Lancet*, vol. 382, pp. 1723–32, Published online September 17, 2013 http://dx.doi.org/10.1016/S0140–6736(13)61406–3.

Tracy, S, Sullivan, E, Wang, A, Black, D & Tracy, M 2007, 'Birth outcomes associated with interventions in labour amongst low risk women: A population-based study', *Women and Birth*, vol. 20, no. 2, pp. 41–8.

Tracy, S, Welsh, A, Hall, B, Hartz, D, Lainchbury, A, Bisits, A, White, J & Tracy, M 2014, 'Caseload midwifery compared to standard or private obstetric care for first time mothers in a public teaching hospital in Australia: a cross sectional study of cost and birth outcomes', *BMC Pregnancy and Childbirth*, vol. 14, p. 46, viewed 5 April 2014, E publication online, <http://www.biomedcentral.com/1471–2393/14/46>.

Tracy, SK, Sullivan, ES & Tracy, MB 2007, 'Admission of term infants to neonatal intensive care: a population-based study', *Birth: Issues in Perinatal Care*, vol. 34, no. 4, pp. 301–7.

Tranfield, D, Denyer, D & Smart, P 2003, 'Towards a methodology for developing evidence-informed management knowledge by means of systematic review', *British Journal of Management*, vol. 14, pp. 207–22.

Tulchinsky, T & Varavikova, E 2014, *The new public health,* 3rd edn, Elsevier Academic Press, San Diego, CA.

Turnbull, D, Baghurst, P, Collins, C, Cornwell, C, Nixon, A, Donnellan-Fernandez, R & Antoniou, G 2009, 'An evaluation of Midwifery Group Practice. Part I: Clinical effectiveness', *Women and Birth*, vol. 22, no. 1, pp. 3–9.

Turnbull, D, Holmes, A, Schields, N, Cheyne, H, Twaddle, S, Gilmour, WH, McGinley, M, Reid, M, Johnstone, I, Geer, I, McIlwaine, G & Lunan, CB 1996, ‘Randomised, controlled trial of efficacy of midwife-managed care’, *The Lancet*, vol. 348, no. July 27, pp. 213–8.

Twaddle, S & Young, D 1999, 'Chapter 8, The economics of maternity care', in G Marsh & M Renfrew (eds), *Community-based maternity care*, Oxford University Press, Oxford, UK, pp. 119–36.

Ullah, S, Finch, C & Day, L 2010, 'Statistical modelling for falls count data', *Accident Analysis and Prevention*, vol. 42, no. 2010, pp. 384–92.

United Nations 2010, *The millennium development goals report*, United Nations Department of Economic and Social Affairs.

United Nations Population Fund 2014, *The state of the world's midwifery, a universal pathway. a woman's right to health*, New York, pp. 1–228, <http://www.unfpa.org/sites/default/files/pub-pdf/EN_SoWMy2014_complete.pdf>.

van Gool, K, Savage, E, Viney, R, Haas, M & Anderson, R 2009, 'Who's getting caught? An analysis of the Australian Medicare Safety Net', *The Australian Economic Review*, vol. 42, no. 2, pp. 143–54.

Van Lerberghe, W, Matthews, Z, Achadi, E, Ancona, C, Campbell, J, Channon, A, de Bernis, L, De Brouwere, V, Fauveau, V, Fogstad, H, Koblinsky, M, Liljestrand, J, Mechbal, A, Murray, SF, Rathavay, T, Rehr, H, Richard, F, ten Hoope-Bender, P & Turkmani, S 2014, 'Country experience with strengthening of health systems and deployment of midwives in countries with high maternal mortality', *The Lancet*, vol. 384, no. 9949, pp. 1215–25.

Van Wagner, V 2007, 'Reclaiming birth, health, and community: midwifery in the Inuit Villages of Nunavik, Canada', *Journal of Midwifery & Women's Health: Special Issue – Global Perspectives on Women's Health: Policy and Practice*, vol. 52, no. 4, pp. 384–91.

Vedam, S, Stoll, K, Schummers, L & Fulton, C 2013, *Home birth: an annotated guide to the literature*, Open access, Vancouver, British Columbia, viewed 24 August 2015, <www.midwifery.ubc.ca/files/2013/11/HomeBirth_AnnotatedGuideToTheLiterature.pdf>.

Victora, CG & Barros, FC 2006,’Beware: unnecessary caesarean sections may be hazardous’, *The Lancet*, vol. 367, pp. 1796–7.

Victorian Auditor General 2011, *Maternity services: capacity*, Victorian Auditor-General's Office, Melbourne.

Villar, J, Ba'aqeel, H & Piaggio, G 2001, ' WHO randomised controlled trial for the evaluation of a new model of routine antenatal care ', *The Lancet*, vol. 357, pp. 1551–64.

Villar, J, Carroli, G, Khan-Neelofur, D, Piaggio, G & Gulmezoglu, M 2007, Patterns of routine antenatal care for low risk women (Cochrane Review), *Cochrane Database of Systematic Reviews,* issue 4, Art. No.: CD000934, pp. 1–33. <http://apps.who.int/rhl/reviews/langs/CD000934.pdf>.

Vitikainen, K, Street, A & Linna, M 2009, 'Estimation of hospital efficiency—Do different definitions and casemix measures for hospital output affect the results?', *Health Policy*, vol. 89, no. 2, pp. 149–59.

von Gruenigen, V, Powell, D, Sorboro, S, McCarroll, M & Unhee, K 2013, 'The financial performance of labor and delivery units', *American Journal of Obstetrics & Gynecology*, vol. July 2013, pp. 17–9.

Wadsworth, Y 2010, *Building in research and evaluation: human inquiry for living systems,* Action Research Press, Hawthorn and Allen & Unwin, Sydney.

Wagner, M 1998, 'Midwifery in the industrialized world', *Journal of the Society of Obstetricians & Gynaecologists of Canada*, vol. 20, no. 13, pp. 1225–34.

Wagstaff, A & van Doorslaer, D 2001, 'Chapter 34 Equity in health care finance and delivery', in AJ Culyer & JP Newhouse (eds), *Handbook of Health Economics*, North Holland, Amsterdam, The Netherlands.

Waldenstrom, U & Turnbull, D 1998, 'A systematic review comparing continuity of midwifery care with standard maternity services', *British Journal of Obstetrics and Gynaecology*, vol. 105, no. 11, pp. 1160–70.

Walker, D & Koniak-Griffin, D 1997, ‘Evaluation of a reduced-frequency prenatal visit schedule for low-risk women at a free-standing birthing centre’, *Journal of Nurse-Midwifery*, vol. 42, pp. 295–303.

Walker, P & Stone, P 1996, 'Exploring cost and quality: community based versus traditional hospital delivery', *Journal of Health Care Finance*, vol. 23, pp. 23–41.

Webb, P & Bain, C 2011, *Essential epidemiology: an introduction for students and health professionals*, Cambridge University Press, Cambridge.

Wennberg, J 2010, *Tracking medicine: a researcher's quest to understand health care*, Oxford University Press, New York.

Wennberg, J 2014, 'Forty years of unwarranted variation – and still counting', *Health Policy*, vol. 114, pp. 1–2.

Werner, D & Sanders, D, 1997, *Questioning the solution: the politics of primary health care and child survival*, Health Right, Palo Alto, CA.

Western Australian Legislative Assembly 1995, *Select Committee on Intervention in Childbirth Report*, Western Australian Legislative Assembly, WA Health.

White Ribbon Alliance for Safe Motherhood 2011, *Respectful maternity care: the universal rights of childbearing women*, White Ribbon Alliance for Safe Motherhood, Washington, DC.

Whittemore, R & Knafl, K 2005, 'The integrative review: updated methodology', *Journal of Advanced Nursing*, vol. 52, pp. 546–53.

Wilkes, E, Teakle, B & Gamble, J 2009, 'Medicare rebates for midwives: an analysis of the 2009/2010 federal budget', *Women and Birth*, vol. 22, no. 3, pp. 79–81.

Wilkes, L, Gamble, J, Adam, G & Creedy, D 2015, 'Reforming maternity services in Australia: outcomes of a private practice midwifery service', *Midwifery*, vol. 31, no. 10, pp. 935–40.

Willan, A & Briggs, A 2006, *Statistical analysis of cost-effectiveness data*, John Wiley & Sons Ltd, Chichester, England.

Williams, O, Mutch, A, Douglas, P, Boyle, F & Hill, P 2015, 'Proposed changes to Medicare: undermining equity and outcomes in Australian primary health care?', *The Australian and New Zealand Journal of Public Health*, vol. 39, no. 2, pp. 106–8.

Willis, E 1983, *Medical dominance: the division of labour in Australian health care*, Allen & Unwin, Sydney.

Willis, E, Reynolds, L & Keleher, H 2012, *Understanding the Australian Health Care System,* 2nd edn, Elsevier, Sydney, Australia.

Wilson, NW, Couper, ID, De Vries, E, Reid, S, Fish, T & Marais, BJ 2009, 'A critical review of interventions to redress the inequitable distribution of healthcare professionals to rural and remote areas', *Remote Health*, vol. 9 (Online), viewed October 20 2010, <http://www.rrh.org.au/articles/showarticlenew.asp?ArticleID=1060>.

Women's & Children's Hospital 2006, *Midwifery group practice: an evaluation of clinical effectiveness, quality and sustainability*, Government of South Australia: Children Youth and Women's Health Service, Women's & Children's Hospital, Government of South Australia, Adelaide.

Women's Healthcare Australasia 2015, *Individual benchmarking reports–activity & costing 2014/2015*, viewed 20 October 2015, <https://women.wcha.asn.au>.

World Health Organization 1996, *Care in normal birth: a practical guide, WHO/FRH/MSM/96.24*, Division of Family and Reproductive Health, World Health Organization, Geneva.

World Health Organization 2000, *The world health report 2000. Health Systems: improving performance*, World Health Organization,Geneva.

World Health Organization 2007, *Achieving health equity: from root causes to fair outcomes*, Commission on Social Determinants of Health, World Health Organization, Geneva.

World Health Organization 2009, *Mental health – aspects of women's reproductive health: a global review of the literature*, World Health Organization, Geneva.

World Health Organization 2014, WHO global data base on body mass index, World Health Organization, viewed 9 August 2015, <http://www.apps.who.int/bmi/index.jsp?introPage=intro_3.html>.

Yao, R, Ananth, C, Park, B, Pereira, L & Plante, L 2014, 'Obesity and the risk of stillbirth: a population-based cohort study', *American Journal of Obstetrics & Gynecology,* vol. 210, issue 5, pp. 457.e1–457.e9.

Yelland, J, Riggs, E, Small, R & Brown, S 2015, 'Maternity services are not meeting the needs of immigrant women of non-English speaking background: Results of two consecutive Australian population based studies', *Midwifery*, vol. 31, no. 7, pp. 664–70.

Yelland, J, Sutherland, G & Brown, S 2012, 'Women's experience of discrimination in Australian perinatal care: the double disadvantage of social adversity and unequal care', *Birth*, vol. 39, no. 3, pp. 211–20.

Young, D, Lees, A & Twaddle, S 1997, 'The costs to the NHS of maternity care: midwife-managed vs. shared', *British Journal of Midwifery*, vol. 5, no. 8, pp. 465–72.

Zadoroznyj, M 2008, 'Neo-liberalism and maternity care: choice, inequality and maternal health outcomes in Canada and Australia', paper presented to Families @ Flinders, Flinders University Seminar Series: Health & Society Area of Strategic Research Initiative 30 October.