Integrating Clinical and Economic Perspectives to Effectively Evaluate PTSD Treatments: Improving Consistency, Methodology and Data Availability

By

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Abstract

Posttraumatic stress disorder (PTSD) is a debilitating condition associated with significant distress, impairment, and economic burden. Despite strong evidence supporting numerous treatments for PTSD, access remains limited, particularly in public healthcare settings, where resource constraints can be a barrier to implementation. Economic evaluations are critical for informing funding decisions and supporting advocacy for training and resources, yet evaluations of PTSD treatments are scarce. This thesis addressed key methodological gaps impacting the rigour, consistency, and applicability of economic evaluations of PTSD treatments through three interrelated studies, informed in part by an open trial of Cognitive Processing Therapy (CPT) in an Australian public mental health setting.

Chapter 1 presents a concise and critical summary of the literature relevant to the evidence base for psychological therapies such as PTSD, as well as highlighting key issues that underpin our understanding economic evaluations. Chapter 2 presents a systematic review, where substantial variability across existing model-based economic evaluations of PTSD treatments was identified. Differences in model structures, assumptions, and cost components limited comparability and relevance for decision-makers. These findings highlight the need for a standardised reference model to ensure consistent, clinically relevant, and policy-informed economic evaluations.

Chapter 3 examines the suitability of the Assessment of Quality of Life-8 Dimension (AQoL-8D) for capturing PTSD-related treatment effects. Quality-adjusted life years (QALYs), derived from generic preference-based quality-of-life measures (GPQoLs) such as the AQoL-8D, are the recommended outcome metric for economic evaluations, as they allow comparisons across conditions. However, research suggests that GPQoLs may not fully capture the complexities of mental health disorders. This study found that while the AQoL-8D detected some PTSD-related changes, it was less sensitive to treatment effects than the PTSD Checklist for DSM-5 (PCL-5). These findings highlight that economic evaluations relying solely on QALY-based outcomes may

underestimate the benefits of PTSD treatments, reinforcing the need for more responsive outcome measures.

Chapters 4 and 5 report findings from an open trial of CPT conducted in the South Australian public mental health system, examining clinical effectiveness, treatment costs, and healthcare utilisation. The study demonstrated significant PTSD symptom reductions and quality-of-life improvements, consistent with international implementation studies. Importantly, the study captured key cost components, including training and supervision, to enhance real-world applicability of economic evaluations. Healthcare utilisation data, derived from Commonwealth sources, indicated reductions in mental health service use following CPT; changes in *medication* use were more variable. The importance of incorporating data from national data sources such as Medicare-funded services into Australian economic evaluations of PTSD treatments, is highlighted.

The broader implications of this program of research are summarised in Chapter 6. Together, findings from these studies illustrate the critical methodological challenges as well as opportunities for improving economic evaluations of PTSD treatments. Strengthening collaboration between clinicians and health economists, developing a standardised reference model, improving the sensitivity of GPQoL measures, and embedding economic data collection into routine clinical research are argued to be key next steps in advancing the field. By addressing these issues, this thesis succeeds in its goal to provide more robust foundational economic evidence and guidance that will ultimately support future research that will lead to improved funding decisions and expanded access to cost-effective PTSD treatments in public healthcare settings.

Declaration

I certify that this thesis:

1. does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university

2. and the research within will not be submitted for any other future degree or diploma without the permission of Flinders University; and

3. to the best of my knowledge and belief, does not contain any material previously published or written by another person except where due reference is made in the text.

Signed: Sheradyn Matthews

Date: 16/03/2025

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CHAPTER 1:

Introduction and Literature Review[1]

Overview: Posttraumatic stress disorder (PTSD) is a debilitating mental health condition associated with significant psychological distress and functional impairment (Koenen et al., 2017). Beyond its clinical impact, PTSD imposes substantial economic costs due to higher healthcare service use, productivity losses, and reliance on social welfare systems (Davis et al., 2022; Ferry et al., 2015). Despite the availability of effective, evidence-based treatments, access to these interventions remains limited (Finch et al., 2020b), particularly in public health settings, where clients typically experience greater socioeconomic disadvantage and higher rates of PTSD (Australian Bureau of Statistics, 2022). Resource constraints in public healthcare settings often limit the adoption of these therapies, highlighting the need for robust economic evidence—alongside clinical effectiveness data—to support integration into routine care. PTSD treatments have shown potential cost-effectiveness (von der Warth et al., 2020), but their influence on health policy decision-making is hindered by limited comparability across studies. Differences in quality, reporting standards, methodological approaches, and the availability of country-specific data contribute to this challenge.

This thesis addresses these gaps through three interconnected studies. First, a systematic review of model-based economic evaluations of PTSD treatments identifies the different model structures and parameter inputs used, examining their influence on study validity and conclusions drawn. Second, a validation study evaluates whether the Assessment of Quality of Life-8 Dimension (AQoL-8D), a widely used quality-of-life measure used in economic evaluations, is suitable for capturing PTSD-related changes following treatment by comparing its performance to a PTSD-specific symptom measure. Finally, an open trial of Cognitive Processing Therapy (CPT) was conducted in the South Australian public mental health system to assess its clinical outcomes

[1] This chapter contains content from the introduction of a published paper (Matthews et al., 2023), further reported in Chapter 3.

and explore data required for economic evaluation including treatment costs and healthcare utilisation. This trial aimed to provide insight into the feasibility of implementing CPT in this setting and generate context-specific data to inform future economic evaluations of PTSD interventions.

Ultimately, this thesis aims to enhance the methodological rigor, comparability, and policy relevance of future economic evaluations of PTSD treatments, with the goal of generating high-quality evidence for PTSD treatment options to guide resource allocation. By presenting both clinical and economic perspectives, this research seeks to increase clinician awareness of the key inputs required for economic evaluation and support advocacy efforts for improved access to and funding for PTSD interventions. This introductory chapter outlines the prevalence, diagnostic criteria, and impact of PTSD, followed by a discussion of current treatments, the broader need for health services PTSD research, and the role of economic evaluation in informing health policy and resource allocation decisions.

Posttraumatic stress disorder (PTSD) Prevalence and Diagnostic Criteria

PTSD is a debilitating mental health condition that can develop following exposure to a traumatic event. Globally, 315.6 million individuals are expected to experience PTSD in their lifetime, representing 3.9% of the population (Koenen et al., 2017). In Australia, PTSD is one of the most common mental health disorders, with a lifetime prevalence of 10.7% and a 12-month prevalence of 5.6% (Australian Bureau of Statistics, 2022).

PTSD can be diagnosed using two major classification systems: the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; American Psychiatric Association, 2022) and the International Classification of Diseases, 11th Revision (ICD-11; World Health Organization, 2022). While both frameworks recognise PTSD as a response to traumatic events, they differ in their diagnostic criteria and symptom classifications. According to the Diagnostic and Statistical Manual of Mental Disorders Fifth Edition (DSM-5; American Psychiatric Association, 2022), PTSD can develop following exposure to a Criterion A trauma, defined as actual or threatened death, serious injury, or sexual violence. These events can be experienced directly, witnessed, learned about occurring to a close family member or friend, or through indirect exposure to aversive details. Globally, the most common Criterion A traumas reported include the unexpected death of a loved one, witnessing death and serious injury, and motor vehicle accidents (Kessler et al., 2017). Whilst not all individuals exposed to such traumas develop PTSD, those who do often face enduring and disruptive symptoms that significantly impair functioning (Hinton et al., 2021). These symptoms can be categorised into four core clusters: intrusive memories (e.g., flashbacks or distressing nightmares), avoidance behaviours (e.g., avoiding reminders of the trauma), negative alterations in mood and cognition (e.g., persistent feelings of guilt and an inability to experience positive emotions), and hyperarousal (e.g., sleep disturbances, irritability, and heightened startle response) (American Psychiatric Association, 2022).

An alternative classification system, the International Classification of Diseases, 11th Revision (ICD-11; World Health Organization, 2022), provides a framework for diagnosing PTSD that is less proscriptive in definitions of a traumatic event and with a smaller grouping of required

symptom clusters. The ICD-11 requires exposure to an event described as 'extremely threatening or horrific' and symptoms across three core clusters: re-experiencing the trauma, avoidance, and a persistent sense of heightened threat. The ICD-11 also introduces Complex PTSD — a diagnosis not yet included in the DSM — which requires these core symptoms along with additional impairments in emotional regulation, self-concept, and interpersonal relationships. Complex PTSD is often associated with prolonged or repeated trauma (World Health Organization, 2022). Regardless of the classification system used, both stipulate that symptoms must persist for at least one month and cause significant functional impairment.

Impact of PTSD

PTSD significantly affects individuals' mental, physical, and social functioning. Those living with PTSD frequently report substantial distress and diminished quality of life (Galatzer-Levy et al., 2013; Giacco et al., 2013) and the disorder is often compounded by high rates of comorbid mental and physical health conditions. Nearly 80% of individuals diagnosed with PTSD experience additional mental health diagnoses, most commonly depression, leading to increased symptom severity and functional impairment (Chan et al., 2009; Qassem et al., 2021) and PTSD is also associated with chronic physical health issues such as cardiovascular disease, chronic pain, and immune system dysregulation (Ryder et al., 2018). These challenges often lead to functional limitations, such as difficulties in employment, education, or relationships, and can further contribute to social isolation and distress (Jellestad et al., 2021). PTSD can also be a chronic condition, with some estimates suggesting that approximately 50% of individuals with PTSD experience a recurrent or chronic trajectory of the disorder (Morina et al., 2014; Steinert et al., 2015) and Australian evidence suggests that 37% of individuals with PTSD remained symptomatic even after 30 years, with 10% enduring a lifelong course (Chapman et al., 2012).

The mental and physical impacts of PTSD translate into significant economic burden on healthcare systems and society more broadly. People with PTSD have significantly higher healthcare utilisation, including more frequent hospitalisations, mental-health related service use,

and medication use, compared to those without PTSD (Davis et al., 2022; Lamoureux-Lamarche et al., 2016; Marshall et al., 2000) and compared to those with other mental health conditions (Chan et al., 2009; Ivanova et al., 2011). Evidence suggests that effective treatment can reduce the negative economic impact of PTSD through reduced service utilisation (Casey et al., 2023; Meyers et al., 2013; Tuerk et al., 2013). In Australia, mental illness is also a leading cause of productivity loss contributing significantly to reduced workforce participation, absenteeism, and reliance on welfare support (Australian Productivity Commission, 2020)—trends that have also been documented in populations with PTSD (Davis et al., 2022; Ferry et al., 2015). This economic impact further extends to caregivers, who often provide substantial informal support, which can limit their workforce participation and overall productivity (Shepherd-Banigan et al., 2020). Efforts to ensure the availability of accessible, evidence-based interventions for PTSD is therefore essential.

Evidence-based PTSD Treatments

Numerous evidence-based PTSD treatments exist, including but not limited to cognitive processing therapy (CPT), prolonged exposure therapy (PE), eye-movement desensitisation and reprocessing (EMDR) and trauma focused cognitive behavioural therapy (TF-CBT). These treatments are considered first-line options in Australian and international guidelines (National Institute for Health and Care Excellence, 2018; Phoenix Australia, 2020). They share core therapeutic elements including addressing maladaptive cognitions, promoting exposure to trauma-related reminders, reducing avoidance behaviours, and facilitating emotional processing. While each therapy emphasises these components to varying degrees, they all aim to help individuals process their trauma and alleviate distress (Mavranezouli et al., 2020).

Decades of research have documented the efficacy of these first-line treatments for PTSD. Meta-analyses of randomised controlled trials (RCTs) consistently demonstrate that trauma-focused therapies, such as TF-CBT, CPT, PE, and EMDR, achieve large effect sizes in reducing PTSD symptoms in adults compared to various control conditions (Cusack et al., 2016; Mavranezouli et al., 2020a; Watts et al., 2013). Recovery rates range from 44% to 64% (Cusack et al., 2016), and

available evidence suggests that treatment gains are generally sustained over time with intervals ranging from six months to six years posttreatment (see Kline et al., 2018; Resick et al., 2012). The effectiveness of these interventions has also been demonstrated in routine healthcare settings; however, treatment outcomes are typically more variable and less pronounced compared to controlled trials (Öst et al., 2023). This variability reflects the challenges inherent in routine clinical practice including for example, differences in therapist expertise, client adherence, and the complexity of client presentations (Öst et al., 2023). Beyond symptom reduction, these therapies can also significantly improve quality of life (Fortin et al., 2021; Giacco et al., 2013) and reduce functional impairment (Bonfils et al., 2022, Hinton et al., 2021). Whilst the effectiveness of these treatments is well-established, research conducted in Australia (Issakidis et al., 2004) and the UK (Finch et al., 2020b; Layard & Clark, 2015) suggest that a large portion of individuals seeking help for PTSD do not receive evidence-based PTSD treatments.

Barriers to Evidence-based PTSD Treatment

Efforts to understand barriers to delivering evidence-based PTSD treatments have largely focused on clinician-level factors, such as attitudes toward evidence-based practices and familiarity with treatment protocols (Borah et al., 2017; Finch et al., 2020a). Organisational and system-level challenges have received comparatively less attention (Finch et al., 2020a), though clinicians have reported that organisational resource constraints, limited training opportunities, and inadequate supervision hinder the adoption of evidence-based therapies in practice (Finch et al., 2020a). In Australia, healthcare is funded through federal and state governments as well as private organisations (Cook, 2019) with mental health care typically delivered through both publicly funded services and private practices. Public services, fully funded by the government, typically provide care for individuals with more acute needs or those unable to afford private care. In contrast, private mental health care is partially subsidised through schemes such as the Better Access initiative in Australia, which is funded under the national health insurance scheme, Medicare. This initiative provides a maximum of 10 individual and 10 group allied mental health

services each year. However, significant out-of-pocket costs often remain, limiting access for some individuals (Cook, 2019; Pirkis et al., 2022).

While funding for public mental health services has increased over the years (Australian Institute of Health and Welfare, 2024), so too has demand (Department for Health and Wellbeing, Government of South Australia., 2019), and it remains unclear whether more recent increases in funding have translated into tangible improvements in client mental health outcomes. In the Australian public mental health system, constrained resources and key performance indicators (KPIs) focused on numbers of clients seen or reducing time to first appointment often prioritise acute, crisis-driven care over preventative or sustained mental health interventions, undermining the consistent delivery of effective PTSD treatments (Department for Health and Wellbeing, Government of South Australia., 2019; Petrie et al., 2021). While private psychological care is subsidised, large gap fees and wait-times can prevent the uptake of these services resulting in individuals relying on public mental health services (Pirkis et al., 2022). This reactive model of care often leads to individuals cycling through services, exacerbating psychological distress and contributing to escalating burden on the healthcare system (Petrie et al., 2021). However, addressing these inefficiencies is complicated by the division of healthcare funding across different levels of government, which can create financial silos where investments in one area do not necessarily translate into savings for the same area (Peiris et al., 2024). For example, where increases in funding for state-based publicly funded services may generate savings to federal government through reduced reliance on Medicare-subsidised psychological services and medications.

Financial silos exist not only across different levels of government but also within individual budgets, where costs incurred in one area, such as mental health outpatient services, may not be directly linked to savings in another, such as hospital admissions (Peiris et al., 2024). As a result, services grappling with constrained budgets and competing priorities may be reluctant to invest in high-quality PTSD training and ongoing expert supervision—the gold standard training model in

this area—if the downstream cost savings occur elsewhere in the healthcare system. This is despite evidence suggesting that these investments can lead to overall cost savings through reduced healthcare utilization (Casey et al., 2023; Meyers et al., 2013; Tuerk et al., 2013) and increased productivity (Bubonya et al., 2017; Chan et al., 2003). This type of evidence can inform policy decisions. For example, in the United Kingdom (UK), economic evidence demonstrating reduced healthcare utilisation and increased productivity from evidence-based psychological interventions played a pivotal role in the establishment of the publicly funded National Health Service (NHS) Talking Therapies for Anxiety and Depression program, formerly known as Improving Access to Psychological Therapies (IAPT) (Layard & Clark, 2015; Mukuria et al., 2013). Unlike Australia's Better Access initiative, which provides partially subsidised care for private mental health services, NHS Talking Therapies offers fully funded, evidence-based therapy for common mental health conditions such as depression and anxiety, at low to moderate intensity. It operates within a stepped-care model, triaging individuals to appropriate levels of care based on severity. This initiative illustrates how robust economic arguments for evidence-based interventions can drive large-scale government investment in mental health care, resulting in both clinical improvements and economic benefits. In Australia, conservative estimates suggest that targeted and effective interventions for treating PTSD in adult survivors of childhood trauma could save the government up to $9.1 billion annually by preventing other mental and physical health comorbidities (Kezelman et al., 2015). This figure would likely increase if individuals who experienced trauma during adulthood were also included. Given the potential cost savings of effective treatment in Australia, it is imperative to further investigate the complexities surrounding funding, resource allocation, and the implementation of evidence-based PTSD treatments.

Economic Evaluation - Introduction to Key Concepts

Health economics provides a structured framework for assessing the value of healthcare interventions, ensuring that limited resources are allocated efficiently to maximise population health benefits. (Drummond et al., 2015). Economic evaluations are central to this process, systematically

comparing the costs and outcomes of alternative healthcare strategies to inform evidence-based decision-making. Costs can include direct medical costs (e.g., treatment expenses, healthcare resource use), indirect costs (e.g., productivity losses, informal caregiving), and patient-incurred costs (e.g., travel, out-of-pocket expenses). Outcomes are often measured in terms of symptom improvement, quality-adjusted life years (QALYs)—a metric combining quality and length of life—or other clinical benefits such as a reduction of hospital admissions. Moreover, economic evaluations can be trial-based, model-based, or a hybrid of both. Trial-based economic evaluations, conducted alongside randomised controlled trials (RCTs), collect cost and outcome data directly from participants (Glick et al., 2007), whereas model-based evaluations use mathematical models to simulate costs and outcomes, populating models using data from a variety of sources including RCTs or other trials, published literature and expert opinion (Drummond et al., 2015).

The value of evidence from economic evaluations is recognised internationally by organisations such as the World Health Organisation (WHO), the National Institute for Health and Care Excellence (NICE), and advisory bodies in Australia such as the Pharmaceutical Benefits Advisory Committee (PBAC) and the Medical Services Advisory Committee (MSAC) (Australian Government Department of Health, 2016, 2017; National Institute for Health and Care Excellence, 2013; Tan-Torres Edejer et al., 2003). This recognition is also evident in the Australian guidelines for PTSD, which acknowledge the importance of cost-effectiveness and resource allocation in treatment decisions but do not make specific recommendations due to limited available evidence (Phoenix Australia, 2020). Economic evaluations not only assist policymakers in identifying interventions that offer the greatest value for money but also provide clinical service managers with evidence to advocate for the resources and training needed to deliver effective therapies (Luyten et al., 2016). However, despite the benefits of economic research, evaluations of PTSD treatments remain underexplored compared to other mental health conditions, highlighting a critical research gap.

Cost-effectiveness analysis (CEA) and cost-utility analysis (CUA) are two of the most widely used methods to evaluate health interventions (Luyten et al., 2016). Both assess costs in monetary terms but differ in how health outcomes are measured. CEA uses disorder-specific measures, such as the reduction in PTSD symptoms or the number of hospital admissions avoided, while CUA employs a standardised metric—most commonly quality-adjusted life years (QALYs) (Drummond et al., 2015). QALYs are typically derived from generic preference-based quality of life (GPQoL) measures such as the EQ-5D (Brooks, 1996) and Short Form-6 Dimension (SF-6D; Brazier et al., 2002). One QALY represents one year of life in perfect health, while a score of 0 is equivalent to death, and negative values represent health states considered worse than death. Generic health outcomes are important as they enable comparison of health gains across different conditions and interventions, allowing for meaningful cross sector comparisons. As such, QALYs are particularly valuable for informing resource allocation decisions and consequently, they have become the preferred outcome measure for most national funding bodies, including Australia (Australian Government Department of Health, 2016) and the UK (Longworth et al., 2014), to support the assessment of health technologies such as medications, psychological therapies, and medical devices (Drummond et al., 2015).

Current Literature on the Economic impact of PTSD and Evidence-Based Treatments

A recent systematic review by von der Warth et al. (2020) examining the economic impact of PTSD provided an overview of different types of economic evidence related to PTSD, including cost-of-illness (COI) studies and full economic evaluations of PTSD treatments. The cost-of-illness studies identified consistently found that PTSD imposes substantial economic burden, though direct healthcare costs varied widely. Estimates ranged from $512 USD per person annually when considering only primary care costs in a sample of active-duty military personnel (Eekhout et al., 2016) to $19,435 USD when including psychiatric contacts, inpatient, and outpatient care based on a sample of individuals exposed to motor vehicle accidents (O'Donnell et al., 2005). Indirect costs, such as productivity losses and informal caregiving, further amplify this burden, with one

Australian study estimating annual indirect excess costs of $5,021 USD (PPP) per person following a single traffic accident (Chan et al., 2003). Variation in results were attributed to differences in healthcare system structures, country-specific wages and costs, and variability in trauma exposure types (von der Warth et al., 2020). In terms of full economic evaluations comparing alternative PTSD treatments, eight full economic evaluations were identified (von der Warth et al., 2020). Most studies focused on TF-CBT, with evidence supporting its cost-effectiveness both alone and in combination with SSRIs compared to no treatment or treatment as usual, despite SSRIs not being recommended as a first-line treatment (Phoenix Australia, 2020). More recent studies further support the cost-effectiveness of TF-CBT (Lebenbaum & Hassan, 2024; Mavranezouli et al., 2020b), with emerging evidence for other first-line treatments, such as EMDR (Mavranezouli et al., 2020b).

While existing evidence highlights the economic benefits of evidence-based PTSD treatments, key methodological limitations and data gaps continue to hinder the ability to draw meaningful comparisons across studies. Von der Warth et al. (2020) noted that variability in intervention design, quality, and reporting standards—particularly in model-based evaluations, which constituted half of the studies reviewed—limits the ability to establish robust economic conclusions. Notably, model-based studies often lacked adequate descriptions of model structures and assumptions, reducing transparency and reproducibility. Greater consistency in methodological choices, such as standardising the model structures used to represent PTSD, would enhance comparability across studies, strengthening the evidence base for resource allocation decisions and supporting the wider adoption of cost-effective PTSD treatments. Moreover, to improve the accuracy of economic evaluations, von der Warth et al. (2020) emphasised the need for more comprehensive data collection, to better capture the full economic impact of PTSD. Another major limitation identified was the cross-country variability in PTSD-related costs, which limits the generalisability of findings across healthcare systems. As a result, they highlighted the importance

of country-specific evaluations, advocating for economic evidence that reflects the unique structure and cost dynamics of individual healthcare systems rather than reliance on international data.

Given the limited number and high variability of economic evaluations, there is a critical need to strengthen key methodological components to improve rigor, comparability, and applicability. These limitations are pronounced in model-based evaluations which may be more likely to be employed to evaluate PTSD treatments given documented difficulties with conducting RCTs in this population. For example, RCTs can result in significant participant burden and subsequent challenges in recruitment and retention frequently occur. Vogel et al. (2020) highlights that many PTSD trials struggle to reach their planned sample sizes, with common barriers including the distress of discussing traumatic experiences, logistical difficulties (e.g., transportation, scheduling), and the high risk of dropout. Although researchers in the field of PTSD acknowledge the need for economic evidence to complement their clinical findings (Casey et al., 2023; Knapp & Wong, 2020; Varker et al., 2020), a disconnect remains between PTSD research and health economics, with economic evaluations in this area remaining scarce. For example, a recent review of model-based evaluations in depression identified 41 full economic evaluations of treatments for depression (Kolovos et al., 2017), compared to the four identified in von der Warth et al. (2020). High-quality economic evaluations have the potential to serve multiple functions. They provide clinical service managers with robust evidence to advocate for greater investment in PTSD training, supervision, and service delivery—ensuring that clinicians have the necessary skills and resources to effectively implement evidence-based treatments (Borah et al., 2017). As more economic evidence becomes available, it can inform clinical guidelines by identifying cost-effective treatments, helping clinicians and services make informed decisions about which therapies to pursue training in. At a broader level, economic evaluations guide large-scale policy and funding decisions, influencing national health strategies and service models that determine the accessibility and sustainability of PTSD treatments (Layard & Clark, 2015; National Institute for Health and Care Excellence, 2013)

To ensure economic evaluations can effectively fulfill these functions, key methodological challenges and data gaps must first be addressed. Three key areas warrant further investigation: (1) understanding methodological approaches across model-based economic evaluations of PTSD treatments, to facilitate consistency across studies and subsequent conclusions drawn; (2) the adequacy of generic preference quality-of-life measures, used to calculate QALYs, in capturing PTSD-specific outcomes; and (3) the collection of key clinical and economic variables related to evidence-based PTSD treatment within the Australian healthcare context. Strengthening these areas will enhance the quality of future economic evidence for PTSD treatments, supporting more effective policy to facilitate greater access to cost-effective PTSD treatments. The following sections will explore these three key areas in greater detail to provide a comprehensive understanding of the challenges and opportunities for improving economic evaluation of PTSD treatments.

Model-based Economic Evaluations

Economic evaluations are required to support funding decisions at the national level (Knapp & Wong, 2020) but can also be used to support local level resource prioritisation decisions (Isobel et al., 2021). Economic evaluations conducted alongside a clinical trial can provide high-quality evidence specific to a trial population; however, they are often constrained by short follow-up periods, limited generalisability beyond the trial cohort, and reliance on data collected within the trial, which may omit important costs or outcomes (Glick et al., 2007). Despite recommendations, economic evaluations are rarely conducted alongside RCTs due to the additional time, expertise, and resources required. This challenge is particularly evident in evaluating well-established therapies, where feasibility and high costs may limit RCTs focused on evaluating their cost-effectiveness (Franklin et al., 2020). RCTs in mental health research can also face ethical concerns (e.g., withholding treatment from those who would benefit), difficulties in establishing an appropriate treatment comparator and more generally, challenges in achieving adequate sample sizes (Franklin et al., 2020; Vogel et al., 2020).

Model-based economic evaluations provide an alternative to trial-based approaches offering greater flexibility through integrating data from multiple relevant sources, including meta-analyses, RCTs, observational studies, and expert opinion (Caro & Möller, 2014). Model-based economic evaluations also offer the flexibility of simulating longer-term costs and outcomes, making it possible to consider broader populations and scenarios not captured in individual trials. These features make model-based evaluations particularly valuable for addressing complex health questions and informing policymaking (Drummond et al., 2015). Despite these advantages, model-based evaluations require the development of a detailed analytic framework involving numerous methodological decisions including the broad modelling approach employed, such as decision trees (DT) or Markov models, appropriate treatment comparators, time horizon (i.e., the duration over which outcomes are assessed), and discount rates (i.e., adjustments to reflect the present value of future costs and benefits). Furthermore, decisions also need to be made regarding the most appropriate data to inform model parameters including at minimum clinical effectiveness and costs, and key assumptions made (Brennan et al., 2006).

As highlighted in the review by von der Warth et al. (2020), these methodological decisions vary considerably across model-based economic evaluations. For example, across the four model-based economic evaluations identified, the time horizon employed ranged from 1 (Macdonald et al., 2016) to 31 years (Gospodarevskaya & Segal, 2012). This variability can influence model conclusions and hinder the ability to meaningfully compare results across economic evaluations (Caro & Möller, 2014). For policymakers allocating resources, these inconsistencies can reduce the practical value of economic evaluations. Understanding differences in how PTSD is conceptualised across model-based evaluations can support the development of clear methodological approaches to enhance consistency, transparency, and comparability across studies, ultimately generating more robust findings to inform policy decisions.

The Adequacy of Generic Preference-based Quality of Life (GPQoL) Measures

As outlined earlier, GPQoL measures are used in economic evaluations to estimate quality-adjusted life years (QALYs), providing a standardised metric that allows comparisons across different health conditions and interventions (Drummond et al., 2015). A critical area of research requiring further investigation is the extent to which GPQoL measures effectively capture treatment-related improvements in mental health outcomes (Finch et al., 2018). Many commonly used GPQoL measures were originally developed to assess health-related quality of life in physical health conditions such as diabetes, cancer, and cardiovascular disease, with the goal of providing a standardised measure applicable across diverse populations and health conditions (Longworth et al., 2014). For this reason, they are commonly used to inform estimation of QALYs for inclusion in economic evaluations considered by national Health Technology Assessment agencies internationally, including PBAC (Pharmaceutical Benefits Advisory Committee, 2016) and MSAC (Gallego et al., 2011) in Australia. These measures generate scores that are typically interpreted on a continuous scale of health-related quality of life. These scores can then be converted into utility values using population-based preference weights, which reflect how the general public values different health states, where 0 usually represents death, 1 represents perfect health, and scores below 0 represent health states considered worse than death (Luyten et al., 2016). Utility values are subsequently multiplied by the duration of time spent in a particular health state to calculate QALYs (Drummond et al., 2015). Understanding the applicability and limitations of GPQoL measures in mental health is essential for ensuring that QALYs and therefore economic evaluations, can accurately reflect the benefits of interventions for conditions such as PTSD.

The EQ-5D is the most widely used GPQoL measure and is recommended for economic evaluations of new health technologies by national advisory bodies such as NICE and the Pharmaceutical Benefits Advisory Committee (PBAC) in Australia (Australian Government Department of Health, 2016). While the EQ-5D and other widely used generic preference-based

measures, such as the Short Form-6 Dimension (SF-6D) and the Health Utilities Index Mark 3 (HUI-3), are effective in detecting changes in depression and anxiety symptoms following treatment for mental illness (Finch et al., 2018), there is growing evidence that these instruments may lack sensitivity for conditions characterised by broader and more complex symptomatology, such as schizophrenia, bipolar disorder, and personality disorders (Abdin et al., 2019; Finch et al., 2018; Mulhern et al., 2014).

Limited research has specifically evaluated the performance of GPQoL measures in PTSD, despite their widespread use in economic evaluations. This is a critical gap, as PTSD is defined by a diverse symptom profile spanning four clusters—re-experiencing, avoidance, negative alterations in mood and cognition, and hyperarousal (American Psychiatric Association, 2022). Commonly used QOL measures, such as the EQ-5D, assess mental health through a single anxiety/depression item with three response categories ('I am not anxious or depressed,' 'I am moderately anxious or depressed,' and 'I am extremely anxious or depressed') (Brooks, 1996). This narrow focus may overlook key aspects of PTSD symptomatology, such as dissociation, hypervigilance, or cognitive distortions, limiting the capacity of these measures to capture meaningful treatment-related changes.

If GPQoL measures do not adequately reflect improvements in PTSD symptoms, their use in economic evaluations could distort comparisons between mental and physical health conditions. The reliance on instruments primarily designed to capture depression and anxiety risks biasing economic assessments in favour of conditions with more directly measurable symptom changes, potentially underestimating the benefits of PTSD treatments. Given the increasing emphasis on economic evidence to inform funding decisions, further research is needed to determine whether commonly used QOL instruments are fit for purpose in PTSD evaluations or whether alternative approaches, such as condition-specific utility measures, should be considered.

Model Inputs in Economic Evaluations of PTSD Treatments

In addition to the appropriateness of the measures used to capture quality of life, the data sources used to populate model-based economic evaluations play a crucial role in shaping conclusions. At a minimum, these sources include estimates for QALYs, intervention costs, and downstream healthcare utilisation, but they may also extend to transition probabilities (e.g., the likelihood of moving from PTSD to recovery or relapse), mortality risks, and broader societal costs such as productivity losses and informal caregiving. The selection and availability of these data sources influence both the internal validity and real-world applicability of economic models. Two critical data gaps identified in the economic evaluations reviewed by von der Warth et al. (2020) were the availability of appropriate QALY estimates and comprehensive cost data, which this thesis will address.

Most economic evaluations of PTSD treatments, including those conducted in Australia, report QALYs as the primary outcome measure (von der Warth et al., 2020). Many clinical studies routinely incorporate quality-of-life measures as an integral secondary outcome, with examples including the Short-Form Health Survey (SF-36) and the World Health Organization Quality of Life (WHOQOL) measure (Balayan, 2014). However, not all of these measures are suitable for economic evaluation, as some, such as the WHOQOL, lack predefined utility weights required for QALY estimation. While mapping methods exist to estimate utility values from quality-of-life measures that lack predefined utility weights (e.g., Mukuria et al., 2025), these approaches introduce additional uncertainty, as they rely on statistical models rather than direct preference-based ratings, making direct data collection of utility values preferable. In Australia, economic evaluations of PTSD have predominantly relied on utility estimates from the 2007 Australian National Survey of Mental Health and Wellbeing (see e.g., Gospodarevskaya & Segal, 2012; Mihalopoulos et al., 2015). This survey included diagnostic interviews to establish mental health diagnoses and a GPQoL measure, the Assessment of Quality of Life – 4-Dimension (AQoL-4D) with Australian population norms available. The AQoL-4D facilitates QALY estimation with 12

items across four dimensions—independent living, relationships, mental health, and senses (Hawthorne & Osborne, 2005). While this remains the best available Australian data source, subsequent national surveys have excluded GPQoL measures, limiting updated population-based utility estimates. Moreover, depending on how data from these surveys are extracted and reported, utility values derived from nationally representative samples may not fully capture the heterogeneity in health-related quality of life and treatment responses among PTSD-affected subgroups. For example, individuals from lower SES backgrounds, who experience higher PTSD prevalence and poorer clinical outcomes, may systematically report lower utility values and less pronounced benefit from evidence-based treatments (Bastardo & Mendoza, 2016; Kim et al., 2017). Consequently, further research is needed to establish a robust evidence base of utility values that account for these variations, ensuring that economic evaluations reflect the heterogeneity of PTSD populations.

While QALYs are integral to measuring treatment benefits, equal attention must be given to the costs included in economic evaluations to fully assess the value of PTSD treatments. Healthcare utilisation represents a key cost in economic evaluations; however, substantial variation exists in how it is defined and included in existing economic evaluations of PTSD treatments (von der Warth et al., 2020). Although substantial evidence indicates that individuals with PTSD have high healthcare utilisation (Chan et al., 2009; von der Warth et al., 2020), fewer studies have examined the extent to which treatment influences subsequent service use—a critical factor in assessing long-term cost-effectiveness and the potential for cost offsets. In child populations, research has reported reductions in school-based therapy, welfare services, nurse appointments, rehabilitation support, and medication use following TF-CBT (Aas et al., 2019), as well as decreased inpatient and primary care costs (Shearer et al., 2018). In adult populations, studies have primarily focused on international veteran samples, with evidence suggesting that evidence-based PTSD treatments reduce mental health service use (e.g., therapy or counselling sessions) but have little impact on primary care visits or emergency department admissions (Meyers et al., 2013; Tuerk et al., 2013).

The only Australian-based study examining healthcare utilisation changes in this population compared service use 12 months before and after Cognitive Processing Therapy (CPT), a first-line PTSD treatment, within a tertiary mental health outpatient service. The study reported reductions in mental health-related psychiatric triage service calls, episodes of care with mental health clinicians, hospital admissions, and total inpatient days (Casey et al., 2023). However, consistent with Meyers et al. (2013), no significant changes were observed in emergency department visits. While there is some consistency in the reduction of mental health service utilisation following treatment, the specific services examined across studies vary considerably, likely reflecting country-specific healthcare structures. Differences in service availability, funding models, and healthcare system design influence access to and demand for care (von der Warth et al., 2020). In Australia, primary healthcare services—including general practitioners, private mental health professionals subsidised by the Medicare Benefits Schedule (MBS), and pharmaceuticals subsidised by the Pharmaceutical Benefits Scheme (PBS)—account for a substantial proportion of healthcare use. In the 2022–2023 financial year, 18% of the Australian population was prescribed mental health-related medication, over 2 million people received mental health support from a general practitioner, and more than 1.8 million accessed care from psychologists and other allied health professionals (Australian Institute of Health and Welfare, 2024). Given the high reliance on these Medicare subsidised services, understanding how evidence-based PTSD treatments influence primary healthcare utilisation is critical for assessing their broader economic impact and determining the importance of these costs for incorporation into economic evaluations of PTSD treatments.

Summary and Aims of the Current Thesis

In this chapter I have established that posttraumatic stress disorder (PTSD) is a debilitating mental health condition associated with significant psychological distress, functional impairments, and comorbid physical and mental health conditions (Bastardo & Mendoza, 2016; Kim et al., 2022). While evidence-based treatments are widely recommended, their implementation faces persistent barriers, including clinician- and organisational-level challenges, where organisational challenges

are often rooted in funding constraints that can hinder the delivery of high-quality care, particularly in public mental health settings (Finch et al., 2020b; Petrie et al., 2021). Economic evaluation of PTSD treatments can support evidence-based decision making to ensure cost-effective PTSD treatments are delivered either at a national or local level. Despite this, economic evaluations of PTSD treatments remain scarce, with a lack of evidence regarding consistent approaches for model-based evaluations. It is also unclear on how appropriate commonly used GPQOL measures are for capturing PTSD-specific changes, and what types of healthcare utilisation data are relevant in Australian-based economic evaluations of PTSD treatments. Addressing these gaps can help identify and improve methodological inconsistencies and ultimately support more appropriate methodological approaches in future economic evaluations of PTSD treatments.

This thesis aims to address these gaps through three distinct but interconnected studies. In Chapter 2, I present the results of a systematic review of model-based economic evaluations of PTSD treatments, which identifies the different model structures and parameter inputs used and examines their influence on model validity and conclusions drawn. The review provides the first step towards achieving greater consistency in future economic evaluations to support improved decision-making for funding PTSD interventions. In Chapter 3, I examine the adequacy of the AQOL-8D, a GPQoL measure commonly used to generate QALYs for economic evaluation, to capture change in PTSD symptoms. The construct validity and responsiveness of the AQoL-8D was compared to a widely used self-report PTSD measure (the PTSD Checklist; PCL-5) to determine its ability to capture treatment-related change when included in economic evaluations in PTSD research.

Chapter 4 presents clinical outcomes from an open trial of CPT conducted across public mental health sites within South Australia Health (SA Health), a state-funded public health service. Twenty-seven clinicians were trained in CPT using the gold-standard training model, which included a two-day workshop, 13 hours of online training, and six months of ongoing supervision. CPT is a well-established first-line treatment for posttraumatic stress disorder (PTSD), with strong

implementation evidence from international cohorts supporting its feasibility in real-world mental health services (Rosen et al., 2016). Given these strengths, CPT was selected for this open trial due to its structured, manualised approach, robust evidence base, and standardised training model, all of which facilitate consistent implementation across diverse clinical settings. These characteristics enhance its feasibility for large-scale dissemination within the Australian public healthcare system, making it an ideal candidate for collecting utility values and relevant cost data to inform future economic evaluations. Although the timeframe and scope of this PhD did not allow for a full economic evaluation to be conducted, combined with limitations observed in model-based evaluations identified in chapter 2, capturing clinical and cost data within this open trial setting provides several important outcomes. This open trial demonstrated the feasibility of implementing evidence-based PTSD treatment in a complex clinical environment, while demonstrating how valuable economic data can be collected. It also provided critical data to populate future economic evaluations, ensuring greater relevance to the Australian healthcare context. By generating context-specific economic evidence, this work aims to encourage future economic evaluations and ultimately support evidence-based funding decisions for PTSD treatments in Australia. Therefore, Chapter 5 examines the direct costs of treatment (e.g., therapy delivery) and the costs associated with receiving CPT such as healthcare utilisation (e.g., primary and secondary care as well as medication use).

Together, these chapters provide important evidence for improving the rigour, comparability, and policy relevance of future research in PTSD. By providing policymakers with high-quality data, it seeks to support informed resource allocation and ultimately improve patient outcomes. To maximise the impact of these findings, they must be presented in a way that is accessible to clinicians and clinical researchers. By offering insights from both clinical and economic perspectives, this thesis aims to commence bridging the gap between these disciplines and encourage more integrated, methodologically rigorous evaluation of PTSD treatment that considers both clinical and economic outcomes that reflect real-world clinical practice.

Strengthening this intersection will enhance the relevance of evidence required to support policy, funding, and service delivery in Australia.

CHAPTER 2:

Systematic Review of Model-based Economic Evaluations of PTSD Treatments

Abstract: PTSD is a debilitating condition that arises after exposure to a traumatic event, leading to significant impairment in daily functioning if left untreated. Economic evaluations are essential for understanding the comparative value of PTSD treatments and ultimately supporting their implementation. Several model-based economic evaluations exist in this area; however, model-based evaluations can differ in their methodological approaches, which can influence conclusions drawn. This systematic review aimed to explore model structures employed in model-based economic evaluations of PTSD treatment. Methods: A literature search was carried out in the following databases: MEDLINE, PsycINFO, SCOPUS, Econlit, CINAHL, Web of Science Core Collection and Cochrane Collaboration Library between January 1st 2000 and October 31st 2024. Studies were eligible if they presented a full economic evaluation of a treatment for PTSD using a decision-analytic model. Data relating to the model structure and parameter inputs were extracted and quality assessment was conducted. This review identified 12 model-based studies, of which 2 used decision trees, 4 used a Markov model, 4 used a combined decision tree and Markov model and the remaining 2 studies used an agent-based model. There was significant variation across model parameters, including in disease conceptualisation and progression, data sources utilised, assumptions reported, and included costs. The quality assessment revealed key areas of concern were insufficient consideration of methodological uncertainty and heterogeneity, internal consistency, and incorporation of relevant disease and intervention characteristics. This paper highlights important variations in current model-based economic evaluations of PTSD treatment. Future work should seek to generate evidence to support consistency in future economic evaluations of PTSD treatment options.

Introduction

As outlined in Chapter 1, posttraumatic stress disorder (PTSD) is a chronic and debilitating mental health condition. Fortunately, several well-established evidence-based treatments exist, and emerging research suggests they are cost-effective (Gospodarevskaya & Segal, 2012; Mavranezouli et al., 2020b; Mavranezouli et al., 2020c). However, economic evaluations of PTSD treatments remain scarce.

Economic evaluations can be conducted either alongside clinical trials (trial-based) or using modelling techniques (model-based), each offering distinct advantages and limitations. Trial-based evaluations provide direct cost-effectiveness evidence but are often constrained by short follow-up periods, limited generalisability, and reliance on trial-specific data (Drummond et al., 2015). While model-based evaluations can overcome many of these limitations, their reliability depends on key structural and methodological choices, including modelling technique, relevant clinical and economic factors, time horizon, and parameter inputs (Weinstein et al., 2003).

A recent review identified only eight full economic evaluations of psychotherapy for PTSD since 2004, four of which were model-based (von der Warth et al., 2020). Across the model-based studies, substantial variation was observed in methodological choices, including the selection of input parameters and key assumptions. For example, the time horizon across model-based PTSD evaluations ranged from 1 year (Macdonald et al., 2016) to 31 years (Gospodarevskaya & Segal, 2012), with discount rates varying from 3% to 5%. Even when all other parameters remain constant, such differences can impact cost-effectiveness conclusions (von der Warth et al., 2020). Moreover, a quality assessment of these models highlighted limitations in model transparency and validity. The methodological quality of these studies varied widely, with adherence to the International Society for Pharmacoeconomics and Outcomes Research (ISPOR)—a commonly used benchmark for assessing the robustness of health economic models—ranging from 40% (Macdonald et al., 2016) to 87% (Mihalopoulos et al., 2015). Key methodological weaknesses included a lack of

internal and external validation and inadequate model design, raising concerns about the reliability of modelled estimates.

To our knowledge, the structure of model-based economic evaluations for PTSD has not been systematically reviewed. To address this gap, we conducted a systematic review of model-based economic evaluations of treatments for posttraumatic stress disorder (PTSD). We summarise the different model structures and parameter inputs utilised and explore how these factors might influence model validity and subsequent conclusions drawn. The primary goal of the review was to highlight differences in model structures employed in the economic evaluation of PTSD treatment.

Method

This review was preregistered with the International Prospective Register of Systematic reviews (PROSPERO; ID: CRD42023403300) and followed the Preferred Reporting Items for Systematic Reviews and Meta-analysis guidelines (PRISMA; Page et al., 2021). The PRISMA checklists for this study can be found in Appendix A.

Search Strategy

The following electronic databases were last searched on October 31st 2024: MEDLINE, PsycINFO, SCOPUS, Econlit, CINAHL, Web of Science Core Collection and Cochrane Collaboration Library. Manual searches were conducted on Google Scholar and the following economic databases and registries: Cost-Effectiveness Analysis Registry (CEA), NHS (National Health Service) Economic Evaluation Database (NHS EED) and National Institute for Health and Care Research Health Technology Assessment Database (NIHR HTA). Search terms included economic related keywords (e.g., economics, costutility/benefit/consequence/minimisation/reduction, economic model/analysis/study/evaluation, pricing, Markov chain, decision tree/analysis/model, discrete event simulation, micro simulation, Monte Carlo) and PTSD keywords (e.g., PTSD, posttraumatic, post-trauma, traumatic event, stress disorders, C-PTSD, CPTSD). See appendix B for an example of the search strategy used.

Inclusion Criteria

Articles were included in the review if they met the following criteria: (a) full economic evaluation (e.g., cost-benefit, cost-effectiveness, cost-utility analysis) of a treatment or preventative treatment for posttraumatic stress disorder; (b) used a decision-analytic model such as a decision tree, Markov model, state transition model, discrete event simulation, agent-based modelling, or partitioned survival model; (c) participants were diagnosed with PTSD, probable-PTSD or were at risk of developing PTSD (e.g., individuals recently exposed to a criterion A trauma as per the Diagnostic and Statistical Manual (DSM, 5th edition) (American Psychiatric Association, 2022); (d) diagnostic status was determined using standard diagnostic criteria (e.g., DSM, International

Classification of Diseases) or with a standardised measure that enabled probable-PTSD status to be determined (e.g., Posttraumatic Checklist for DSM-5); (e) published after the year 2000 and, (f) peer-reviewed. Exclusion criteria included model-based economic evaluations without an explicit model structure, and at full text, studies that were written in languages other than English.

Articles were uploaded to the online systematic review software, Covidence, where duplicates were automatically removed. Titles and abstracts were screened for relevance by two independent assessors with any discrepancies resolved via discussion. Full-text articles were then retrieved and reviewed by two reviewers, SM and LCE. Data extraction was carried out by SM, while a senior author (LCE) independently screened 10% of extracted data for accuracy.

Data Extraction

The following information was extracted from each article: authors, publication date, country, participant and intervention characteristics, outcome measures and details of the economic model including model type and structure, health states and events used, data sources to populate the model, markers/measures used to model disease progression, intervention and healthcare costs included, and structural and parameter uncertainty.

Quality Assessment

Study quality was assessed using Philips checklist (Philips et al., 2004), a comprehensive framework which contains descriptions of good practice and questions for critical appraisal across three domains: structure, data and consistency. This checklist was created by systematically reviewing existing good practice guidelines and consulting experts to create a tool that covers all relevant indicators of the quality of an economic evaluation. Quality assessment was supplemented with evaluation of uncertainty using a tool developed by Bilcke et al. (2011). This tool includes questions pertaining to the extent to which uncertainty has been adequately accounted for and described. All studies were rated using this quality assessment method by one reviewer (SM), with a secondary senior author (LCE) rating 10% of the studies to check for accuracy. No exclusion criteria for quality were applied.

Results

Summary of Included Studies

Figure 2.1 depicts the results of the literature search. The search yielded 8862 records. After the removal of duplicates 3509 records underwent title and abstract screening with 49 studies selected for full text review. Of these, 37 studies were excluded (27 were not model-based evaluations, 6 were partial economic evaluations, 3 were not peer-reviewed and 1 evaluated a smoking cessation program adjunct to PTSD treatment, rather than a PTSD intervention directly) resulting in 12 studies being included in the review.

Table 2.1 describes the background information of the twelve studies included in the review. All included studies were published in the past twelve years with the majority (n=8, 67%) in the past four years. All studies were conducted in high-income countries: five (42%) in the USA, four (34%) in the UK, two (17%) in Australia and one (9%) in Canada. Eight studies (73%) took a health care sector perspective, three studies took a healthcare payer perspective, and one study took a societal perspective (9%) in the base case analysis. Studies conducted either a cost-utility analysis (n=7, 58%); cost-effectiveness analysis (n=2, 17%) or both (n=3, 25%) and all were published in clinical journals (n=5 in psychology and/or psychiatry journals; n=7 in medical and/or science-based journals). Seven studies considered only adults as their target population, three studies considered only children, and two studies considered all ages.

Figure 2.1

Flow Diagram of the Systematic Review Literature Search.

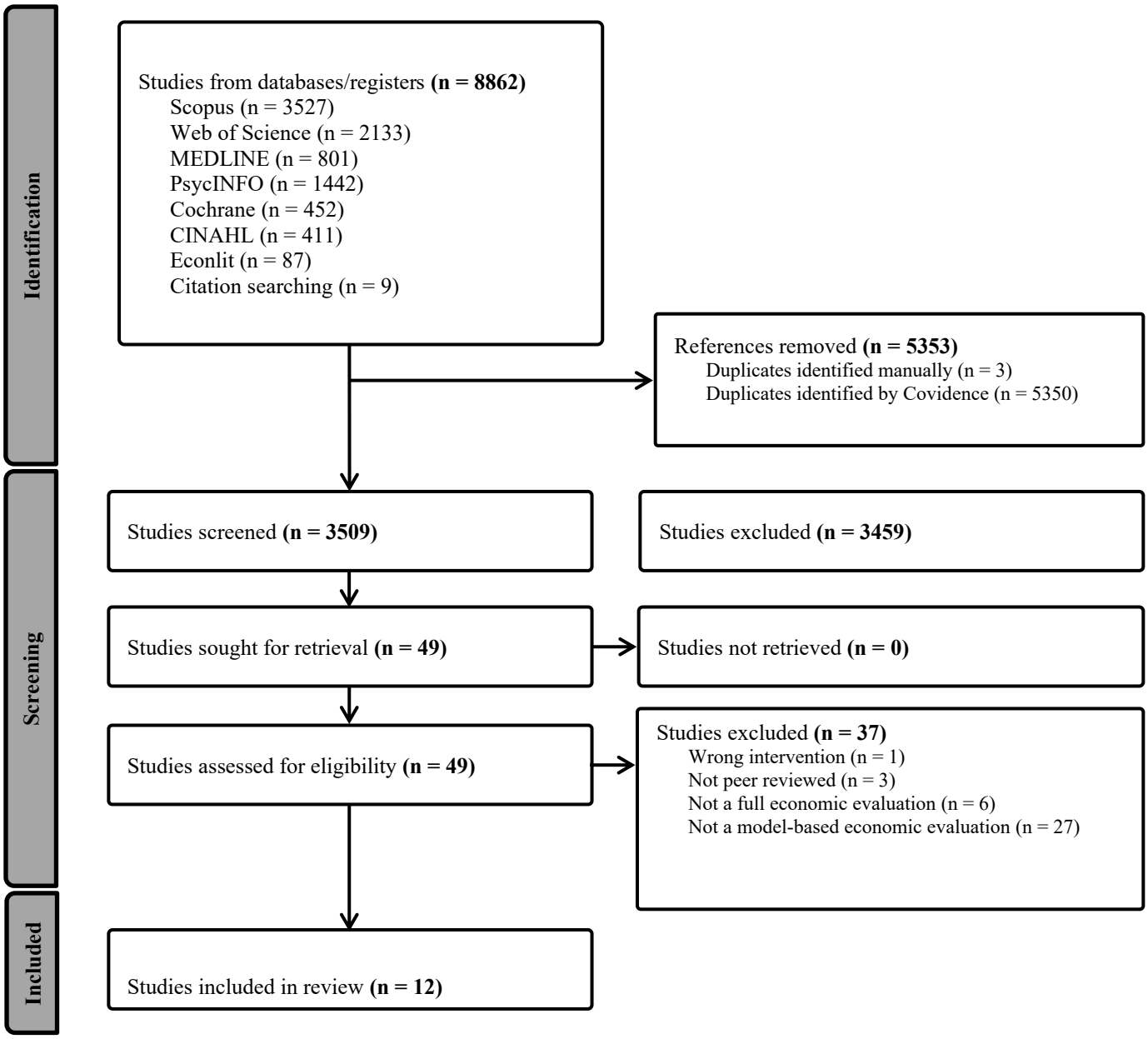


Table 2.1

Characteristics of Included Studies.

Study	Year	Study Aim	Proposed Intervention(s)	Comparators(s)	Population	Type of Economic Evaluation	Perspective	Country/Year of Pricing
Decision tree								
Hogan et al.	2021	Screen and treat for PTSD post terrorist attack	Outreach assessment + CBT	No outreach, CBT through usual care	Adults	Cost utility	Health care sector	UK, 2018
Mihalopoulos et al.	2015	Shift from current practice to evidence-based treatment for PTSD in the community	TF-CBT SSRIs	Usual care (counselling) Medication other than SSRIs	Adults and children	Cost utility	Health care + patient out of pocket costs	AUS, 2012
Combined decision tree/ Markov model								
Gospodarevskaya & Segal	2012	Evaluation of treatments for PTSD in sexually abused children	TF-CBT with SSRI TF-CBT Non-directive counselling	No treatment	Children	Cost utility	Health care sector	AUS, 2010/2011
Mavranezouli et al.	2020b	Evaluation of treatments for PTSD in adults in the community	EMDR TF-CBT Non-TF-CBT Combined somatic/cognitive therapies SSRIs Combined TF-CBT/SSRIs Self-help +/- support Counselling	No treatment	Adults	Cost utility	Health care sector	UK, 2017

Study	Year	Study Aim	Proposed Intervention(s)	Comparators(s)	Population	Type of Economic Evaluation	Perspective	Country/Year of Pricing
Mavranezouli et al.	2020c	Evaluation of treatments for PTSD in children and young people	Psychoeducation TF-CBT Cohen TF-CBT CPT Narrative exposure therapy Group CBT EMDR Family therapy Play therapy Parent training Supportive counselling	No treatment	Children	Cost utility	Health care sector	UK, 2017
Shearer et al.	2018	Comparison between Cognitive Therapy and usual care in children and adolescents with PTSD following a single traumatic event	Cognitive Therapy for PTSD	Waitlist control	Children and adolescents	Cost utility	Health care payer	UK, 2014
Markov model								
Avanceña et al.	2022	Comparison between MDMA assisted therapy and standard of care across 3 coverage targets (25%, 50% and 75%) for eligible Americans	MDMA assisted psychotherapy	No treatment	Adults	Cost utility /Cost-effectiveness	Health care payer	USA, 2020
Lebenbaum & Hassan	2024	Screen and treat for PTSD post exposure to a natural disaster	Outreach assessment + TF-CBT or SSRIs	No outreach, SSRI through usual care	Adults	Cost utility	Societal + Health care sector	Canada, 2020

Study	Year	Study Aim	Proposed Intervention(s)	Comparators(s)	Population	Type of Economic Evaluation	Perspective	Country/Year of Pricing
Marseille et al.	2020	Comparison between MDMA-assisted therapy and standard of care in people experiencing chronic treatment resistant PTSD	MDMA assisted psychotherapy	No treatment	Adults	Cost utility/cost-effectiveness	Health care payer	USA, 2019
Marseille et al.	2022	Updated findings comparing MDMA-assisted therapy and standard of care in people with chronic PTSD	MDMA assisted psychotherapy	No treatment	Adults	Cost utility/cost-effectiveness	Health care payer	USA, 2020
Agent based model								
Abdalla et al.	2022	Usual care compared to a stepped care model for a community exposed to a mass shooting	CBT for PTSD positive cases and SPR for PTSD negative cases	SPR	Children and Adults	Cost-effectiveness	Health care sector	USA, NR
Cohen et al.	2017	Usual care compared to a stepped care model for a community exposed to a natural disaster	CBT for PTSD positive cases and SPR for PTSD negative cases	SPR	Children and Adults	Cost-effectiveness	Health care sector	USA, NR

Note. CBT = cognitive behaviour therapy, CPT = cognitive processing therapy, CT-PTSD = cognitive therapy for posttraumatic stress disorder, EMDR = eye movement desensitization and reprocessing, MDMA = Methylenedioxymethamphetamine, NR = not reported, PTSD = posttraumatic stress disorder, SPR = Skills for Psychological Recovery, SSRI = Selective serotonin reuptake inhibitors, TF-CBT = Trauma-focused cognitive behaviour therapy.

Study Overview

Most studies examined the impact of implementing cognitive behavioural therapy (CBT) against a no treatment comparator (n=8, 67%) or treatment as usual (TAU; n=4, 33%) to evaluate community-based interventions (n=5), pharmacological interventions (n=3), and/or interventions for young people (n=3).

Community based interventions

Four studies explored the impact of implementing variations of an outreach screen and treat approach compared to TAU following a single incident trauma including a hypothetical terrorist attack (Hogan et al., 2021), mass shooting (Abdalla et al., 2022), or natural disaster (Cohen et al., 2017; Lebenbaum & Hassan, 2024). A positive screen for PTSD at either 4 weeks (Abdalla et al., 2022; Cohen et al., 2017), or three- and nine-months post exposure (Hogan et al., 2021; Lebenbaum & Hassan, 2024) triggered a diagnostic interview and delivery of CBT (Abdalla et al., 2022; Cohen et al., 2017; Hogan et al., 2021; Lebenbaum & Hassan, 2024) or SSRIs (Lebenbaum & Hassan, 2024) when PTSD was confirmed. The comparator group did not undergo screening, instead receiving either a general mental health program (Skills for Psychological Recovery; Abdalla et al., 2022; Cohen et al., 2017), CBT if PTSD was identified by a GP during routine care (Hogan et al., 2021) or SSRIs through usual care (Lebenbaum & Hassan, 2024). Two studies considered the impact of psychotherapy and pharmacological treatment options for individuals presenting to primary care with PTSD. Mihalopoulos et al. (2015) examined current psychotherapy and medication-based treatment patterns among Australians with PTSD, modelling the effects of a shift to TF-CBT for eligible adults and children, and SSRIs for eligible adults. Mavranezouli et al. (2020b) evaluated ten common treatments for PTSD compared to no-treatment for adults presenting to primary care with clinically significant PTSD symptoms in the UK.

Pharmacological interventions

Three studies explored the implementation of Methylenedioxymethamphetamine-assisted therapy (MDMA-AT) for treatment-resistant PTSD compared to no treatment (standard care) in

adults presenting with moderate to extreme (Marseille et al., 2020, 2022) or severe to extreme PTSD (Avanceña et al., 2022) in America.

Interventions for young people

Three studies evaluated PTSD treatment specifically for children and adolescents comparing therapy alone or in combination with pharmacological treatment compared to no treatment. Gospodarevskaya and Segal (2012) explored three treatment options (TF-CBT, TF-CBT + SSRI, and non-directive supportive counselling) in children aged 10 years who had previously been exposed to childhood sexual abuse and diagnosed with PTSD or PTSD and depression. Shearer and colleagues (Shearer et al., 2018) explored the impact of therapy compared to waitlist control, representing usual care in the UK National Health Service (NHS), in children aged 8 to 17 years old, 2-6 months post a single incident trauma (e.g., car accident, assault). Mavranezouli et al. (2020c) assessed a variety of psychotherapies for PTSD in children and adolescents under 18 years of age in the UK, comparing these treatments to no intervention.

Modelling Approach

Table 2.2 describes the modelling techniques used and parameters included in each model-based economic evaluation. The primary modelling approaches included a combined decision tree and Markov model (4 studies, 33%) or standalone Markov model (4 studies, 33%), followed by a decision tree (2 studies, 17%) and agent-based model (2 studies, 17%). The following section briefly describes each modelling approach and the key parameters included in each study by model type.

Table 2.2

Model Features in the Base Case Analysis.

Study	Health states	Clinical considerations	Time Horizon (years)	Cycle length (months)	Annual base case discount rate (costs and benefits)
Decision tree					
Hogan et al. (2022)	N/A	PTSD, Partial recovery from PTSD, PTSD free, enrolment and completion of treatment, false positives and negatives from assessment measure, delayed onset PTSD, spontaneous remission, increased mortality risk	5	N/A	3.5
Mihalopoulos et al. (2015)	N/A	PTSD, PTSD free, enrolment and adherence to therapy	5	N/A	3
Combined decision tree/ Markov model					
Gospodarevskaya & Segal (2012)	PTSD only, PTSD + depression, no PTSD + no depression, death from suicide due to PTSD and depression, death from suicide due to PTSD, death from suicide in general population, death from suicide due to depression, depression only, death from other causes (9)	Remission without care, relapse of depression (not PTSD), age-related suicide rates, delayed response to treatment	31 (dt = 1y; mm = 30y)	3	5
Mavranezouli et al. (2020b)	PTSD, PTSD free, death (3)	Mortality, risk of side effects from SSRI, relapse, natural remission	3 (dt = 0.5; mm = 2.5)	3	3.5

Study	Health states	Clinical considerations	Time Horizon (years)	Cycle length (months)	Annual base case discount rate (costs and benefits)
Mavranezouli et al. (2020c)	PTSD, PTSD free (2)	Natural remission, relapse	3 (dt = 0.5; mm = 2.5)	3	3.5
Shearer et al. (2018)	PTSD, PTSD free (2)	Natural remission	3 (dt=0.21; mm = 2.79)	3	3.5
Markov model					
Avanceña et al. (2022)	Asymptomatic, mild, moderate, severe, extreme PTSD, death (6)	Mortality	30	12	3
Lebenbaum & Hassan (2024)	Never PTSD, remitted PTSD, undiagnosed active PTSD, diagnosed active PTSD, diagnosed active PTSD with treatment, and death (5)	Spontaneous remission, relapse, enrolment in treatment, false positives and negatives from assessment measure, adverse events	5	3	1.5
Marseille et al. (2020)	Asymptomatic, mild, moderate, severe, extreme PTSD, death (6)	Mortality	30	12	3
Marseille et al. (2022)	Asymptomatic, mild, moderate, severe, extreme PTSD, death (6)	Mortality	30	12	3
Agent based model					
Abdalla et al. (2022)	N/A	PTSD, PTSD free, remission without treatment, relapse, enrolment in treatment	10	N/A	3
Cohen et al. (2017)	N/A	PTSD, PTSD free, remission without treatment, relapse, enrolment in treatment	10	N/A	3

Note. dt = decision tree, mm = Markov model, PTSD = posttraumatic stress disorder, SSRI = Selective serotonin reuptake inhibitor

Decision trees

A decision tree is a graphical representation used to model decision-making processes, evaluating the outcomes of alternative healthcare strategies (Drummond et al., 2015). The tree moves from left to right beginning with a decision node which represents the decision being modelled (e.g., alternative PTSD treatment) followed by chance nodes which represent uncertain events (e.g., remission vs. no remission). Probabilities are assigned to the chance nodes, representing the likelihood of each outcome occurring. The space between chance nodes is known as a branch which combine to form pathways that represent possible scenarios. The model ends with terminal nodes which represent clinical endpoints. Typically, an effectiveness value is assigned (e.g., utility) at the terminal node, whereas the costs are assigned to various events within the tree. A decision tree is most appropriate for simpler, shorter-term decisions with fewer states (Roberts et al., 2012). To account for longer term impacts and for more chronic conditions, Markov models may be more appropriate as they can handle cyclical events and transitions between health states over an extended period (Brennan et al., 2006).

The number of treatment pathways within a single decision tree varied considerably from 2 (Hogan et al., 2021; Mihalopoulos et al., 2015; Shearer et al., 2018) to 11 (Mavranezouli et al., 2020b; 2020c). Two studies that utilised a decision tree model alone both employed a 5-year time horizon (Hogan et al., 2021; Mihalopoulos et al., 2015). In studies with a combined decision tree and Markov model, the decision tree component of the time horizon ranged from 11 weeks (Shearer et al., 2018) to 12 months (Gospodarevskaya & Segal, 2012).

Markov models

Markov models describe the progression of a disease through a series of health states (e.g., the presence or absence of PTSD) that a patient can occupy at any given time point. The models are typically organised into cycles which represent discrete time intervals, during which patients can transition between different states (Cao et al., 2016). Transition probabilities, which represent the likelihood of a patient moving from one health state to another, determine these transitions and can

be influenced by factors such as treatment effectiveness. These probabilities are conditional on the patient's current health state. Costs and effects are assigned to each health state, and these accumulate over time based on the duration a patient spends in each state within the model. Markov models can represent more complex conditions as they are able to account for the dynamic nature of disease progression (Roberts et al., 2012). Factors such as longer term disease management, remission and relapse over time can be more easily incorporated into such models (Drummond et al., 2015).

The time horizon specified across the seven Markov models included 2.5 years (Mavranezouli et al., 2020b; Mavranezouli et al., 2020c), 2.75 (Shearer et al., 2018), 5 (Lebenbaum & Hassan, 2024) and 30 years (Avanceña et al., 2022; Gospodarevskaya & Segal, 2012; Marseille et al., 2020, 2022), with cycle lengths of either 3 months (Gospodarevskaya & Segal, 2012; Lebenbaum & Hassan, 2024; Mavranezouli et al., 2020b, 2020c; Shearer et al., 2018) or one year (Avanceña et al., 2022; Marseille et al., 2022, 2022). The number of states in each model ranged from 2 (Mavranezouli et al., 2020b; Shearer et al., 2018) to 9 (Gospodarevskaya & Segal, 2012), with all studies incorporating two health states: PTSD and no PTSD at minimum (see table 2.2). Five studies included a single death state (Avanceña et al., 2022; Lebenbaum & Hassan, 2024; Marseille et al., 2020, 2022; Mavranezouli et al., 2020b), with one study including multiple death states: death from suicide due to PTSD and depression, death from suicide due to PTSD, no death from suicide in general population, death from suicide due to depression, and death from other causes (Gospodarevskaya & Segal, 2012).

Agent-based Modes

Agent-based models (ABM) are dynamic in nature and can account for individual differences and are the most sophisticated modelling technique presented in this review. This approach involves simulating agents with a set of unique characteristics which can include individual and environmental level factors (Chhatwal & He, 2015). Agent's progress through the model based on both their own history (e.g., PTSD treatment, socioeconomic status) and the current

context, including interactions with other agents. The key parameter in these models are rules which govern how agents behave and interact with their environment and other agents. These rules can be based on empirical data, theory or assumptions. Given the dynamic nature of these models, costs and effects can be assigned to agents based on their individual characteristics, behaviours and interactions (Roberts et al., 2012). Whilst ABMs can capture complex conditions, they have high computational demands, requiring extensive amounts of data to allow for appropriate model parametrisation and validation. Therefore, they are typically less transparent and can be harder to replicate (Drummond et al., 2015).

Two studies used an ABM approach following the same methodology. Both studies employed a 10-year time horizon and used similar sub-models to calculate agent behavioural probabilities such as prior treatment enrolment, assignment to treatment condition, treatment uptake, symptom reduction and relapse (Abdalla et al., 2022; Cohen et al., 2017).

Regardless of the modelling approach taken, economic evaluation must account for key elements such as disease progression, clinical outcomes and costs. In the following section, we highlight the key similarities and differences across studies in how each of these factors are addressed. The base case analysis reported serves as our reference unless otherwise specified.

Disease Progression

At the most basic level, PTSD was conceptualised as the presence or absence of PTSD (Mavranezouli., 2020b, 2020c; Mihalopoulos et al., 2015; Shearer et al., 2018). More complex conceptualisations included different levels of PTSD related to symptom severity from three (Abdalla et al., 2022; Cohen et al., 2017) through to five severity levels (Avanceña et al., 2022; Marseille et al., 2020, 2022) and different levels of recovery (3 levels; Hogan et al., 2021) or diagnosis and treatment (never PTSD, remitted PTSD, undiagnosed active PTSD, diagnosed active PTSD, diagnosed active PTSD with treatment; Lebenbaum & Hassan, 2024). One study explicitly considered comorbid depression, including PTSD and no PTSD states in combination with the absence or presence of depression (Gospodarevskaya & Segal, 2012). Other clinical factors

included spontaneous remission (8 studies, 67%), relapse (6 studies, 50%), enrolment in treatment (5 studies, 42%), mortality (5 studies, 42%), suicide (1 study, 8%), completion of treatment (1 studies, 8%) delayed response to treatment (1 study, 8%) and risk of side effects from SSRIs (2 studies, 17%). Studies also varied in how they modelled treatment benefit over time with only one incorporating treatment decay (Mihalopoulos et al., 2015) and one incorporating no benefit beyond treatment endpoint (Mavranezouli, 2020c). See Table 2.2 for details on the health events included in each model.

Clinical Outcomes

Table 2.3 summarises the measurement tools and data sources used in each study. Most studies captured outcomes using quality-adjusted life-years (QALYs; 10 studies, 80%). The most commonly used Generic-Preference Quality of Life (GPQoL) measure was the AQoL-4D, with six studies (50%) deriving utility values from the National Survey of Mental Health and Wellbeing Australian (Bureau of Statistics, 2008). Two studies used utility estimates from randomised controlled trials (RCTs; Avanceña et al., 2022, Marseille et al., 2020), employing the EQ-5D. Additionally, one study (Shearer et al., 2018) used a general child outcome measure, the Strengths and Difficulties Questionnaire (SDQ), which was converted into a utility measure using a mapping algorithm, from an RCT. Other outcomes considered included disability-adjusted life years (DALYs) (Abdalla et al., 2022; Cohen et al., 2017; Mihalopoulos et al., 2015) with disability weights derived from the Burden of Disease studies (Mathers et al., 1999; Whiteford et al., 2013) deaths averted (Avanceña et al., 2022; Marseille et al., 2020, 2022), PTSD free days and risk ratio or risk difference in PTSD prevalence (Abdalla et al., 2022; Cohen et al., 2017). Treatment effect (i.e., the direct impact of the intervention on PTSD symptom severity or PTSD diagnosis) was estimated from the following sources: observational studies (Hogan et al., 2021), RCTs (Abdalla et al., 2022; Avanceña et al., 2022, 2022; Cohen et al., 2017; Gospodarevskaya & Segal, 2012; Marseille et al., 2020, 2022; Mihalopoulos et al., 2015; Shearer et al., 2018) and meta-analyses (Lebenbaum & Hassan, 2024; Mavranezouli et al., 2020b, 2020c; Mihalopoulos et al., 2015).

Broader clinical inputs such as mortality, natural remission and relapse rates were estimated from observational studies (Avanceña et al., 2022; Gospodarevskaya & Segal, 2012; Hogan et al., 2021; Mavranezouli et al., 2020b) through to published meta-analyses (Abdalla et al., 2022; Cohen et al., 2017; Shearer et al., 2018).

Table 2.3

Outcome Measures and Corresponding Data Sources in the Base Case Analysis.

Study	Outcome variables	Utility measure	Data source			
			Utility estimate[a]	Disability weight*	Clinical inputs[b]	Treatment effect
Decision tree						
Hogan et al. (2022)	QALYs	AQoL-4D	2007 Australian NSMHW[c]	N/A	Unpublished observational study, published systematic review, authors judgement	Published observational study
Mihalopoulos et al. (2015)	QALYs DALY	AQoL-4D	2007 Australian NSMHW	Australian Burden of Disease Study	National statistics, unpublished meta-analysis, published RCT	Unpublished meta-analysis, published RCT
Combined decision tree/ Markov model						
Gospodarevskaya & Segal (2012)	QALYs	AQoL-4D	2007 Australian NSMHW	N/A	Published RCT, published national statistics, published systematic reviews, published observational study	Published RCTs
Mavranezouli et al. (2020b)	QALYs	AQoL-4D	2007 Australian NSMHW[c]	N/A	Published longitudinal study, expert opinion, published observational study, published national statistics	Published network meta-analysis
Mavranezouli et al. (2020c)	QALYs	AQoL-4D	2007 Australian NSMHW[c]	N/A	Expert opinion, published longitudinal study	Published network meta-analysis
Shearer et al. (2018)	QALYs	SDQ mapped to CHU9D	Authors trial data	N/A	Published meta-analysis	Published RCT
Markov model						
Avanceña et al. (2022)	QALYs Deaths	EQ-5D-5L	Authors trial data	N/A	Observational study, authors judgement	Published RCT

Study	Outcome variables	Utility measure	Data source			
			Utility estimate[a]	Disability weight*	Clinical inputs[b]	Treatment effect
Lebenbaum & Hassan (2024)	QALYs	AQoL-4D	2007 Australian NSMHW	N/A	National statistics, published review, authors judgment, published economic evaluation, published observational study	Published network meta-analysis
Marseille et al. (2020)	QALYs Deaths	Unclear[d]	Unclear[d]	N/A	Published longitudinal study, authors judgment	Published RCT
Marseille et al. (2022)	QALYs Deaths	EQ-5D-5L	Authors trial data	N/A	Published longitudinal study, authors judgment	Published RCT
Agent based model						
Abdalla et al. (2022)	DALYs PTSD free days RR/RD in PTSD Prevalence	N/A	N/A	GBD	Published meta-analysis, published longitudinal studies	Published RCT, authors assumption
Cohen et al. (2017)						
Hogan et al. (2022)	DALYs PTSD free days RR/RD in PTSD Prevalence	N/A	N/A	GBD	Published meta-analysis, published longitudinal studies	Published RCT, authors assumption

Note. AQoL-4D = Assessment of Quality of Life - 4 Dimension, CHU9D = Child Health Utilities 9 Dimension, DALY = disability adjusted life year, EQ-5D-5L = EuroQol 5 Dimension 5 Level, GBD = Global Burden of Disease, NSMHW = National Survey of Mental Health and Wellbeing, PTSD = posttraumatic stress disorder, QALY = quality adjusted life year, RCT = randomised controlled trial, RR/RD = risk ratio/risk difference, SDQ =

Strengths and Difficulties Questionnaire.

[a] N/A was provided for studies that did not include QALYs or DALYs as an outcome measure.

[b] Includes clinical characteristics such as relapse, natural remission and mortality, excluding treatment effect.

[c] These studies sourced their utility estimates from prior economic evaluations based on the 2007 Australian National Survey of Mental Health. Hogan et al. (2021) and Mavranezouli et al. (2020c) used estimates from Gospodarevskaya & Segal (2015) and Mavranezouli et al. (2020b) derived their estimates from Mihalopoulos et al. (2015)

[d] The measure used to derive the utility values was unclear. No reference to a utility measure or relevant utility values could be located in citation of the Global Burden of Disease study provided and the authors did not respond when asked for clarification.

Costs

Table 2.4 presents costs captured and the data sources used in their estimation. All studies included costs associated with the treatment intervention. Downstream change in healthcare utilisation and associated costs were captured for 10 studies, with most considering change in medication (in addition to treatment; 7 studies), GP/specialised physician services (7 studies), social services (6 studies), nurse practitioner care (7 studies), and inpatient (8 studies) and outpatient services (8 studies). Less commonly considered healthcare utilisation costs included emergency department visits (6 studies), homecare (1 study), acupuncture/myotherapy services (1 study) and self-help/advice groups (1 study). Additional costs captured were overheads (6 studies), productivity losses (4 studies), patient out of pocket costs (1 study), caregiving (1 study) and unemployment (1 study).

Most studies used national sources such as government reimbursement schedules to estimate direct treatment costs, while a wider range of sources were used to estimate broader costs, such as healthcare utilisation (Table 2.4). Four studies derived cost estimates from other health economic studies included in the review (Abdalla et al., 2022; Avanceña et al., 2022; Marseille et al., 2022; Mavranezouli et al. 2020c). For example, Marseille et al. (2022) and Avancena et al. (2022) obtained health care utilisation estimates from Marseille et al. (2020) who estimated the average annual cost of health care utilisation for people with PTSD based on three observational studies of a total of 25,547 American adults and one RCT with 666 American adults receiving PTSD treatment (Chan et al., 2009; Ivanova et al., 2011; Lavelle et al., 2018; Marciniak et al., 2005). The types of healthcare included in these estimates were inpatient admissions, outpatient visits, pharmaceutical dispensing (Chan et al., 2009; Ivanova et al., 2011; Lavelle et al., 2018), and emergency department visits (Ivanova et al., 2011; Lavelle et al., 2018). Mavranevouli et al. (2020c) adopted the service utilisation costs linked with PTSD and no-PTSD health states from Shearer et al. (Shearer et al., 2018) who had estimated these from a cohort of 29 young people who received PTSD treatment as part of an RCT in England. Baseline costs represented the PTSD group costs, while costs for those who remitted posttreatment (n = 14), irrespective of group allocation and excluding treatment costs,

represented the PTSD-free group costs. Abdalla et al. (Abdalla et al., 2022) derived the cost of treatment (CBT and Skills for Psychological recovery program) from Cohen et al. (2017) with data originally being sourced from a non-peer reviewed conference presentation.

Table 2.4

Costs Included in Each Study in the Base Case Analysis.

	Hogan et al.	Mihalopoulos et al. (2015)	Gospodarevskaya & Segal, (2012)	Mavranezouli et al. (2020)	Mavranezouli, et al. (2020b)	Shearer et al. (2018)	Avanceña et al. (2022)	Lebenbaum & Hassan (2024)	Marseille et al. (2020)	Marseille et al. (2022)	Abdalla et al. (2022)	Cohen et al. (2017)
Treatment cost	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Screening/intake	✓	✓					✓	✓	✓	✓		
Psychological treatment[a]	✓	✓		✓	✓	✓	✓		✓	✓		
Home care				✓								
GP/Specialized physician		✓[a]		✓	✓	✓	✓		✓	✓		
Social services				✓	✓	✓	✓		✓	✓		
Self-help/advice groups				✓								
Nurse practitioner	✓			✓	✓	✓	✓		✓	✓		
Medication[a]	✓				✓	✓	✓	✓	✓	✓		
Inpatient hospital care	✓			✓	✓	✓	✓	✓	✓	✓		
Emergency department					✓	✓	✓	✓	✓	✓		
Ambulance					✓	✓						
Outpatient	✓			✓	✓	✓	✓	✓	✓	✓		
Patient out of pocket costs		✓										
Productivity losses							✓	✓	✓	✓		
Unemployment								✓				
Caregiving								✓				
Overheads				✓	✓	✓	✓		✓	✓		

Note. Treatment costs include all costs associated with the treatment program, including both psychological and pharmacological treatments. See table 2.1 for the treatments provided in each economic evaluation. The categories of treatment cost and psychological treatment include a range of treating professionals such as psychiatrists, psychologists, psychological well-being practitioners, and psychological therapists. Social services include family support workers, social services and social workers.

[a] In addition to treatment.

[b] Visits and associated costs were only varied for the child-based economic evaluation.

Table 2.5

Data Sources of Costs Included in Each Study.

	Data source
Hogan et al.	Unpublished observational study, published national rebates/schedule of fees
Mihalopoulos et al.	Government rebates, expert opinion
Gospodare-vskaya, E., & Segal, L.	Published national rebates/schedule of fees, published association recommended fees
Mavranezouli et al[a].	Published network meta-analysis, published national statistics, published cohort study, expert opinion, published national unit costs
Mavranezouli et al[b].	Published national unit costs, published national statistics, published economic evaluation, expert opinion
Shearer et al.	Published trial data
Avanceña et al.	Published economic evaluation
Marseille et al[a].	Published national statistics, published RCT, published observational studies
Marseille et al[b].	Published trial data, published economic evaluation, published national unit costs
Abdalla et al.	Published economic evaluation
Cohen et al.	Unpublished conference presentation
Lebenbaum & Hassan.	Published observational studies, published national statistics

Accounting for uncertainty

Modelled economic evaluations are associated with uncertainty in methodological choices, structural inputs and parameters that can all influence conclusions drawn (Bilcke et al., 2011). All studies considered uncertainty analyses, with the majority conducting univariate sensitivity analysis (Abdalla et al., 2022; Avanceña et al., 2022; Cohen et al., 2017; Gospodarevskaya & Segal, 2012, 2012; Hogan et al., 2021; Lebenbaum & Hassan, 2024; Marseille et al., 2020, 2022; Mavranezouli et al., 2020b, 2020c; Shearer et al., 2018, 2018), nine conducting probabilistic sensitivity analysis (Avanceña et al., 2022; Gospodarevskaya & Segal, 2012; Hogan et al., 2021; Lebenbaum & Hassan, 2024; Marseille et al., 2020, 2022; Mavranezouli et al., 2020b, 2020c; Mihalopoulos et al., 2015; Shearer et al., 2018) and five conducting multivariate sensitivity analysis (Abdalla et al., 2022; Gospodarevskaya & Segal, 2012; Marseille et al., 2022, 2022; Mavranezouli et al., 2020b; Mihalopoulos et al., 2015).

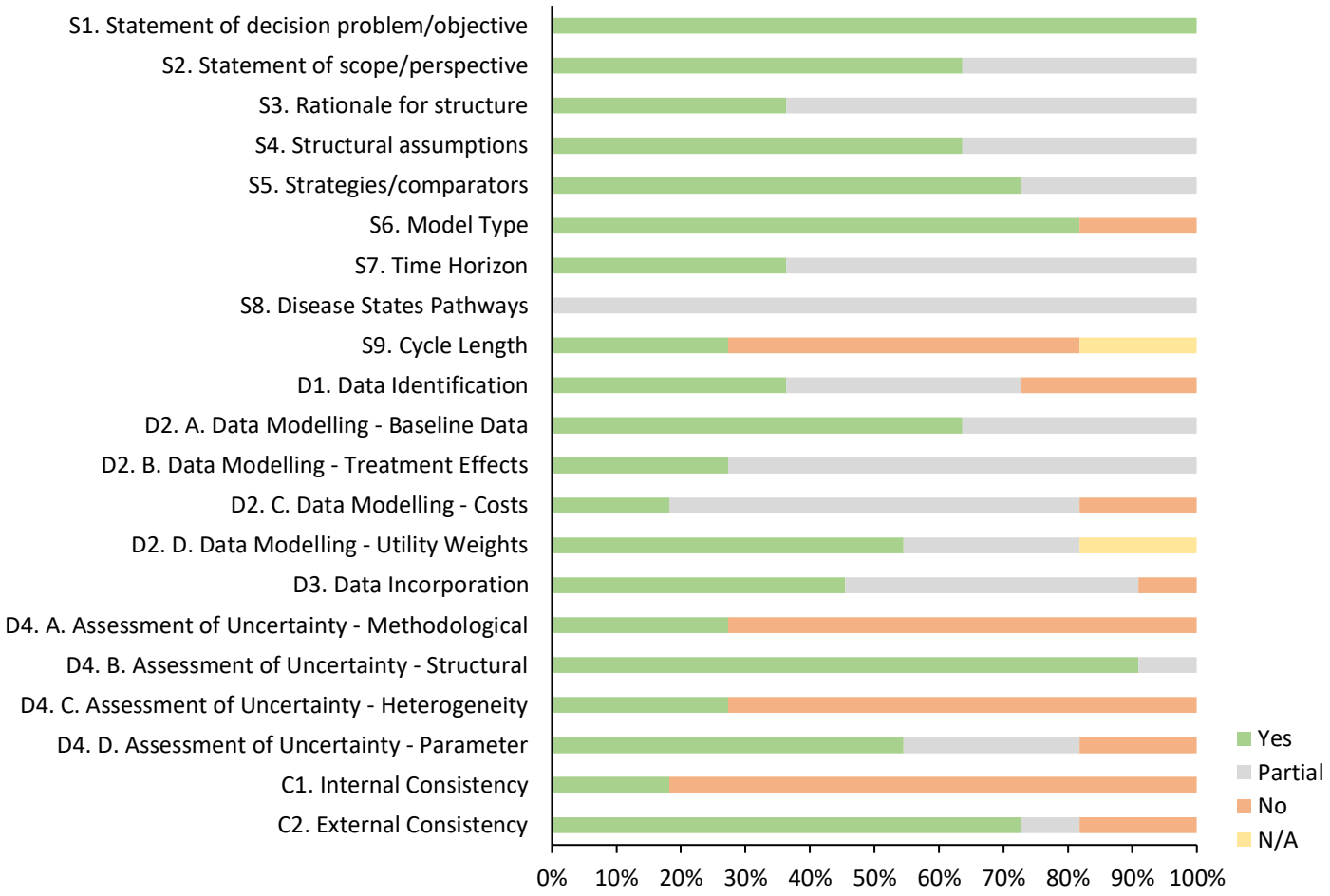
Quality Assessment

Figures 2.2 and 2.3 represent the distribution of responses for the quality assessment criteria for the Philips (Philips et al., 2004) and Bilcke et al. (Bilcke et al., 2011) checklists (see Appendix B and C, for table of results).

On average across all studies, 77% (range: 61%, 87%) of items in the Philips checklist were met with either a yes or 'partial' rating, with 21% of items not reported on within the paper. The items with the greatest number in the not reported category (across all studies) were those with reference to internal consistency and the assessment of uncertainty related to methodological decisions and heterogeneity. On average 45% (range: 25%, 50%) of items in the Bilcke et al.'s checklist were reported across studies, with 34% (range: 13%, 75%) not reported. Items related to incorporation of relevant disease and intervention characteristics and sources of uncertainty were less frequently reported across studies, though there was greater reporting detailing the effects of these omissions across studies.

Figure 2.2

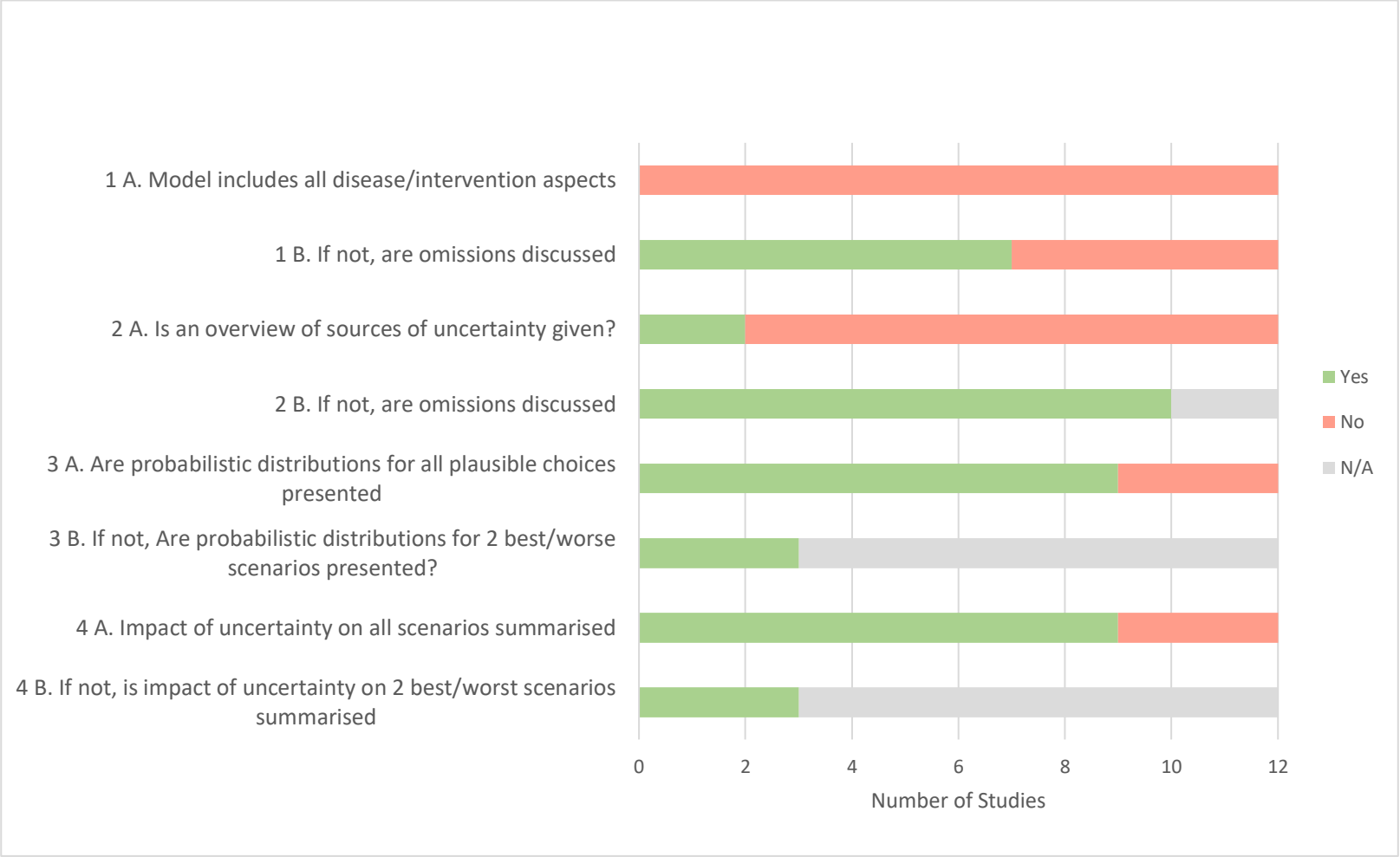
Quality assessment Using the Phillips Checklist.



Note. A partial response indicates that there was a mix of yes/no answers to the suggested sub questions for an item. N/A was assigned when the item was irrelevant to the model structure.

Figure 2.3

Quality assessment using Bilcke et al.'s Uncertainty Checklist.



Discussion

This study aimed to systematically review the methodological approaches and parameter inputs used in model-based economic evaluations of PTSD treatments. The included studies varied considerably in their methodological approaches and parameter inputs used to populate models. Across the 12 included studies, the majority employed a combination of a decision tree and Markov model or standalone Markov model, with others utilising either a decision or an ABM. A key consideration when determining an appropriate model structure is that it must adequately address the decision problem and capture all clinical aspects of the disorder to reflect the natural progression of the disease or condition. For PTSD, the model structure should therefore be able to model cyclical factors such as relapse or remission given evidence that these can occur beyond the typical 3–6-month follow-up period adopted in most clinical studies (Levy et al., 2021; Morina et al., 2014). As decision trees cannot represent cyclical transitions between health states, Markov models or ABMs may be better suited for capturing such events, especially over longer time horizons.

Both Markov models and ABMs offer distinct advantages for modelling more complex health conditions like PTSD. Markov models are particularly useful for representing cyclical transitions between health states over extended periods. ABMs, while more complex, may be appropriate in the presence of complex subgroup characteristics such as differential treatment response based on demographic factors or treatment and disease history. Current understanding of these factors in PTSD is challenging due to inconsistencies in the literature, however, there is evidence that treatment outcomes can be moderated by certain clinical characteristics, such as mental health and physical comorbidities (Dewar et al., 2019), indicating that ABMs could potentially be appropriate. Although not a factor in model choice, the extensive data requirements of ABMs may pose significant challenges to the practical implementation of these models. Additionally, as demonstrated in several of the Markov-based studies reviewed, subgroup differences such as comorbidities (Gospodarevskaya & Segal, 2012) and varying levels of PTSD

severity (Avanceña et al., 2022; Marseille et al., 2020, 2022) can be addressed by expanding the number of health states in a Markov model. While this approach can be effective, it may also risk overcomplicating the model, especially when multiple factors are considered simultaneously (Cao et al., 2016; Haji Ali Afzali et al., 2012). Ultimately, each modelling approach has its benefits and limitations, and when selecting the appropriate model researchers must carefully balance the decision problem with current knowledge of the disorder. The ISPOR-SMDM Task Force has published guidelines to aid researchers in choosing a model type that is simple yet sufficiently complex to accurately represent the disorder and treatments being studied (Roberts et al., 2012).

Beyond the choice of model structure, another critical decision that shapes the scope of an economic evaluation is the perspective adopted, which can be influenced by the purpose of the economic evaluation, with most national funding bodies taking a healthcare sector perspective in the base case (Lathe et al., 2024). Most studies adopted either a healthcare sector or payer perspective, with only one study considering a societal perspective (Lebenbaum & Hassan, 2024). This was acknowledged as, a limitation by authors in many of the studies, given the high rates of productivity loss in this cohort (Dams et al., 2020; Fox et al., 2014; Lee et al., 2017). As such, a societal perspective could offer information regarding the broader impact of implementing the relevant treatment. The importance of considering a societal perspective was highlighted in Lebenbaum & Hassan (2024), who reported that TF-CBT and SSRIs were cost-effective from a societal, but not from a healthcare perspective. Future research should consider inclusion of broader societal costs and benefits to more appropriately capture the full benefit of PTSD treatment as recommended by PBAC (Pharmaceutical Benefits Advisory Committee, 2016).

While the inclusion of costs is typically guided by the chosen perspective, there was significant variation in the costs captured across reviewed studies, as similarly reported in a prior review of model and trial-based economic evaluations for PTSD (Warth et al., 2020). Many studies estimated treatment costs based on simplified or idealistic models of care, often overlooking additional real-world expenses that could influence the cost of PTSD care. In particular, costs

related to training and ongoing supervision — considered best practice for the provision of evidence-based PTSD treatments (Dondanville et al., 2021) — were often omitted from treatment costs or assumed to be part of standard professional development and included in clinicians' salaries. These costs should be incorporated given that access to adequate training and supervision for PTSD is not standard practice across various mental health professions (Finch et al., 2020; Rosen et al., 2017). Shearer et al. (Shearer et al., 2018) highlights the impact of excluding these costs reporting that including training and supervision costs in scenario analyses increased the cost per quality-adjusted life-year (QALY) from £2,205 to £16,187. The selection of costs should be carefully guided by consultation with clinical experts or industry leaders to ensure that economic evaluations reflect the complexities of real-world treatment conditions and are relevant and applicable to decision-makers.

In addition to accurately reflecting real-world treatment conditions, equal attention must be given to the conceptualisation and representation of PTSD, which varied across the models reviewed. Many studies assessed treatment benefit based on whether individuals no longer met the diagnostic criteria for PTSD. However, research suggests that individuals can experience meaningful improvements in symptoms and quality of life while still meeting diagnostic criteria for PTSD [54,55]. For example, one model used utility estimates of 0.83 for mild PTSD and 0.37 for extreme PTSD, on a scale where 1 represents perfect health and 0 represents death. These values were derived from a randomised controlled trial (RCT) of 90 individuals seeking treatment for PTSD [29]. These findings align with evidence that PTSD severity is negatively correlated with quality of life [56,57], highlighting the limitations of a binary diagnostic approach. However, defining PTSD severity remains a challenge. The most used self-report measure, the PTSD Checklist for DSM-5 (PCL-5), and the clinician-administered Clinician-Administered PTSD Scale for DSM-5 (CAPS-5) do not have predefined severity levels. Several economic evaluations in this review assigned severity ratings, but the cut-offs were often arbitrary or based on outdated CAPS-5 classifications (Avanceña et al., 2022; Marseille et al., 2020, 2022), limiting their applicability to

current diagnostic standards. Alternative approaches, such as assessing varying degrees of recovery [23], offer a potential solution but lack standardisation, leading to inconsistencies across studies. Incorporating greater heterogeneity in PTSD symptom severity within model-based economic evaluations could improve the precision of treatment benefit estimates. Therefore, future research would benefit from generating standardised severity classifications on common PTSD measures and more nuanced recovery metrics that capture different levels of recovery, to promote more consistent measurement of treatment effects, improve comparability across studies, and enhance the validity of cost-effectiveness analyses in capturing PTSD.

While some model decisions, such as how PTSD is conceptualised, are guided by research evidence, other modelling decisions are partly context dependent. The inclusion of additional clinical and related factors such as disengagement from treatment (Lewis et al., 2020; Varker et al., 2021), delayed onset PTSD (Andrews et al., 2007; Bonde et al., 2022), mortality (Ahmadi et al., 2011; Roberts et al., 2020) and suicide (Fox et al., 2021) depend on their relevance to the specific research context. For example, in models implementing outreach interventions following a single incident trauma (e.g., Abdalla et al., 2022; Cohen et al., 2017; Hogan et al., 2021; Lebenbaum & Hassan, 2024) it is important to consider a delayed screening time (e.g., Hogan et al., 2021) to capture delayed onset PTSD, with estimates suggesting that this occurs for 8- 15% of the general population (Andrews et al., 2007; Bonde et al., 2022). However, this issue is less relevant for models exploring treatment in routine clinical care where clients are actively seeking treatment after the development of PTSD symptoms, often after having PTSD for years if not decades (e.g., Casey et al., 2023).

The inclusion of other clinical factors such as mortality are similarly context-dependent and can be influenced by the characteristics of the study cohort such as age and type of trauma exposure. For example, Mavranezouli et al. (2020c) excluded mortality in their model, citing that it was not clinically relevant for children, their cohort of interest, within the 3-year modelling timeframe. PTSD-related mortality may be more relevant for inclusion in models with a lifetime

horizon, given extensive epidemiological research shows that both a diagnosis of PTSD and repeated childhood trauma or adversities, such as ongoing abuse or neglect, are linked to higher mortality and morbidity in adulthood (Brown et al., 2009; Copeland et al., 2018; Lohr et al., 2015; Yu et al., 2022). This literature should inform the inclusion of PTSD-related mortality when the time horizon for the economic evaluation extends into adulthood and when repeated trauma has been experienced. Economic evaluations should provide clear justifications for the inclusion or exclusion of clinical factors to ensure that decision makers can assess the appropriateness of the model inputs to the specific context.

In addition to the inclusion of clinical factors, the choice of time horizon must also be sufficient to capture relevant treatment costs and benefits (Kim et al., 2017). While data limitations may present challenges to modelling an appropriate time horizon, they should not be the primary determinant of the time horizon (Haacker et al., 2020). Instead, the focus should be on ensuring that the chosen time horizon adequately represents the full spectrum of clinically relevant change for PTSD. Shorter time horizons were often employed due to uncertainty in longer-term clinical outcomes and treatment effect data. Although meta-analyses have supported effectiveness of PTSD treatment for up to one-year for a range of evidence-based PTSD treatments for children and adults, the number of studies with significantly longer follow-up periods is low (Gutermann et al., 2017; Kline et al., 2018; Rith-Najarian et al., 2019; Van Dis et al., 2020; Weber et al., 2021). The lack of available clinical evidence presents a significant challenge for modelling the appropriate time horizon. Therefore, capturing the longer-term impact of evidence-based PTSD treatments should be a priority in clinical research.

Many of the reviewed papers also highlighted a lack of data on PTSD remission rates following treatment, as well as utility values and relapse rates (Berge et al., 2020; Brooks & Greenberg, 2024). Data on relapse rates are also confounded by differential definitions (Brooks & Greenberg, 2024) of these constructs, making meaningful synthesis for economic evaluation difficult. Despite these challenges, lack of data or poor-quality data should not limit authors from

exploring all plausible aspects of PTSD and PTSD treatment that could be relevant to the specific decision context. For example, in Australia, the Pharmaceutical Benefits Advisory Committee (PBAC) guidelines state that a model should not be limited by data availability, instead, authors should conduct thorough scenario, sensitivity, and uncertainty analyses to account for uncertainty around key parameters (Pharmaceutical Benefits Advisory Committee, 2016). To address these data availability challenges, the reviewed studies utilised a range of data sources to populate their economic models. With regard to treatment utility estimates, there was heavy reliance on the 2007 National Health Survey, highlighting the lack of utility estimates available. Moreover, most studies estimated treatment effectiveness from either standalone RCTs or meta-analyses of RCTs. Some authors assumed that clinical factors such as drop out and comorbid conditions were implicitly captured through intent to treat data. However, the types and rates of comorbidities within study samples can vary, and follow-up data may disproportionately reflect treatment completers, both of which can introduce potential bias in effectiveness estimates, especially if these factors are not managed using appropriate statistical methods (Gupta, 2011).

To derive cost and utility estimates, many of the reviewed papers drew from a small number of economic evaluations also included in this review. Although the lack of data availability was generally acknowledged by study authors, it is important to explicitly justify *how* the target population and inclusion and exclusion criteria of these sources align with their study. When clear differences arise, as was observed across several studies, the potential impact of these assumptions on the results should be explicitly addressed qualitatively in the text and quantitatively through uncertainty analyses. As highlighted in the quality assessment of reviewed studies, transparency regarding data assumptions and their potential consequences was not routinely addressed. Guidelines such as the Consolidated Health Economic Evaluation Reporting Standards (Husereau et al., 2022) can be used to support transparent, replicable, and standardised economic models.

This review is limited by single author data extraction due to resource constraints, which may introduce bias. However, good interrater reliability was demonstrated in the 10% of data that

was cross-checked by a second author. Additionally, whilst two published tools were used to grade each study reviewed, the use of binary response formats can oversimplify complex methodological quality considerations, therefore hindering more nuanced comparisons between reviewed studies. Despite these limitations, the review possessed several strengths including the large number of databases searched, adherence to PRISMA guidelines and the novel exploration of modelled economic evaluations in the field of PTSD.

This review offers important implications for future economic evaluations in PTSD and clinical research. Due to the variability in model structure, there is a need for a standardised models to evaluate PTSD treatments. This review details the range of parameters included that could be used to identify the best model representation for PTSD in consultation with experts. Efforts to enhance consistency and transparency in economic evaluations have been successful in other areas, such as Chronic Obstructive Pulmonary Disease (Tabberer et al., 2017), frailty (Haji Ali Afzali et al., 2019), and multiple myeloma (Gonzalez-McQuire et al., 2019), where Delphi techniques have been used to inform key components of reference models. Applying similar methods could guide the development of a PTSD-specific reference model, promoting more reliable and comparable evaluations across future studies. Additionally, future research should aim to generate evidence on important clinical characteristics of PTSD outcomes required for model-based economic evaluation, such as utility estimates and relapse and remission rates over longer follow-up periods.

It is critical for resource prioritisation at either the national or local organisational level that outcomes from model-based economic evaluations are comparable; consistency in model inputs and structure can support this. We have highlighted how current model-based economic evaluations of PTSD treatment vary, with the goal to guide future thinking with respect to the development of a standardised approach to support consistency across economic evaluations of PTSD treatments.

CHAPTER 3:

Assessing the Validity and Responsiveness of a Generic Preference Quality of Life Measure (GPQoL) in the Context of Posttraumatic Stress Disorder[2]

Abstract: There is limited research exploring the usefulness of GPQoL measures used to facilitate economic evaluation in the context of posttraumatic stress disorder (PTSD). The aim of the current study was to explore the validity and responsiveness of a common GPQoL measure (Assessment of Quality of Life 8 Dimension [AQoL-8D]) in relation to a PTSD condition-specific outcome measure (Posttraumatic Stress Disorder Checklist for the DSM-5 [PCL-5]). This aim was investigated in a sample of individuals (N = 147) who received trauma-focused cognitive behavioural therapies for posttraumatic stress disorder. Convergent validity was investigated using spearman's correlations, and the level of agreement was investigated using modified Bland-Altman plots. Responsiveness was investigated by exploring the standardised response means (SRM) from pre-post treatment across the two measures, which allow the comparison of magnitude of change between the measures over time. Correlations between the AQoL-8D (dimensions, utility and summary total scores) and the PCL-5 total score ranged from small to large and agreement between the measures was considered moderate to good. While SRMs were large for the AQoL-8D and PCL-5 total scores, the SRM for the PCL-5 was nearly double that of the AQoL-8D. Our findings demonstrate that the AQoL-8D has good construct validity but provide preliminary evidence that this measure, and potentially other GPQoL instruments, may be less sensitive to change than condition-specific measures in the context of PTSD.

[2] This chapter was published in a peer review journal (Matthews et al., 2023). Sheradyn Matthews was involved in the design of the study, completed all data analysis, and wrote the first draft of the publication.

Introduction

As outlined in the introduction, cost-effectiveness analysis (CEA) and cost-utility analysis (CUA) are the most common types of economic evaluations (Drummond et al., 2015). These two methods are identical in how costs are quantified; however, they differ in how health outcomes are measured. In CEAs, outcomes are measured in natural units relevant to the disorder/disease in question (e.g., PTSD symptoms, number of hospital admissions), whereas in CUA the outcome is measured in terms of a generic metric of health (Luyten et al., 2016), most commonly expressed in Quality Adjusted Life Years (QALYs). A QALY represents the quantity and quality of an individual's life where one QALY is equivalent to one year in perfect health (Drummond et al., 2015). Generic or condition-specific preference quality of life instruments allow the calculation of QALYS where the total scores of these measures are converted into utility scores which are then used to calculate QALYS (Luyten et al., 2016).

Given that QALYS are a generic measure, they can enable comparison of QALYS gained from different treatments across various condition/disease areas (Drummond et al., 2015). For this reason, policy bodies such as the Medical Benefits Advisory Committee (MSAC) in Australia and the National Institute for Health and Clinical Excellence (NICE) in the United Kingdom recommend the use of preference-based QoL measures in economic evaluations to facilitate the calculation of QALYS (Australian Government Department of Health, 2017; National Institute for Health and Care Excellence, 2013). Policymakers can then make cross-health sector comparisons to better inform decisions regarding the allocation of resources across the entire health sector (Drummond et al., 2015).

There have, however, been inconsistent findings surrounding the usefulness of GPQoL instruments in the field of mental health. A recent review of reviews by Finch et al. (2018) found that three common GPQoL instruments - EQ-5D (Brooks, 1996), Short Form-6 Dimension (SF-6D; Brazier et al., 2002), and the Health Utilities Index Mark 3 (HUI-3; Horsman et al., 2003) - generally performed well in terms of their convergent validity and responsiveness to symptom

change following treatment when compared to depression and anxiety measures. However, the EQ-5D, a widely used GPQoL measure in the health and mental health field, performed poorly when compared to specific measures of schizophrenia, bipolar and personality disorders (Devlin & Brooks, 2017; Finch et al., 2020). The authors were unable to comment on the efficacy of the SF-6D and HUI-3 in relation to schizophrenia, bipolar and personality disorder due to the limited studies including these measures. However, individual studies elsewhere have also shown inconsistencies in the validity and responsiveness of these in these conditions (Abdin et al., 2019; Mulhern et al., 2014).

Whilst limited studies have explored this relationship in relation to PTSD, a recent study by Dams et al. (2021) compared the EQ-5D to a self-report (University of California Los Angeles PTSD Reaction Index) and a clinician-administered measure of PTSD (Clinician Administered PTSD Scale for Children and Adolescents [CAPS-CA]) in adolescents and young adults. A moderate correlation was found between the EQ-5D and both PTSD measures (rs between -.50 to -.53). Furthermore, this study found that the EQ-5D's ability to detect PTSD symptom change after treatment (which was only examined in relation to the CAPS-CA) was weak, either demonstrating non-significant changes over time or associated with small effect sizes between follow-up time points. There is a need for further research and replication to understand better the relationship between GPQoL measures and PTSD symptom measures, particularly in adult populations.

GPQoL instruments may be less useful in more complex disorders as they typically have limited scope in capturing mental health aspects. For example, the EQ-5D measures mental health through a single anxiety/depression item (Crick et al., 2018), suggesting this instrument may not appropriately capture changes in PTSD symptomatology, where mood changes only contribute to one of the four symptom clusters. Some GPQoL measures have more than one item measuring mental health (e.g., Short Form-6 Dimension [SF-6D; Brazier et al., 2002] and Assessment of Quality of Life 8 Dimension [AQoL-8D; Richardson, Iezzi, et al., 2014]), which may better capture more complex mental health disorders.

To our knowledge, no studies have examined the validity and responsiveness of GPQoL instruments in relation to assessing change in PTSD symptoms in an adult population, highlighting a need to investigate these relationships. Accordingly, the current study used pooled data from studies in which individuals had received trauma-focused cognitive-behavioural therapy for PTSD. This study aimed to examine whether a commonly used GPQoL instrument (AQoL-8D) is as valid and responsive as a widely used self-report PTSD symptom measure (the PCL-5). When exploring this relationship, we were interested in examining the construct validity and responsiveness (defined as the ability to measure symptom change in treatment) of our measures. The PCL-5 is one of the field's most commonly used self-report PTSD measures and has consistently demonstrated excellent validity and psychometric properties (Bovin et al., 2016). The AQoL-8D is designed to provide greater sensitivity to psycho-social health compared to more commonly used GPQoL instruments such as the EQ-5D and HUI3 (Richardson, Sinha et al., 2014). Over half of the 35 AQoL-8D items combine to form the super-dimension 'psycho-social health' (Richardson, Iezzi, et al., 2014). As such, this measure may have greater sensitivity to changes in mental health symptoms than other measures. If GPQoL measures adequately capture PTSD symptom change, efforts should be focused on increasing the use of GPQoL measures in PTSD research instead of promoting the use of condition-specific measures to facilitate economic evaluation.

Given that numerous studies have documented that PTSD is associated with poor quality of life (e.g., Giacco et al., 2013; Schnurr et al., 2006; Vogt et al., 2017), it was predicted that the PCL-5 would have a negative correlation with AQoL-8D summary score and utility scores. Moreover, it was predicted that the mental health dimension of the AQoL-8D would have the greatest negative correlation with PCL-5 total scores, compared to the other AQoL-8D dimensions. Given the lack of previous research, no specific predictions were made regarding reliability and responsiveness of the AQoL-8D compared to the PCL-5, thus these analyses constituted a first, exploratory examination of these relationships.

Method

Participants

Data were collected from participants who received PTSD treatment at the Flinders University PTSD Clinic, a research-focused intervention clinic, across three different treatment studies. The included studies were approved by The *Southern* Adelaide Clinical *Human Research Ethics Committee* or the Women's and Children's Health Network Research Ethics Committee and *informed consent was obtained from all individual participants.* To be included in the treatment studies, participants had to be 18 years and older and meet at least 3 of the 4 PTSD symptom clusters, plus all impairment criteria (see *Measures* for details), established using the Clinician-Administered PTSD Scale (CAPS) [24]. Exclusion criteria included severe cognitive impairment, concurrent treatment for PTSD, uncontrolled substance use or psychosis, and individuals that posed imminent harm to themselves or others. Participants completed a battery of questionnaires, including the AQoL-8D and PCL-5 at pre- and posttreatment (2 weeks after ceasing therapy). The final sample included 147 participants (see Table 3.1 for demographic and trauma-related information).

Table 3.1

Client Demographic and Trauma Information for Intent-to-treat Sample (N = 146).

Characteristics	*M* (SD) or *n* (%)
Age (years)	42.90 (13.07)
Female	100 (68.49)
White ethnicity	120 (82.19)
Index Trauma	
Child sexual abuse	27 (18.49)
Adult sexual assault	15 (10.27)
Child physical abuse	8 (5.48)

Motor vehicle accident	14 (9.59)
Witness death	25 (17.12)
Serious injury/threat of death	18 (12.32)
Physical assault	26 (17.80)
Traumatic loss	9 (6.16)
Home invasion/rape	4 (2.74)
Years since index trauma	15.95 (14.48)

Note. Index trauma reflects the trauma for which an individual was seeking treatment.

Treatments

Two of the treatment studies used the same trauma-focused therapy, Cognitive Processing Therapy (CPT; Resick et al., 2016), a form of Cognitive Behavioural Therapy that is a recommended first-line PTSD treatment (National Institute for Health and Care Excellence [NICE], 2018; Phoenix Australia, 2020). CPT involves challenging client's unhelpful thoughts and behaviours associated with the traumatic event. Various cognitive-behavioural techniques are used, including Socratic questioning, challenging unhelpful beliefs, identifying patterns of problematic thinking, and constructing alternative, more helpful thoughts. Modules in the program specifically focused on how the trauma(s) negatively impacted beliefs about safety, trust, power and control, esteem, and intimacy.

The third treatment study initially used a low-intensity trauma-focused cognitive-behaviour therapy (This Way Up: TWU; Clinical Research Unit for Anxiety and Depression et al., n.d.), from which participants could be stepped up to receive CPT if they did not initially respond to treatment. TWU is a therapist-assisted, guided online self-help approach based on a trauma-focused, cognitive-behavioural protocol. The program involved eight lessons of online material which clients work through each week (see Matthews et al. [2021] for further details on the treatments provided across the studies).

Measures

The Posttraumatic Stress Disorder Checklist for the DSM-5 (PCL-5; Weathers et al, 2013) is a 20-item self-report questionnaire that measures the impact of an individual's PTSD symptoms over the last month. The PCL-5 captures the four symptom clusters of PTSD as defined by the DSM-5 which include reexperiencing symptoms (cluster B; items 1-5), avoidance symptoms (cluster C; items 6-7), negative alterations in mood/cognition (cluster D; items 8-14) and alterations in arousal (cluster E; items 15-20). Participants rate how bothered they were by a particular symptom on a 4-point scale ranging from 0 (not at all) to 4 (extremely). Scores are combined to create a total severity score ranging from 0-80, with greater scores indicating increased PTSD severity. The PCL-5 has demonstrated test-retest reliability of r = .84, internal consistency of a = .96 (Bovin et al., 2016) and great discriminant and convergent validity across numerous studies (e.g., Bovin et al., 2016, Blevins et al., 2015).

Assessment of Quality of Life 8 Dimension (AQoL-8D; Richardson, Iezzi, et al., 2014) is a 35-item Generic Preference Quality of Life (GPQoL) instrument that indexes health-related quality of life. The AQoL-8D contains eight dimensions: independent living, relationships, mental health, coping, pain, senses, happiness, and self-worth. Item responses vary from a 4-point scale to a 6-point scale. The scoring algorithm available through https://www.aqol.com.au was used to create a summary score whereby responses are summed, and higher scores indicate greater health-related quality of life. An algorithm is also used to calculate the AQoL-8D utility values applied for economic evaluation. The utility values were determined using a combined Visual Analogue Scale (VAS) and Time Trade-off (TTO) approach based on an Australian general population. AQoL-8D utility values can range from less than 0 (worse than death) to 0 (death) to 1 (good health) (Richardson, Sinha et al., 2014). The AQoL-8D has demonstrated internal consistency a = .96 and test-retest reliability of ICC = 0.91 (Richardson, Iezzi, et al., 2014).

Statistical Analyses

Data were pooled across the three treatment studies. Descriptive statistics were estimated and the Shapiro-Francia test was used to test the distribution of the PCL and AQoL-8D summary and utility scores, and PCL-5 total scores. Where scores were not normally distributed, non-parametric tests were applied (e.g., Spearman's correlations). Pre to posttreatment effect sizes were calculated as per Morris (2008) and interpreted as follows: <0.2 = small, 0.5 = moderate, and 0.8 = large (Cohen, 1988). Convergent validity was explored using Spearman's correlations which were interpreted as per Kaambwa et al. (2018): $r > 0.30$ = weak, 0.40 to 0.50 = moderate, and above 0.50 = strong. The levels of agreement between the instruments were estimated through Modified Bland-Altman plots; these plot the difference between the two instruments against the mean value for each individual person. To construct the plot, the PCL-5 and AQoL-8D utility scores were converted to Z scores as the instruments have varying rating scales leading to differences in the magnitude of scores (Harrison et al., 2009; van Hateren et al., 2012). Before calculating Z scores, instrument totals were power transformed to follow a normal distribution. Responsiveness was measured through comparing the magnitude of change, indexed by the standardised response mean statistic (SRM), between the PCL-5 and AQoL-8D summary and utility scores from pre to posttreatment. The SRM was calculated as the difference in scores from pre-post treatment divided by the standard deviation of the difference. SRM values were interpreted as follows: < 0.2 = small, 0.5 = moderate, and 0.8 = large (Cohen, 1988). To account for missing data at posttreatment (28.76% for PCL-5 and 28.08% for AQoL-8D), a linear mixed model approach using restricted information maximum likelihood estimation was adopted to derive the descriptive statistics necessary to calculate the SRM (and this analysis was used to report on treatment outcomes). As the linear mixed model output provides only the standard error, this was used to derive the standard deviation using the following calculation, $(SE*\sqrt{(N)})\sqrt{(N)})$, in order to calculate the SRM.

Results

Pre- and posttreatment PCL-5 and AQoL-8D scores can be seen in Table 3.2. Overall, PTSD treatment was effective, with clients experiencing a significant reduction in PCL-5 scores from pre-post treatment, $F(16, 92.85) = 52.99$, $p < .001$, $d = 1.70$ [CI: 1.38 - 2.00] . Client's AQoL-8D summary scores were significantly higher from pre-post treatment, indicating an overall increase in health-related quality of life $F(1, 108.01) = 190.87$, $p < .001$, $d = 1.35$ [CI: 1.10-1.60]. Similarly, AQoL-8D utility scores also increased from pre-post treatment, $F(1, 104.29) = 180.66$, $p < .001$, $d = 1.38$ [1.11-1.64].

Table 3.2

Means and Standard Error of Pretreatment and Posttreatment Measures.

Variable	Pretreatment	Posttreatment
	Mean (SE)	Mean (SE)
PCL-5: PTSD Checklist	48.99 (.95)	11.88 (1.28)
Assessment of Quality of Life 8 Dimension summary total	55.89 (1.04)	71.35 (1.29)
Assessment of Quality of Life 8 Dimension utility total	0.43 (0.01)	0.66 (0.02)

To assess convergent validity, Spearman's correlations were estimated between the PCL-5 symptom clusters and total score and the AQoL-8D dimensions and total scores at pretreatment and posttreatment (See Table 3.3). At pretreatment, the dimensions of independent living, relationships, and the super dimension (physical) had small negative relationships with PCL-5 total scores (r's -.24 to -.38). AQoL-8D summary total, utility scores and dimensions of mental health, happiness/coping, super dimension (psychosocial) were all moderately correlated with the PCL-5. Pain and senses were the only dimensions not significantly correlated to PCL-5 scores. Similar patterns can be seen when comparing the AQoL dimensions and total scores to posttreatment PCL

scores, however, all correlations were larger. Scatterplots showing the relationship between the AQoL-8D summary score and utility score with PCL-5 total scores at pretreatment and posttreatment can be seen in Figures 3.1 and 3.2 and Figures 3.3 and 3.4, respectively.

Figure 3.1

Scatterplot Between PCL-5 and AQoL-8D Summary Scores at Pretreatment.

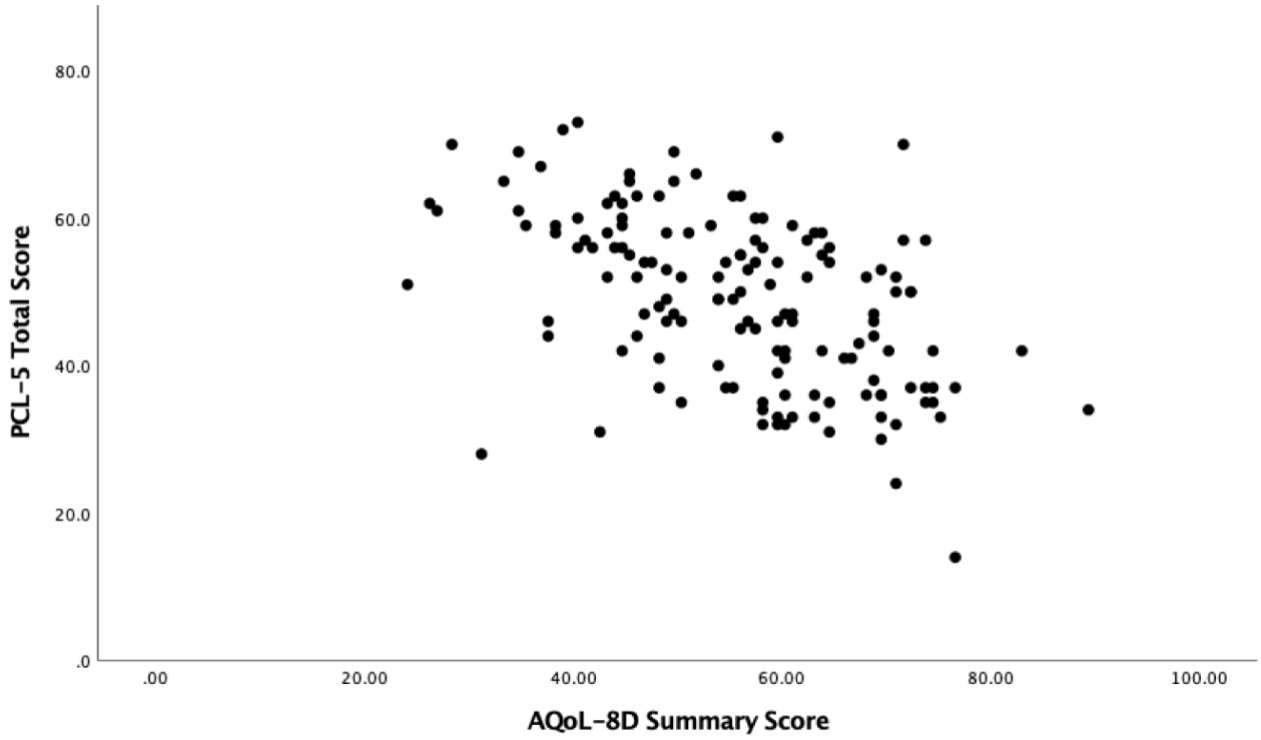


Figure 3.2

Scatterplot Between PCL-5 and AQoL-8D Utility Scores at Pretreatment.

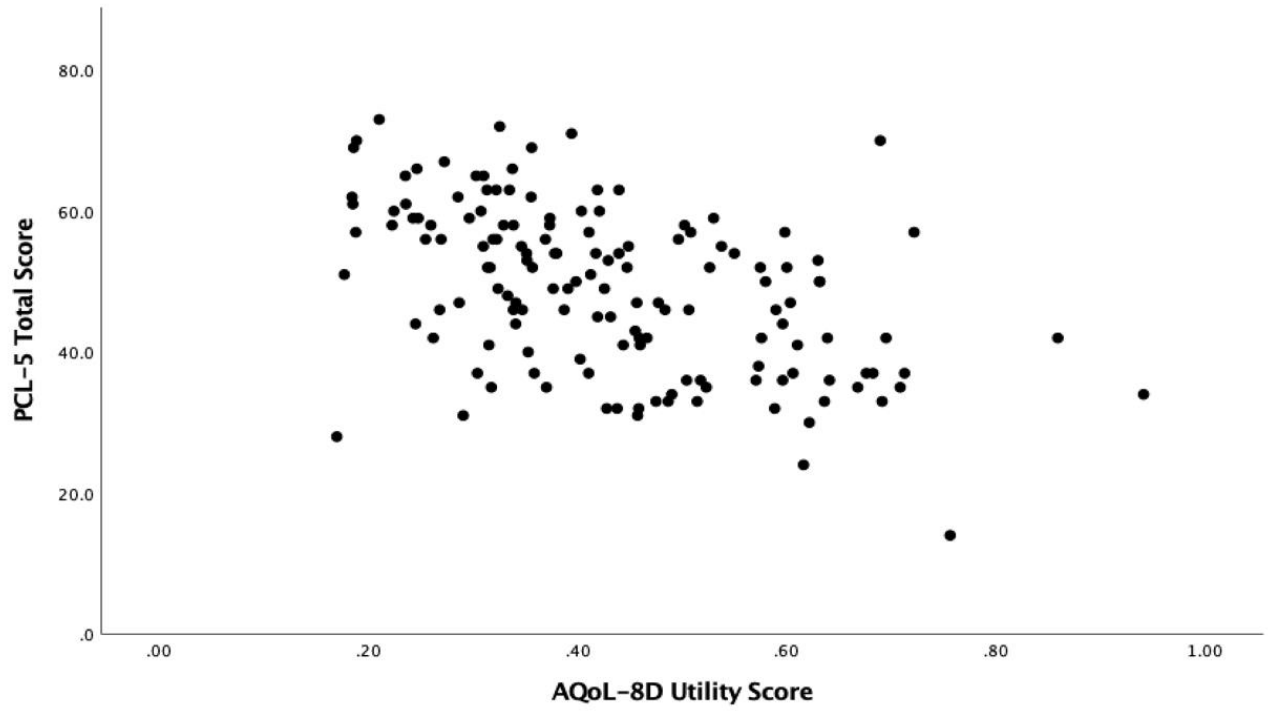


Figure 3.3

Scatterplot Between PCL-5 and AQoL-8D Summary Scores at Posttreatment.

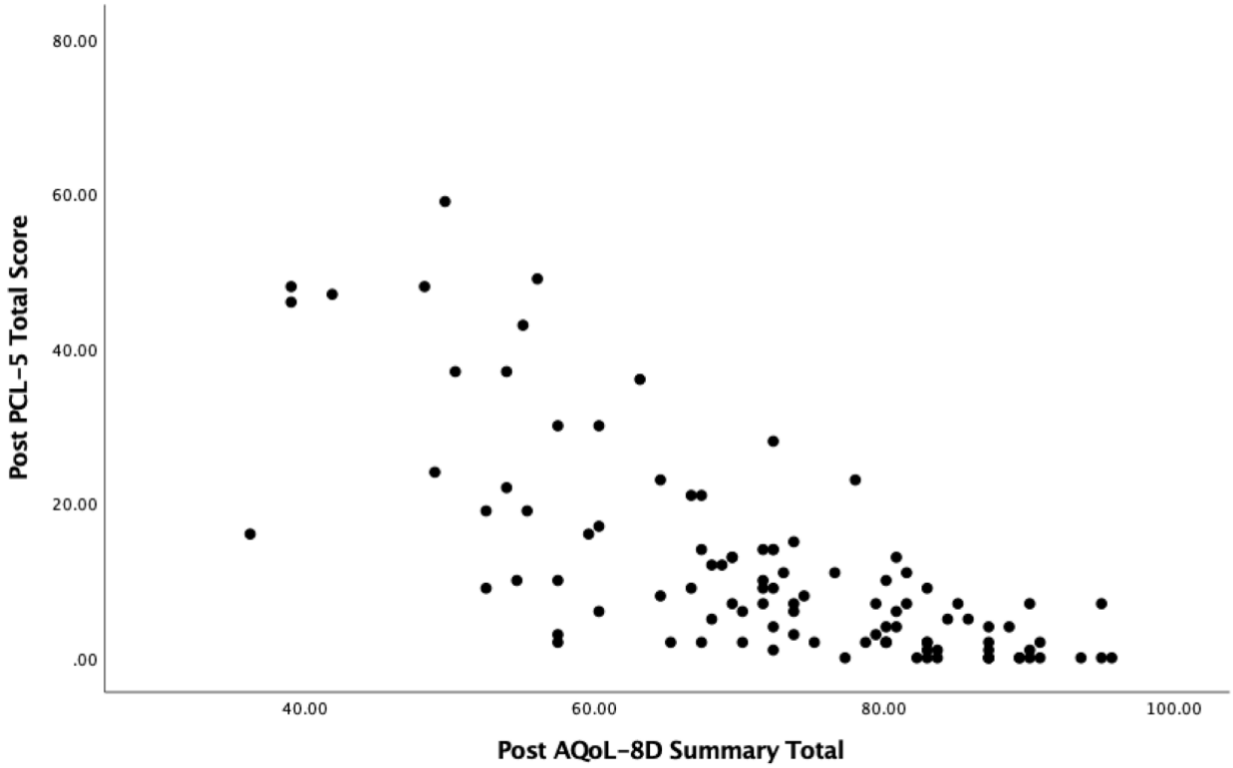


Figure 3.4

Scatterplot Between PCL-5 and AQoL-8D Utility Scores at Posttreatment.

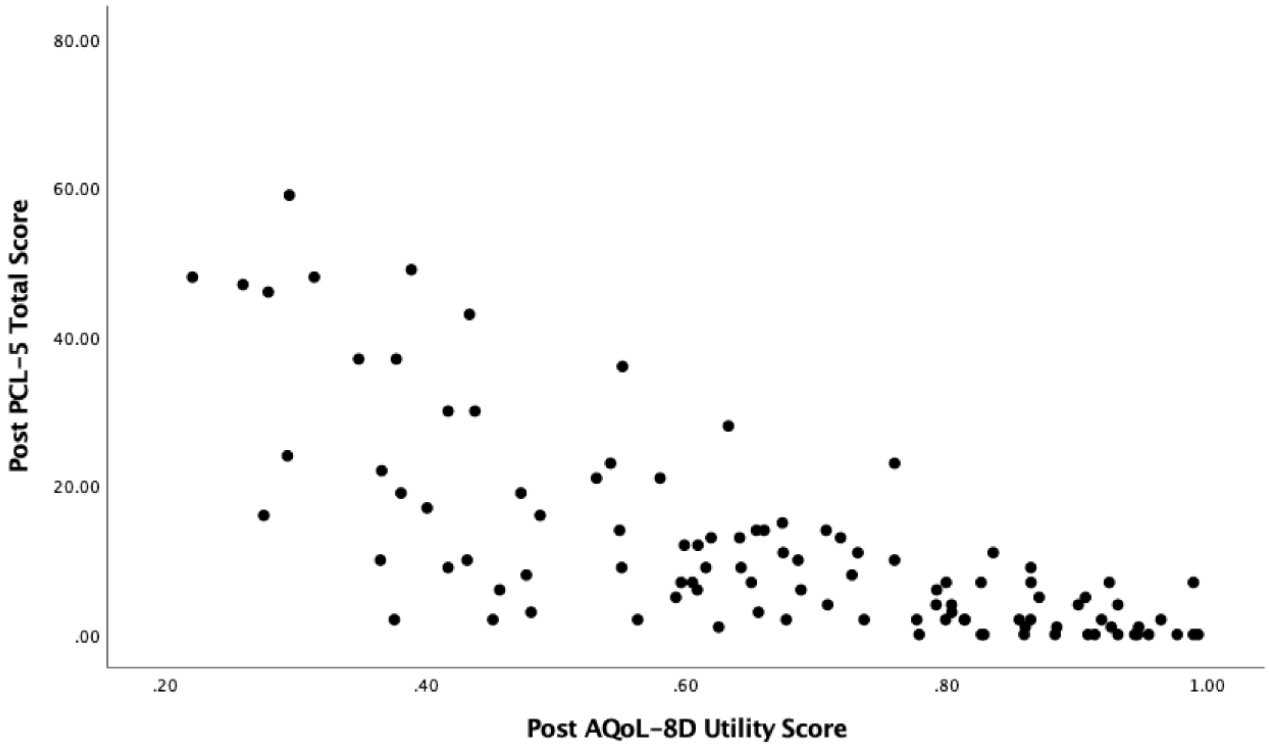


Table 3.3

Correlations Between Pre- and Posttreatment AQoL-8D Dimension and Total Scores, and the PCL-5 Symptom Clusters and Total Score.

	AQoL-8D dimensions											
Variable	Independent living	Pain	Senses	Mental health	Happiness	Coping	Relationships	Self-worth	Super – Physical	Super – psychosocial	AQoL-8D summary total	AQoL-8D utility total
	Pretreatment scores											
Pre PCL-5 total	-.24*	-.11	-.09	-.53**	-.42**	-.48**	-.38**	-.41**	-.23*	-.52**	-.52**	-.50**
Reexperiencing	-.15	-.14	.001	-.35**	-.17*	-.29**	-.11	-.19*	-.14	-.27**	-28**	-.29**
Avoidance	-.10	.06	-.09	-.24**	-.20*	-.23**	-.19**	-.19**	-.04	-.25**	-.23**	-.21*
Mood/cognition	-.26**	-.10	-.03	-.51**	-.50**	-.48**	-.48**	-.48**	-.19*	-.60**	-.56**	-.52*
Arousal	-.16	-.04	-.14	-.37**	-.24**	-.34**	-.20*	-.25**	-.13	-.33**	-.33**	-.34**
Variable	Independent living	Pain	Senses	Mental health	Happiness	Coping	Relationships	Self-worth	Super – Physical	Super – psychosocial	AQoL-8D summary total	AQoL-8D utility total
	Posttreatment scores											
Post PCL-5 total	-.46**	-.18	-.37**	-.75**	-.68**	-.66**	-.70**	-.63**	-.40**	-.79**	-.75**	-.75**
Reexperiencing	-.34**	-.09	-.28**	-.55**	-.49**	-.47*	-.48**	-.48**	-.27**	-.57**	-.54**	-.55**

Avoidance	-.26*	-.09	.37**	-56**	-.50*	-.46**	-.56**	-.43*	-.27**	-.60**	-.55**	-.57**
Mood/cognition	-.49**	-.22*	-.34**	-.71**	-.69**	-.63**	-.74**	-.66**	-.43**	-.79**	-.72**	-.76**
Arousal	-.46**	-.20*	-.30**	-.74**	-.64**	-.70**	-.61**	-.60**	-.37**	-.74**	-.70**	-.70**

Note. PCL-5 = The Posttraumatic Stress Disorder Checklist for the DSM-5, AQoL-8D = Assessment of Quality of Life 8 Dimension. * $p < .05$, ** $p <$ .001. Correlations with moderate-strong effect sizes have been underlined.

Agreement between the PCL-5 total and AQoL-8D utility total was examined using a modified Bland-Altman plot (see Figure 3.5); 3.42% of Z scores fell outside the 95% limits of agreement, suggesting moderate to good agreement between the two measures. The overall limits of agreement were marginal, ranging from -3.39 to 3.39. As the data points appear evenly spread above and below the mean difference of 0, this suggests that there is no consistent bias in the PCL-5 or AQoL-8D compared to the other. A similar pattern of results was found when examining the relationship between the PCL-5 and AQoL-8D summary total (see Figure 3.6).

Responsiveness was assessed by comparing the SRM statistic between the AQoL-8D total scores and the PCL-5 total score. As seen in Table 3.4, clients experienced a large change in PCL-5, AQoL-8D summary and utility scores from pre- to posttreatment. The magnitude of the SRM for the PCL-5 was nearly double that of the AQoL-8D total scores.

Figure 3.5

Modified Bland-Altman plots comparing the AQoL-8D utility total score and PCL-5 total score.

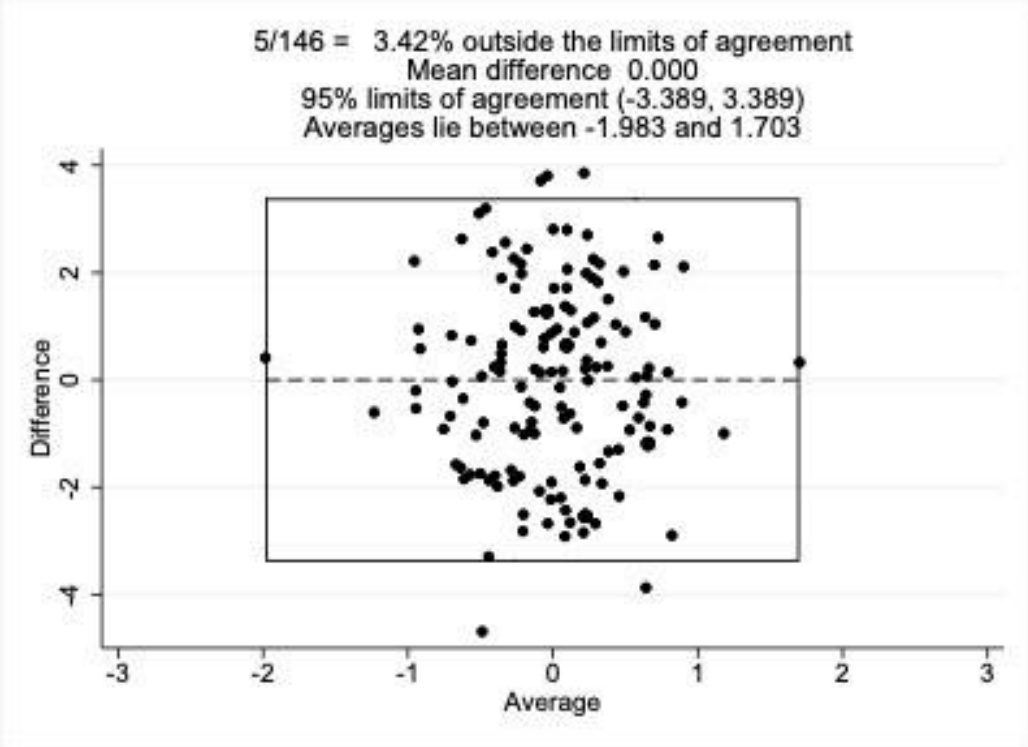


Figure 3.6

Modified Bland-Altman plots comparing the AQoL-8D summary total score and PCL-5 total score.

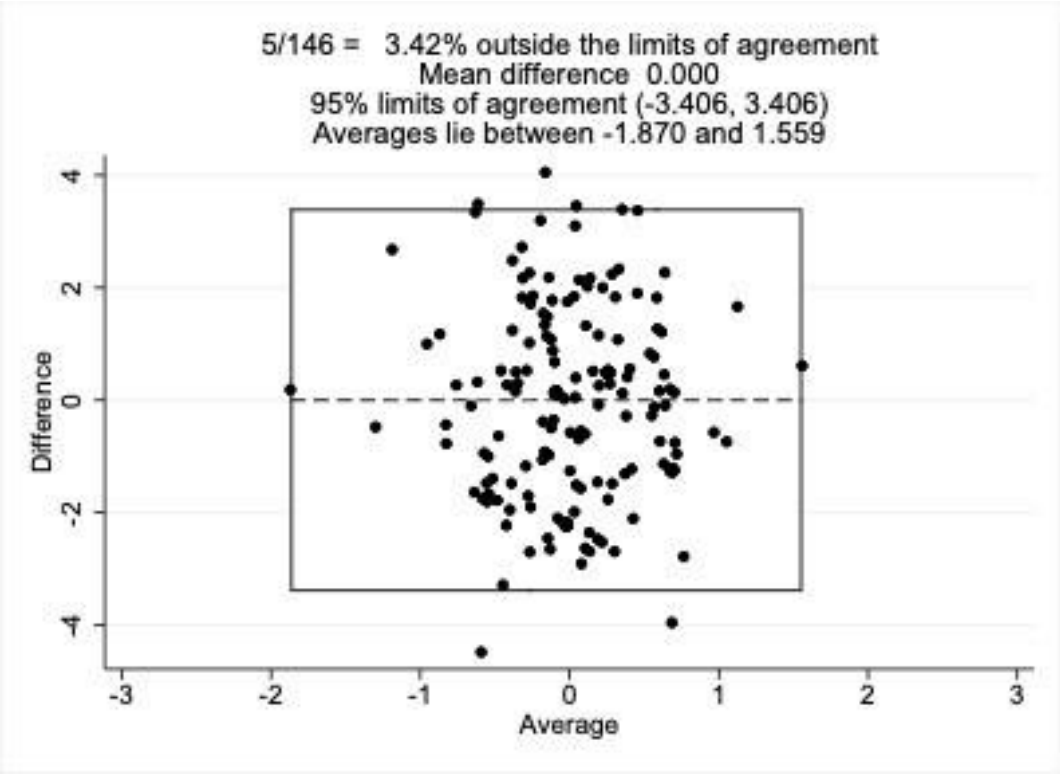


Table 3.4

Standardised Response Mean (SRM) of Client's Pre-post PTSD Treatment Change.

Variable	Raw mean change	SD change	SRM
PCL-5 total	37.12	17.56	2.11
AQoL-8D summary score	15.46	13.52	1.14
AQoL-8D utility total	0.23	0.21	1.10

Discussion

To our knowledge, this study represents the first direct comparison of the validity and responsiveness of a GPQoL instrument and a condition-specific PTSD instrument in an adult population. As expected, there was a negative relationship between client's PTSD symptoms and their quality of life whereby as PTSD symptoms reduced quality of life increased (correlations ranging from small to large). There was moderate to good agreement between the two measures, as demonstrated by the modified-bland Altman plots. Whilst the SRM of both measures was large, the magnitude of change of the PCL-5 was nearly double that of the AQoL-8D summary total and utility score, suggesting that the AQoL-8D was not as sensitive as the PCL-5 to PTSD symptom change over time.

Whilst causality cannot be established from our research, the negative relationship between PTSD symptoms and quality of life is in line with literature demonstrating the pervasive deleterious impact that PTSD can have on an individual's quality of life (e.g., Giacco et al., 2013; Schnurr et al., 2006; Vogt et al., 2017). When examining the relationship between quality of life and PTSD based on AQoL-8D dimensions, it was found that the strength of the relationships ranged from small to large. Whilst it was predicted that the mental health AQoL-8D dimension would have the strongest relationship with the PCL-5, it was found that the coping dimension and psycho-social super dimension (including dimensions of mental health, relationships, coping, self-worth, happiness) also shared similar strength relationships. This finding is unsurprising given that increased PTSD severity and mental health difficulties are associated with and can impact one's ability to cope, overall happiness, self-worth, and relationships (Hansford & Jobson, 2021; Schnurr et al, 2006).

From a health economic point of view, the mean utility total is the most important value derived from the AQoL-8D for the purpose of health economic evaluation, with previous studies suggesting that a moderate correlation may be sufficient to deem a GPQoL

measure interchangeable with a symptom specific measure (Kaambwa et al., 2015; Chen et al., 2015; Ratcliffe et al., 2012). Therefore, given that the overall AQoL-8D utility total had a strong relationship with the PCL-5 total and that there was moderate to good agreement between the measures, with Z scores showing that the normalised mean scores were all within one standard deviation of each other, our findings show that the AQoL-8D shows some validity in capturing PTSD symptoms. The strength of this relationship is consistent with Dams et al.'s (2021) findings which examined the EQ-5D index (or utility total) against both self-report and clinician-administered measures of PTSD. Despite Dams et al (2021) examining different GPQoL and PTSD symptom measures, these consistent findings suggest that there may not be a notable difference in the EQ-5D and AQoL-8D's ability to capture PTSD severity and change. However, there is need for replication with a larger and more diverse sample to establish whether there is benefit of one measure over the other.

The AQoL-8D was not as sensitive to change that appeared to occur between pre- and posttreatment as the PCL-5. Whilst the magnitude of both changes was large, change measured on the PCL-5 was nearly double that of the AQoL-8D. This suggests that the AQoL-8D might not fully capture PTSD symptom change over time. This finding is important to consider in the context of economic evaluation. If the aim of the economic evaluation is to determine the quality of an intervention in terms of its ability to reduce PTSD symptoms, using only a GPQoL measure may not adequately index the intervention's effectiveness. Further, there are mixed findings relating to the responsiveness of GPQoLs in other fields of mental health (Finch et al., 2020), therefore comparing the cost-effectiveness of treatments across disorders (one of the key benefits of using GPQoL measures) may not be a fair comparison if treatment effectiveness is better captured in one disorder compared to the other (Mulhern et al., 2014). Whilst CUA's are favoured by policymakers for the reasons outlined above, CEA's are considered acceptable if deemed more appropriate (Kaambwa et

al., 2018). Whilst our results are preliminary, they do bring into question the responsiveness of the AQoL-8D in relation to PTSD. Accordingly, providing a CEA alongside a CUA in future research would provide a more thorough and accurate depiction of the cost-effectiveness of PTSD interventions.

Our results regarding the responsiveness of the AQoL-8D must be interpreted cautiously - whilst a strength of the study was that responsiveness was evaluated, the secondary data analysis did not allow for more sophisticated analytic approaches. That said, there is no optimum method for measuring responsiveness. However, it is recommended that a distribution-based approach (e.g., examining SRMs over time) be used in conjunction with an anchor-based approach (e.g., use of an external indicator of change to categorise participants into various levels of deterioration or improvement) (Hans-Helmut et al., 2010). Given that our study did not include a measure that could be used as an external indicator of improvement, only distribution estimates could be calculated from pre- to posttreatment. Future work would benefit from conducting estimate and anchor-based analyses when exploring responsiveness, allowing for more robust conclusions to be drawn.

There are additional limitations that should be acknowledged. First, potentially important differences in PTSD symptoms that might be seen in community samples (e.g., gender differences; Luxton et al., 2010) are not always apparent in treatment-seeking individuals. Future research with both clinical and non-clinical samples would provide more nuanced findings pertaining to the discriminant validity of the AQoL-8D. Second, although we have attributed changes in PTSD symptoms and quality of life to the treatment itself, given that no control group was used, we cannot rule out that other factors may have led to the improvements seen. However, we can feel relatively confident regarding the impact of treatment as it is well established that CPT leads to greater treatment gains compared to non-active control conditions (e.g., those on a waitlist) (Tran et al., 2016).

Despite these limitations, to our knowledge, this is the first study to make a direct comparison between a GPQoL measure and PTSD symptom measure in an adult population. Our findings provide preliminary support for the construct validity of the AQoL-8D in individuals with PTSD. To fully capture nuances in PTSD symptom change, studies should conduct cost-effectiveness analyses alongside cost utility analyses to provide a more accurate depiction of the cost-effectiveness of PTSD treatments.

Chapter 4:

Open Trial of Cognitive Processing Therapy in the Australian Public Mental Health System: Method and Treatment Outcomes

Introduction

As outlined in Chapter 1, Australian research on the economic impact of evidence-based treatments for PTSD remains limited. Individuals receiving care in the Australian public mental health system are particularly vulnerable, as they are typically from lower socioeconomic backgrounds, experience greater financial hardship, and present with elevated rates of PTSD and comorbid conditions (Australian Bureau of Statistics, 2020). These factors contribute to increased reliance on government-funded health services. Despite evidence demonstrating that these populations can benefit significantly from treatment (Casey et al., 2023; Öst et al., 2023) systemic constraints—including limited funding, the prioritisation of number-based key performance indicators (KPIs), and inconsistent implementation of evidence-based practices—continue to restrict individuals accessing high-quality PTSD care (Petrie et al., 2021).

Economic evaluations can play a critical role in supporting the implementation of PTSD treatments at both local and national levels (Knapp & Wong, 2020). However, despite recommendations, they are rarely conducted alongside randomised controlled trials (RCTs) due to the additional time, expertise, and resources required (Franklin et al., 2020). Given these limitations, model-based economic evaluations provide a valuable alternative. However, as identified in Chapter 2, considerable inconsistencies in methodological choices and parameter inputs across existing models were observed. A key issue limiting researchers' ability to conduct robust evaluations was the availability of relevant data used to inform models. For instance, the limited availability of PTSD-specific utility values, essential for generating QALYs, remains a significant challenge globally and particularly in Australia.

Chapter 2 identified this as a major limitation, with half of the reviewed economic models relying on utility estimates from the 2007 Australian National Survey of Mental Health and Wellbeing. Therefore, expanding the availability of utility values for diverse PTSD populations is therefore necessary to improve the accuracy and applicability of future economic evaluations. Moreover, as outlined in Chapter 1, GPQoL measures are frequently included in clinical research, given that quality of life is an important secondary outcome in PTSD research. However, their reporting is often limited to summary scores rather than utility values, restricting their usefulness for economic modelling. Therefore, in addition to expanding the availability of utility estimates, there is a need for a framework on data collection and reporting in clinical research to guide and encourage the inclusion of utility values alongside clinical outcomes.

To address these gaps this chapter estimates the clinical and quality-of-life outcomes of Cognitive Processing Therapy (CPT), one of the most effective evidence-based treatments for PTSD and a viable alternative to standard care. An open trial of CPT was conducted across community mental health sites operated by SA Health, a state-funded public health service, to evaluate its effectiveness in routine care. The trial captured standard clinical outcome measures to inform clinical practice and collected additional data to support broader implementation decisions, including intervention costs and healthcare utilisation which will be presented in Chapter 5. CPT was selected for its strong evidence base, structured manual, and standardised training protocol, which facilitate large-scale dissemination and help ensure treatment fidelity (Johnson et al., 2022; Resick et al., 2016, 2024). Its effectiveness has been demonstrated in both international (Lenz et al., 2014; Öst et al., 2023; Schulz et al., 2006) and Australian public health settings (Casey et al., 2023; Forbes et al., 2012), as well as among individuals with complex presentations (e.g., comorbid alcohol use; Kaysen et al.,

2014 and borderline personality disorder; Bohus et al., 2020; Kleindienst et al., 2021), reinforcing its suitability for use in this context.

Based on this evidence, it was hypothesised that: (1) CPT would lead to significant reductions in PTSD and depression symptoms and improvements in quality of life from baseline to post-treatment, and (2) these reductions and improvements would be maintained at the 6-month follow-up. In addition to evaluating CPT's clinical outcomes, this study provides key data to inform future model-based economic evaluations of CPT for PTSD while also offering a framework for the collection and reporting of this data that can be applied in future clinical research. Strengthening the consistency and accuracy of model-based evaluations will enhance the understanding of the relative value of different PTSD interventions, ultimately supporting their implementation within the Australian public health system.

Method

This project was approved by the Southern Adelaide Clinical Human Research Ethics Committee (reference number: 2021/HRE00041) and the Departments of Defence and Veterans' Affairs Human Research Ethics Committee (reference number: 2021/BN32253040). This study was preregistered on the Australian New Zealand Clinical Trials Registry (reference number: ACTRN12621001083886) and reported in accordance with the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) guidelines (Des Jarlais et al., 2004).

Design

This study was designed as an open trial. Clinicians from mental health sites across SA Health were trained in CPT and subsequently provided CPT to their clients. Client outcomes, including PTSD symptoms, mood, and quality of life, were measured at pretreatment, during therapy, posttreatment, and at a 6-month follow-up. Health service

utilisation data was linked from administrative sources and intervention costs, were collected, detailed further in chapter 5.

Participants

A total of 72 participants were recruited across SA Health mental health sites. To be eligible, participants had to be aged 16 or older and meet either full or subthreshold probable diagnostic criteria for PTSD as determined by the PTSD Checklist (PCL-5), where a score above 31 indicates a probable PTSD diagnosis (Blevins et al., 2015). Subthreshold PTSD was defined as scoring just below the threshold (e.g., a PCL score of 26 or higher), in the context of a DSM-5 Criterion A traumatic event and showing symptoms across all PTSD clusters which was resulting in clinical impairment. In these potential subthreshold cases, the clinician was instructed to consult with the research lead (RN) via email or discuss the case with their CPT supervisor during supervision about eligibility. Exclusion criteria included individuals with moderate to severe traumatic brain injury, intellectual disability or poor literacy that hinders informed consent or participation in regular concurrent psychological therapy. Additional exclusion criteria included poorly controlled psychosis (e.g., symptoms severely impairing insight or consent), active substance dependence requiring urgent attention (e.g., detox), significant risk of harm (e.g., current domestic or family violence), or active suicidality needing immediate and ongoing intervention.

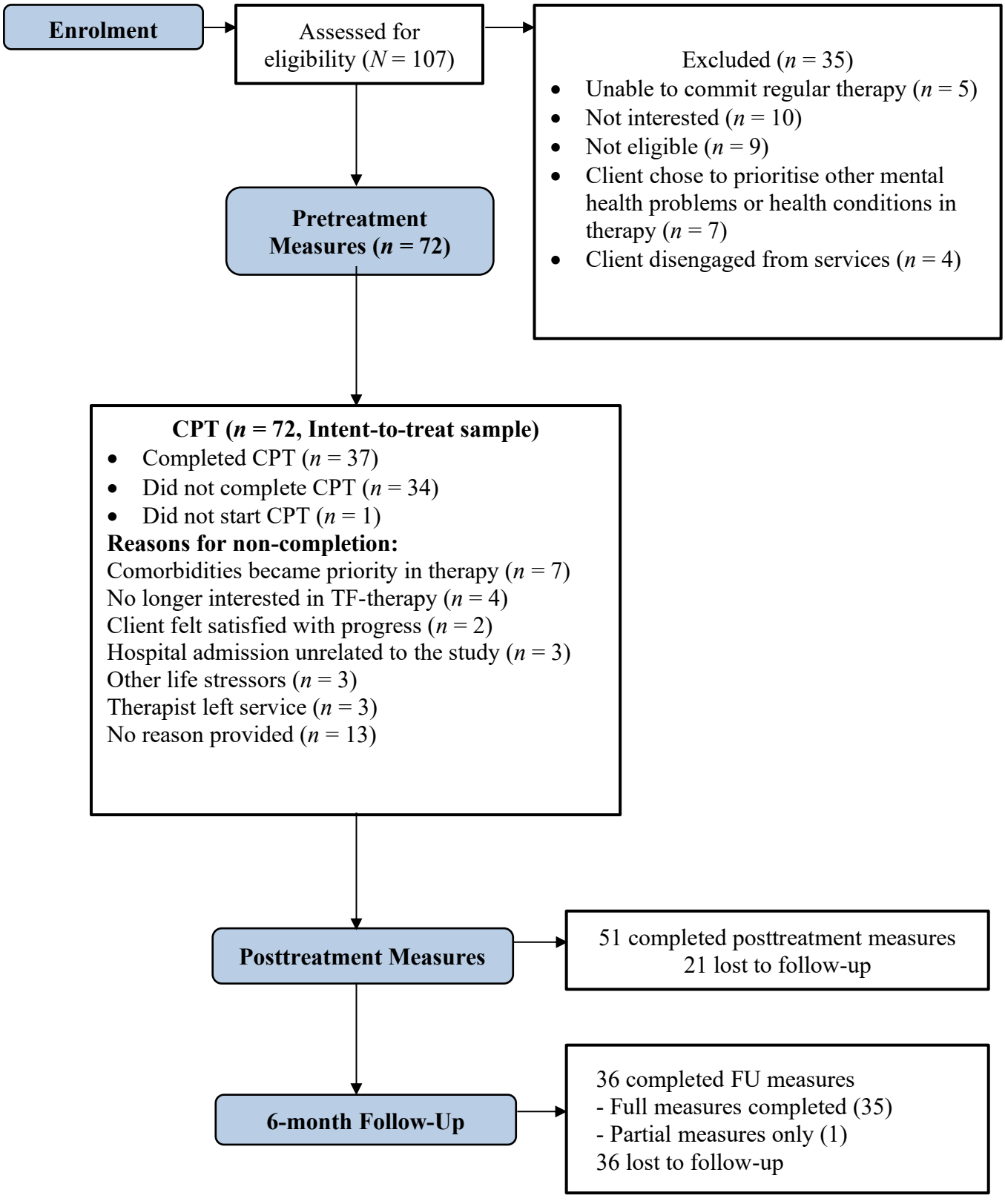
Participants were recruited between September 2021 and January 2023, with follow-ups continuing through to December 2023. As shown in Figure 1, 107 participants were initially screened by clinicians. Of these, 35 were excluded for a range of reasons (see Figure 1), with the two most common being not interested (n = 10) and not meeting eligibility criteria (n = 9; e.g., lacked Criterion A trauma or did not meet threshold or subthreshold criteria). The remaining 72 clients completed pretreatment questionnaires before starting treatment and were included in the intent-to-treat (ITT) sample.

Sample Size and Power

The likely sample size was initially uncertain, as it was difficult to predict how many clients would meet eligibility criteria and engage in treatment across multiple mental health sites. Based on early projections and discussions with the health services, it was estimated that 30 clinicians would receive CPT training, and each would initiate CPT with approximately 5–10 clients, leading to an anticipated sample size of 150–300. Organisational limitations, discussed later in this chapter, resulted in a smaller-than-anticipated sample size of N=72. However, considering that prior research on CPT has demonstrated treatment effect sizes exceeding 1.0 (Lenz et al., 2014; Sager et al., 2025), a sample of only 9-12 participants would be required to detect a large effect ($f = 0.4$) with sufficient power (power = 0.80) using repeated measures within-factors ANOVA (G*Power; Faul et al., 2009). Consequently, the final sample of 72 participants was more than adequately powered to detect typical CPT treatment effects in the current design.

Figure 4.1

Participant Flow Through Open Trial.



Procedure

Following consultations with clinical team leaders across various Local Health Networks (LHNs), three LHNs expressed interest in participating in the study, leading to the involvement of 27 clinicians from 11 mental health sites (see Table 4.1 for site-specific recruitment details). These clinicians, which included psychologists, social workers, psychiatrists, and mental health nurses, received training in CPT. This training consisted of an online CPT course (CPT web 2.0; self-paced, approximately 13 hours duration) followed by a 2-day live in-person workshop. After the workshop, clinicians participated in six months of one-hour weekly supervision sessions with an expert in CPT. Although 20 weeks of CPT supervision is recommended (as per the CPT Australia training recommendations detailed in later chapters), 26 sessions were provided to accommodate potential absences and ensure clinicians had sufficient opportunity to meet the requirement. The supervision was provided by two doctoral-level clinical psychologists, M.E. and S.A., each with over a decade of experience in PTSD research and treatment (both accredited CPT Trainers). Clinicians provided CPT to clients seeking treatment at their respective mental health sites. Each site had its own routine clinical intake process and clients identified as potentially being eligible were administered the PCL-5. Individuals scoring above 31 or falling within the probable subthreshold range were subsequently invited to participate in the study. Following informed consent, the Flinders University research team sent participants an online baseline questionnaire via an email link. Once the baseline questionnaire was complete, the clinician could commence CPT with their client. The Flinders University research team was responsible for sending baseline, posttreatment and follow-up questionnaires throughout the study.

Table 4.1

Recruitment Across the Local Health Network's and their Sites.

Local Health Network	Number of clinicians	Site	Number of clients recruited
CALHN	9	Centre for Treatment of Anxiety and Depression	8
		Eastern Community Mental Health Service	6
		Western Community Mental Health	7
NALHN	8	North East Community Mental Health Service	13
		Northern Community Mental Health	9
		Older Persons Mental Health Service	1
		Wondakka	1
SALHN	10	Jamie Larcombe Centre[a]	19
		Flinders Psychological Therapy Services (FPTS)	4
		Older Persons Mental Health Service	3
		Community Mental Health Service (Noarlunga Hospital)	1

Note. CALHN = Central Adelaide Local Health Network, NALHN = Northern Adelaide Local Health Network, SALHN = Southern Local Health Network.

[a] This site primarily treats veteran and emergency responder clients.

Clinicians and Treatment Overview

Clinicians

Two cohorts of clinicians (N=27) attended the two-day workshop. Most of the clinicians were psychologists (N = 17, 63%), followed by social workers (N = 3, 11.1%), mental health nurses (N = 2, 7.4%), psychologists undergoing a clinical registrar program (N = 2, 7.4%), psychiatrists (N = 2, 7.4%) or psychiatrists undergoing their psychiatry registrar program (N= 1, 3.7%). Over the duration of the study, 5 out of the 27 clinicians did not use CPT with any clients due to various service demands, for example, COVID-19 related position changes, limited client capacity etc. Of the remaining clinicians, the average number of clients treated with CPT was 3.43 (*SD* = 1.87).

Cognitive Processing Therapy

CPT, introduced in Chapter 3, is a well-established, evidence-based treatment for PTSD that has been extensively studied over the past three decades (Asmundson et al., 2019; Sager et al., 2025). Clinicians followed the 2017 version of the CPT manual (Resick et al., 2016), which provides 12 sessions of material designed to be delivered weekly, however, the number of sessions can be adjusted to meet individual client needs. In this study, participants could receive a maximum of 25 sessions (for ITT sample, *M* = 10.90, *SD* = 5.82; for Completers *M* = 15.16, *SD* = 3.14).

In the initial sessions of CPT, clinicians provide a rationale for treatment and deliver psychoeducation on PTSD. Clients are then asked to write an impact statement, detailing their beliefs about the cause of the traumatic event and its effects on their beliefs about themselves, others, and the world. The following sessions focus on challenging unhelpful thoughts and behaviours related to the trauma through Socratic questioning, addressing maladaptive beliefs, identifying patterns of problematic thinking, and assisting clients in constructing more helpful alternative thoughts. The final five sessions cover specific modules

that address how the trauma has negatively impacted client's beliefs regarding their safety, trust, power and control, self-esteem, and intimacy. In the penultimate session, clients are instructed to write a new impact statement, which is discussed in the concluding session. This session primarily focuses on reviewing the treatment and skills, consolidating treatment gains, and discussing strategies for relapse prevention.

Measures

The measures used in this study are described below with an administration schedule presented in Table 4.2.

The **Trauma Interview (Nixon et al., 2016; Nixon & Bralo, 2019; Roberts, 2023)** is a 30-item semi-structured measure created to collect details on client demographics, trauma history and social support. It was administered at pre-treatment assessment to obtain relevant clinical information about the participants.

The Life Events Checklist-5 (LEC-5; Weathers et al., 2013) is a tool used to assess an individual's exposure to potentially traumatic events. The measure consists of two sections, the first evaluates exposure to 16 common traumatic events that can lead to the development of PTSD, while also allowing respondents to report other traumatic experiences not included in the list. Respondents indicate how they were exposed to each event (e.g., direct exposure, witnessing, learning about it, or experiencing it through their work). For the present study, respondents were also asked to rate the frequency of each event on a seven-point scale (0 = never to 6 = more than 20 times) and report the distress it caused on a ten-point scale (1 = minimally distressing to 10 = extremely distressing). The second section of the measure contained eight questions asking details about the most distressing event (e.g., "How long ago did it happen?" and "Was someone's life in danger?")

The Posttraumatic Stress Disorder Checklist for the DSM-5 (PCL-5; Weathers et al., 2013), described previously in chapter 3, is a 20-item self-report instrument designed to

evaluate the 20 DSM-5 diagnostic symptoms that contribute to the criteria for PTSD. Total scores range from 0 to 80, with higher scores reflecting greater symptom severity. The PCL-5 has demonstrated test-retest reliability of r = .84, internal consistency of a = .96 (Bovin et al., 2016) and strong discriminant and convergent validity across numerous studies (e.g., Bovin et al., 2016; Weathers et al., 2018).

Depression Anxiety and Stress Scale (DASS-21; Henry & Crawford, 2005; Lovibond & Lovibond, 1995) is a well-established 21-item self-report measure that contains three subscales to measure depression, anxiety, and stress. Higher total scores indicated a greater degree of overall psychological distress, while higher subscale scores reflected increased levels of depression, anxiety, or stress. The overall scale and the depression scale have good internal consistency, $\alpha = .93$, $\alpha = .82$, respectively. This measure has also demonstrated good construct and convergent validity (Henry & Crawford, 2005). The DASS-21 was administered at all major assessment points. However, only the depression subscale (DASS-D) was included in the final analysis and administered weekly during therapy, given the high comorbidity between depression and PTSD and the importance of depression as a secondary outcome.

Assessment of Quality of Life (AQoL-8D; Richardson, Sinha, et al., 2014) measures eight domains of quality-of-life (Independent Living, Happiness, Mental Health, Coping, Relationships, Self-Worth, Pain, Senses). Respondents rate their agreement with each item on a continuous scale ranging from four to six points, depending on the question format. Scoring procedures, available at https://www.aqol.com.au, were applied to calculate two types of scores: a psychometric score (an unweighted total) and a utility score (a preference-weighted measure reflecting health state utility). Higher scores on both indicate greater quality of life. The utility score, based on Australian population norms (Richardson 2014), ranges from -0.04, representing a health state worse than death, to 0, which reflects a state equivalent to

death, and up to 1, indicating optimal health. The psychometric score is best suited for examining clinical outcomes representing changes in quality of life, whereas the utility value is more relevant for health economic evaluations. The AQoL-8D has demonstrated internal consistency a = .96 and test-retest reliability of ICC = 0.91. The AQoL-8D also demonstrates good convergent validity, correlating highly with other widely used quality-of-life measures used in economic evaluations such as the EQ-5D and, SF-6D (Richardson, Iezzi, et al., 2014).

The Treatment Inventory of Costs in Patients with Psychiatric Disorders (TIC-P; Bouwmans et al., 2013) is a comprehensive self-report measure that indexes health care utilisation as well as self-reported physical and mental health comorbidities. Service utilisation in the TIC-P is captured that reflects contact with a range of health professions (e.g., psychologists, psychiatrists, general practitioners etc.) and also captures hospitalisations and inpatient service use. In its original form the measure has shown satisfactory agreement when clients' self-report data was compared to medical records; for example, 76.7% agreement between reported number of visits with psychotherapists and medical records of such visits has been documented (Bouwmans et al., 2013). The self-reported comorbidity questions were included in this thesis. Health service utilisation data were collected as a contingency measure in case administrative healthcare utilisation records were unavailable at the study's conclusion. As these records were successfully obtained and attrition at follow-up data points limited the reliability and completeness of self-reported health service utilisation data, this section of the TiC-P was not utilised.

Table 4.2

Administration Schedule for Assessment Measures.

Measure	Administration time point			
	Baseline	Before each therapy session[a]	Post-treatment	6-month follow-up
LEC-5	X			
PCL-5	X	X	X	X
DASS-21	X	X	X	X
AQoL-8D	X		X	X
TiC-P	X		X	X

Note. PCL-5 = PTSD Checklist for DSM-5; DASS-D = 21-item Depression Anxiety Stress Scale, Depression subscale; LEC-5 = Life Events Checklist for DSM-5; AQoL-8D = Assessment of Quality of Life – 8 Dimensions; TiC-P = Trimbos and iMTA questionnaire on Costs associated with Psychiatric illness.

[a] Clinicians administered the PCL-5 and the DASS-D (depression subscale) on a weekly basis to inform their CPT work; however, these measures were not central to the analyses presented in the current study.

Statistical Analyses

The data was first checked for missing values, outliers, and normality, following the guidelines provided by Tabachnick and Fidel (2013). The analyses of clinical outcomes presented in this chapter were carried out using IBM's Statistical Package for the Social Sciences (SPSS), version 28.0. The effectiveness of CPT was evaluated using linear mixed modelling (LMM) with planned comparisons to dissect within group change (e.g., pretreatment-to-posttreatment). While this study did not include a between-subjects factor, linear mixed modelling was used as it allows repeated measures analyses and estimates missing data (in this case, due to attrition). Analyses were performed using an intent-to-treat sample unless stated otherwise. Chi-square or Fishers Exact Test were used for dichotomous variables (e.g., diagnostic outcomes) and independent sample *t*-tests were used to test other outcomes of interest. A significance threshold of .05 was applied to all statistical tests and Hedges' *g* was used to provide an unbiased estimate of effect sizes, with confidence intervals calculated for *g* based on a central *t* distribution, following the recommendations of Borenstein et al. (2009) and Goulet-Pelletier and Cousineau (2018). As a repeated measures design was employed, within-group effect sizes were calculated using the baseline standard deviation rather than the pooled standard deviation. This approach is considered to provide a more accurate estimate of population variances, as it remains unaffected by the intervention (Goulet-Pelletier & Cousineau, 2018).

Reliable Change Indices

For outcomes relevant to PTSD and depression, clinical effectiveness was also assessed by evaluating whether clients achieved response to treatment and good end-state functioning using the Reliable Change Index (RCI). The RCI, as described by Jacobson and Truax (1991), is a statistical method used to determine whether changes in an individual's

scores over time are meaningful, exceeding the threshold of measurement error. It is calculated by assessing the difference between baseline and posttreatment scores relative to the standard error of the difference. The standard error is calculated using the baseline standard deviation of the measure and test-retest reliability values, typically drawn from psychometric papers and/or those with samples relevant to the study sample. Test-retest reliability used in the present thesis for the PCL-5 was $r = .91$ (from Krüger-Gottschalk et al., 2017) and $r = .79$ for the DASS-D (from Roberts, 2023). A value exceeding 1.96 on the RCI indicates significant change ($p < .05$), representing a difference of two standard deviations from the mean.

Response to treatment was defined as a participant having a significant RCI in combination with symptom scores reaching below 31 for the PCL-5 (Blevins et al., 2015) and below 14 for the DASS-D (Lovibond & Lovibond, 1995). That is, a reliable change that placed the individual below clinical cut-offs for PTSD and depression symptoms, respectively. Good end-state functioning (GES) was similarly defined but required symptom scores below 19 for the PCL-5 (Matthews et al., 2022; Schnurr et al., 2015; Wachen et al., 2019) and below 10 for the DASS-D (Lovibond & Lovibond, 1995) and can be considered as being in remission (Matthews et al., 2022; Wachen et al., 2019).

Missing data

Posttreatment measures were completed by 70.83% ($n = 51$) of the ITT sample, with 50% ($n = 36$) completing the 6-month follow-up measures. A chi-square test of independence was conducted to examine the association between therapy completion and completion of follow-ups. The results indicated a statistically significant association between these variables at posttreatment, $\chi^2(1, N = 72) = 20.80$, $p < .001$, and at follow-up, $\chi^2(1, N = 72) = 5.53$, $p = .019$. Key baseline variables did not significantly differ between completers and non-

completers, including PTSD symptom severity (PCL-5), $t(70) = 0.64$, $p = .528$, depression (DASS-21), $t(70) = 1.02$, $p = .312$, and quality of life (AQoL-8D), $t(70) = -1.15$, $p = .253$.

Results

Participant Demographic and Clinical Characteristics

The demographic and clinical characteristics of the intent-to-treat sample are summarized in Table 4.3 and 4.4, respectively. The average PCL-5 score was 54.18 (*SD* = 12.20) at pretreatment and 70 participants (92.7%) met criteria for a probable PTSD diagnosis, while 2 participants (2.8%) fell within the subthreshold range. Childhood sexual assault was the most common index trauma (18.1%). A variety of comorbidities were self-reported over the past 12 months. Mood disorders were the most prevalent (80.56%), followed by anxiety disorders (54.17%), with all remaining conditions reported at rates below 14%. Neurodevelopmental disorders, such as autism and ADHD, were each reported by ~4% of participants[3].

Table 4.3

Key Demographic Information – Intent-to-Treat sample (N = 72).

	M (*SD*) or *n (%*)
Age	43.42 (14.45)
Gender	
Female	33 (45.80%)
Male	37 (51.40%)
Nonbinary	2 (2.77%)
Education (years)	12.70 (2.95)

[3] Due to limited funding, formal diagnostic interviews could not be conducted. Instead, clients were asked to self-report their comorbidities using the TIC-P. This information could not verified with other sources, such as clinicians or medical records.

Employed	22 (30.55%)
Net Annual Income (AUD)	
<10,000	6 (8.30%)
10,001 – 30,000	26 (36.10%)
30,001 – 50,000	13 (18.10%)
50,001 – 70,000	12 (16.70%)
70,001 – 90,000	6 (8.30%)
>90,000	5 (6.90%)
Did not disclose	4 (5.60%)
Ethnicity	
Non-Indigenous Australian	40 (55.60%)
Asian	3 (4.20%)
European	19 (26.40%)
Middle Eastern	1 (1.40%)
South American	1 (1.40%)
Multi-ethnic	7 (9.70%)
Marital Status	
Single	26 (36.11%)
In a relationship or married	25 (48.61%)
Divorced or widower	11 (15.28%)

Table 4.4

Baseline Clinical Characteristics for the Intent-to-Treat Sample (N = 72).

	M (*SD*) or *n* (%)
Index Trauma	
Childhood sexual assault	13 (18.06%)
Childhood domestic violence	3 (4.17%)
Adulthood sexual assault	9 (12.50%)
Adulthood domestic violence	9 (12.50%)
Traumatic loss	11 (15.28%)
Life threatening injury/illness	4 (5.56%)
Physical assault	8 (11.11%)
Motor vehicle accident	5 (6.94%)
Work related life threat/death of others	10 (13.89%)
Years since index trauma	19.29 (15.80)
Total number of traumas (LEC-5 total)	5.90 (3.47)
PCL-5	54.18 (12.10)
Probable PTSD	70 (97.22%)
Probable Subthreshold PTSD	2 (2.80%)
Self-reported mental health comorbidities	
Total no. comorbidities	2.61(1.36)
Anxiety disorders	39 (54.17%)
Mood disorder	58 (80.56%)
Eating disorder	1 (1.40%)
Substance use disorder	4 (5.56%)
Psychotic disorder	5 (6.94%)

Borderline personality disorder	9 (12.50%)
Autism	3 (4.17%)
ADHD	3 (4.17%)
Self-reported physical conditions (grouped by affected system or area)[a]	
Heart/blood vessel	24 (33.33%)
Gastrointestinal	18 (25%)
Gallbladder, liver and kidneys	10 (13.89%)
Lungs and sinuses	19 (26.39)
Back and joints	41 (56.94%)
Nervous system	20 (27.78)
Physical injury	72 (100%)

Note. LEC-5 = Life Events Checklist for DSM-5; PCL-5 = PTSD Checklist for DSM-5; ADHD = attention deficit hyperactivity disorder.

[a] Heart and blood vessels = issues due to heart attack, serious heart problem or consequences of a stroke. Gastrointestinal = stomach ulcers, duodenal ulcer, serious intestinal problems lasting longer than 3 months. Gallbladder, liver and kidneys = gallstones or gallbladder inflammation, disease of cirrhosis of liver, kidney stones, serious kidney disease. Lungs and sinuses = asthma, persistent bronchitis, chronic non-specific lung disease, nasal sinusitis, frontal sinusitis or maxillary sinusitis. Back and joints = hernia, other back pain lasting more than 3 months, arthritis of knees, hips or hands, inflamed joints, rheumatism lasting more than 3 months. Nervous system = epilepsy, nervous system disease (e.g., Parkinsons), multiple sclerosis, dizziness resulting in falls, migraines.

Attrition

Participants were considered non-completers if they did not start therapy or terminated therapy prematurely without attaining a clinically significant reduction in PTSD severity on the PCL-5 and their therapist believed that additional PTSD treatment was still necessary. The reasons for non-completion are presented in Figure 1. The primary reason was the perceived need to focus on comorbidities, which was highlighted by both clinicians and clients (n = 7, 20%), followed by a lack of interest in trauma-focused therapy (n = 4).

Treatment Outcomes Over Time

Table 4.5 summarises the descriptive and inferential outcomes across all time points for the intent-to-treat sample. A significant main effect of time was observed for all measures: PCL-5 ($F_{2, 44.69} = 48.08$, $p < .001$), DASS-D ($F_{2, 48.14} = 30.33$, $p < .001$) and AQoL Psychometric ($F_{2, 44.51} = 19.91$, $p < .001$). As predicted, pairwise comparisons revealed significant reductions in PTSD symptom severity from pretreatment to post-treatment ($p < .001$, g = 1.80) and from pretreatment to 6-month follow-up ($p < .001$, g = 1.53**),** associated with large effects. There was no significant change in symptoms between posttreatment and 6-month follow-up ($p = .16$, g **=** -0.25), demonstrating that treatment benefits were maintained over time. The same pattern was observed for depression (pre-post: $p < .001$, g = 1.02; pre-follow-up: $p < .001$, g = 0.82; post-follow-up: p = .14, g = -0.14**)** and quality of life (pre-post: $p < .001$, g = -0.68; pre-follow-up: $p = .002$, g = 0.89; post-follow-up*:* $p = .41$, g **=** -0.14**).** Completers had similar outcomes but with larger effects (e.g., PCL-5 change pre-post, g = 3.00; pre-follow up, g = 2.59**).** See Appendix E (Table 1) for details.

Table 4.5

Estimated Means and Standard Errors for Posttraumatic Stress Symptoms, Depression Severity, and Health-Related Quality of Life (N = 72) Over Time.

	Pretreatment *M* (*SE*)	Posttreatment *M* (*SE*)	Follow-up *M* (*SE*)	Pre-Post *g* (CI_{95})	Pre-FU *g* (CI_{95})	Post-FU *g* (CI_{95})	Main effect *F*(df)
PCL-5	54.18 (1.42)	32.39 (2.35)	35.63(2.78)	1.80 (1.28, 2.32)	1.53 (1.12, 1.94)	-0.25 (-0.42, -0.08)	48.08 (2, 44.69)***
DASS-D	26.94 (1.12)	17.19 (1.52)	19.06 (1.66)	1.02 (0.71, 1.34)	0.82 (0.54, 1.11)	-0.14 (-0.35, 0.06)	30.33 (2, 48.14)***
AQoL Psychometric[a]	43.55 (1.25)	50.80 (1.82)	53.05 (2.86)	-0.68 (-1.04, -0.32)	-0.89 (-1.15, -0.63)	-0.14 (-0.36, 0.07)	19.91 (2, 44.51)***
AQoL Utility[a]	0.29 (0.01)	0.38 (0.02)	0.40 (0.03)	-1.05 (-1.40, -0.71)	-1.29 (-1.64, -0.94)	-0.12 (-0.33, 0.09)	20.04 (2, 43.98)***

Note. PCL-5 = PTSD Checklist for DSM-5; DASS-D = 21-item Depression Anxiety Stress Scale, Depression subscale. AQoL-8D = Assessment of Quality of Life – 8 Dimensions. *F* = main effect of time.

[a] An increase in scores indicate an improvement in quality of life or capabilities.

* $p < .05$; ** $p < .01$; *** $p < .001$.

The analysis above reflects standard clinical outcome reporting in treatment studies. However, as highlighted in the systematic review, reporting utility values, alongside clinical outcomes, can provide a valuable source of data for future economic evaluations. While stratifying utility estimates by severity levels could improve precision, the absence of established cut-off scores—including for subthreshold PTSD—on the PCL-5 precluded this approach. Instead, to maintain comparability with existing economic evaluations, utility estimates were categorised based on scores above and below the probable diagnostic threshold, representing PTSD and non-PTSD group and are presented in table 4.6.

Table 4.6

Utility values for PTSD and Non-PTSD Groups at Each Time Point.

	Utility Estimate					
	N	Pretreatment	N	Posttreatment	N	Follow-up
PTSD	72	0.29	24	0.30	15	0.28
No PTSD	2	0.31	27	0.47	21	0.49

Dichotomous Treatment Outcomes

Table 4.7 summarises the dichotomous treatment outcomes for PTSD and depression. At posttreatment, 47.06% of participants achieved a loss of probable PTSD diagnosis on the PCL-5 (i.e., score <31), with 43.14% meeting criteria for treatment response and 21.57% achieving good end-state functioning. These gains were largely maintained at the 6-month follow-up, with 56.76% of participants achieving loss of diagnosis, 51.35% meeting treatment response criteria, and 21.62% reaching good end-state functioning. Similar patterns were observed for the DASS-D, where 45.10% of participants scored below 10, indicating scores within the "normal" range, 31.37% met criteria for treatment response, and 17.65% achieved good end-state functioning at posttreatment. By 6-month follow-up, these percentages were 32.43%, 18.92%, and 10.81%, respectively.

Completers had similar outcomes with slightly greater reductions observed, see Table 2 in Appendix E for details.

As highlighted in Chapter 2, data on relapse rates should be reported alongside clinical effectiveness to provide economic evaluations with essential inputs for model development. Specifically, relapse rates influence transition probabilities between health states in Markov models, allowing for a more accurate representation of long-term treatment outcomes. These data also help refine cost-effectiveness estimates by accounting for the likelihood of ongoing treatment needs, additional healthcare utilisation, and variations in quality-adjusted life years (QALYs) over time. In the current study, among clients with both posttreatment and follow-up data, 75% (18/24) retained their loss of probable PTSD diagnosis. All individuals who achieved a treatment response (100%, 16/16) or good end state functioning (100%, 7/7) at posttreatment maintained these outcomes at follow-up.

Table 4.7

Dichotomous Treatment Outcomes at Posttreatment and 6-Month Follow-Up for PCL-5 and DASS-D for the Intent-to-treat Sample.

	Below probable diagnostic threshold	Treatment Response	Good end state functioning
PCL-5			
Posttreatment	44.90% (22/49)	44.90% (22/49)	22.45% (11/49)
6-Month FU	55.55% (20/36)	52.78% (19/36)	22.22% (8/36)
DASS-D			
Posttreatment	N/A	34.78% (16/46)	17.65% (9/51)
6-Month FU	N/A	18.92% (7/37)	10.81% (4/37)

Note. Below probable diagnostic threshold indicates scores <31 on the PCL-5 for those in the clinical range at pretreatment. Treatment response reflects a significant Reliable Change Index (RCI) and symptoms <31 on the PCL-5 and <14 on the DASS-D, respectively. Good end-state functioning represents a significant RCI with symptoms <19 on the PCL-5 and <10 on the DASS-D.

Adverse Events

No serious study-related adverse events were reported during the study period. However, three participants were hospitalized and subsequently discontinued CPT. One participant, who had been on the waitlist for electroconvulsive therapy (ECT) prior to starting CPT, discontinued therapy to undergo ECT and prioritized their recovery thereafter. Two participants with longstanding depression were hospitalized due to increased suicidality. Both treating clinicians reported that hospital admissions were not uncommon for these clients and indicated that the suicidality was unlikely to be linked to undergoing CPT. For these individuals, their comorbid conditions were prioritized in their ongoing care, and CPT was not resumed.

Discussion

Establishing the effectiveness of CPT in public mental health settings is essential for assessing its feasibility and supporting the implementation of evidence-based practices in Australian public mental health settings. This chapter reports on clinical outcomes alongside utility data, offering insights to inform implementation efforts and future economic evaluations, while broader cost impacts are examined in the next chapter. As predicted, participants demonstrated significant reductions in PTSD and depression symptoms, along with marked improvements in quality of life from baseline to post-treatment. These gains were largely maintained at the 6-month follow-up, with greater improvements observed among those who completed treatment.

These findings are consistent with a robust body of international literature demonstrating the effectiveness of CPT in significantly reducing PTSD symptoms in community-based settings (Lenz et al., 2014; Öst et al., 2023; Schulz et al., 2006). Additionally, they add to the more limited Australian research literature (e.g., Casey et al., 2023; Forbes et al., 2012), further supporting CPT's effectiveness within local public health systems. While depression symptoms also improved, these effects were less pronounced compared to PTSD symptoms, aligning with existing literature demonstrating that trauma-focused therapies can also improve depressive symptoms (Dominguez et al., 2021; Öst et al., 2023).

Moreover, a key strength of this study is the inclusion of long-term remission and relapse data, which are rarely reported in clinical trials and pose challenges for economic evaluations when modelling the trajectory of PTSD treatment. Findings indicated that participants who achieved a treatment response or good end-state functioning—defined as scoring below 31 and 19 on the PCL-5, respectively, while also demonstrating statistically significant symptom improvement—maintained their gains over time. However, when remission was assessed solely based on the probable diagnostic threshold, without accounting for statistically significant symptom change, 75% of participants still remained below the diagnostic threshold at follow-up. These findings align with prior research suggesting that sustained remission is more likely when individuals not only fall

below a clinical cut-off but also demonstrate meaningful symptom change. These findings reinforce the value of continued engagement in treatment until these thresholds are met to enhance the likelihood of maintaining long-term gains.

Notably, we also observed moderate-to-large improvements in quality of life, an important secondary clinical outcome demonstrating that treating PTSD can contribute to broader, tangible enhancements in overall well-being. These improvements were reflected in utility values, increasing from 0.29 to 0.40 in the intent-to-treat sample, with even greater gains observed among those who no longer met the probable PTSD diagnosis. Compared to previous Australian economic evaluations, which derived utility values from the 2007 National Survey of Mental Health and Wellbeing, the utility values in this study are notably lower. Gospodarevskaya and Segal (2012) reported utility values of 0.61 for PTSD alone, 0.53 for PTSD with depression, and 0.46 for depression in children, with non-PTSD values of 0.87 (ages 10–30) and 0.85 (ages 30–40). Mihalopoulos et al. (2015) estimated values of 0.54 (males) and 0.57 (females) for adults with PTSD without CBT, increasing to 0.63 and 0.64, respectively, following treatment. The notably lower utility values in the current study could be attributed to several factors. First, the 2007 survey employed the AQoL-4D as their GPQoL measure, which is less sensitive to mental health-related quality of life compared to its successor the AQoL-8D, which was used in the current study. Second, those studies used population-based survey data, which may not reflect the level of disadvantage in public mental health cohorts. Despite the lower baseline utility scores in this study, the observed improvements (0.11 for the ITT sample and 0.21 for the PTSD vs. no PTSD group at follow-up) align with existing Australian economic evaluations. The ITT estimate is consistent with Mihalopoulos et al. (gains from 0.07 to 0.09 in adults), while the upper estimate aligns with Gospodarevskaya and Segal (2012) (gains ranging from 0.26 to 0.41 in children). This demonstrates that, despite extremely low baseline quality of life, meaningful improvements are possible following treatment. By demonstrating the clinical effectiveness of CPT in a community-based setting, these findings also reinforce the feasibility of delivering evidence-based trauma-focused

therapy within Australian public health services when appropriate training and supervision are provided.

The noncompletion rate in this study must be acknowledged, 50% is higher than typically observed in CPT trials but is comparable to that reported in one of the two community-based CPT trials conducted in Australia (Forbes et al., 2012). While this rate is at the high end, several U.S.-based studies have reported disengagement rates close to 40%, even in well-supervised trials (e.g., Kehle-Forbes et al., 2016; Shayani et al., 2023), highlighting that dropout rates can vary considerably across settings and study designs. While disengagement rates remain a pertinent issue across all evidence-based therapies for PTSD (Lewis et al., 2020), our disengagement rates must be interpreted within the context of Australian public mental health settings, where clients frequently experience substantial socioeconomic disadvantage, heightened psychological distress, and complex comorbidities (Kehle-Forbes et al., 2016; Shayani et al., 2023). In this sample, 69.45% of participants were unemployed, experienced multiple mental and physical comorbidities, reported exposure to an average of 5.9 criterion A traumas in their life, and had a mean time since the index trauma of 19 years, further highlighting the complexities faced by this population.

Despite these factors, 44% of those in the clinical range at pretreatment achieved a treatment response, indicating that meaningful therapeutic outcomes are attainable even in high-need settings where PTSD might otherwise remain unrecognised and/or untreated (Borah et al., 2017; Finch et al., 2020). Moreover, while CPT completion with an adequate dose of therapy is generally associated with improved symptom outcomes, research suggests that individuals who disengage prematurely can still experience meaningful reductions in PTSD and depression symptoms (Szafranski et al., 2017), as also shown in our intent-to-treat analysis. As such, although individuals using these services encounter substantial barriers to engaging in and completing treatment, these findings highlight the potential for positive change when evidence-based interventions are made accessible.

This study has several limitations that warrant consideration. Although an intent-to-treat sample and linear mixed modelling approach were used to address missing data, attrition rates at post-treatment and follow-up may have introduced bias, potentially affecting the validity of the results. The lack of significant baseline differences between completers and non-completers suggests that attrition was not closely tied to initial severity indicators, however, the influence of unmeasured factors on noncompletion cannot be ruled out. Additionally, resource constraints prevented the use of diagnostic interviews and independent assessments of treatment fidelity. While the PCL-5 is a widely accepted and reliable self-report measure of PTSD symptom change (Lee et al., 2022), diagnostic interviews are considered the gold standard for ensuring diagnostic accuracy (Weathers et al., 2018). Similarly, the reliance on self-report measures for assessing mental health comorbidities in this sample may have introduced inaccuracies, potentially leading to underestimation or overestimation of their prevalence. Moreover, formal assessment of fidelity was not conducted. Whilst this introduces uncertainty regarding the implementation of CPT protocols across clinicians and clinics, it offers effectiveness estimates that are more representative of CPT practice in routine care, where variations in delivery often occur. The training and ongoing supervision model used in this study has been shown to improve treatment fidelity and adherence to the protocol, thereby supporting more consistent and effective CPT delivery in clinical practice (Resick et al., 2024). Additionally, the magnitude of clinical outcomes observed was consistent with those reported in trials with high fidelity (Fortin et al., 2021).

Despite these limitations, this study suggests the clinical effectiveness of CPT for PTSD in an Australian public mental health service, highlighting its potential to improve outcomes for individuals with complex needs and contributing to the limited Australian literature in this area. While increasing treatment engagement and reducing dropout rates remain significant challenges, these findings emphasise that meaningful therapeutic outcomes are achievable even in high-need settings. These findings provide a foundation for the following chapters, which explore the economic implications of delivering CPT in this context.

CHAPTER 5:

Open Trial: Costs of CPT Delivery and Healthcare Utilisation

Introduction

With the findings reported in the previous chapter suggesting the effectiveness of CPT in Australian public mental health settings, the final stage of the research program in this PhD is to now consider broader implementation implications. While strong evidence supports the clinical benefits of a psychological treatment such as CPT, economic arguments are a crucial adjunct to promote wider adoption and equipping clinicians and service managers with the evidence needed to advocate for resources (McDaid et al., 2019). The systematic review in Chapter 2, however, identified several key data gaps in the economic factors included in existing model-based evaluations—many of which also apply to trial-based models. Critical implementation costs such as clinician training and ongoing supervision were often omitted and considerable variation was identified in how downstream healthcare utilisation was captured, with inconsistencies in the types of services included and limitations in the data sources used for estimation. Across the reviewed model-based evaluations, data availability constraints frequently restricted the inclusion of these factors, representing a significant gap in the literature. Addressing these gaps—particularly by exploring full intervention costs and downstream healthcare utilisation—is essential not only for strengthening future economic evaluations but also for providing a framework for data collection in future PTSD treatment trials.

The systematic review identified that initial training and ongoing supervision costs were often excluded from intervention cost estimates. For example, training costs were omitted in the two identified Australian economic evaluations comparing usual care (standard psychological support or no treatment) to TF-CBT for adults (Mihalopoulos et al., 2015) and children (Gospodarevskaya & Segal, 2012). Despite differences in the level of training investment required between usual care and the intervention. Since PTSD-focused training and supervision are not universally provided in standard clinical practice (Finch et al., 2020b), excluding these costs likely underestimates the true

cost of implementation, limiting the relevance of findings for publicly funded services operating under financial constraints (Bowser et al., 2021; Charney et al., 2019; Finch et al., 2020b). Economic evaluations that comprehensively incorporate implementation costs—including direct costs (e.g., training and supervision expenses), direct service costs (e.g., treatment provision), and indirect costs (e.g., opportunity costs from lost billable time)—provide more accurate estimates of real-world feasibility and sustainability (Bowser et al., 2021). While intervention delivery costs can be adapted to local settings, variations in training models, workforce investment, and funding mechanisms across contexts highlight the need for context-specific estimates.

The systematic review further identified considerable variability in how healthcare utilisation was captured across economic models. Some models estimated post-treatment healthcare costs using static assumptions—such as assigning healthcare costs from those without PTSD to remitted individuals or applying arbitrary reductions to cohort service use data post-treatment (Avancena et al., 2022; Marseille et al., 2020, 2022; Mihalopoulos et al., 2015). These approaches do not explicitly capture the impact of treatment on healthcare utilisation. Evaluating patterns of healthcare utilisation before and after treatment provides a more direct measure of change, offering a nuanced understanding of PTSD treatment effects over time and informing on the type of healthcare most relevant to economic evaluations over time.

International studies examining the impact of evidence-based PTSD treatment on service use have shown reductions in mental health-related services, including therapy sessions (Meyers et al., 2013; Tuerk et al., 2015) and urgent mental health care (Meyers et al., 2013), but no significant impact on primary care visits or emergency department admissions (Meyers et al., 2013). Importantly, differences in service availability, funding models, and healthcare system structures can impact access and use of different healthcare services, highlighting the need for country-specific data (von der Warth et al., 2020). To date, only one Australian study (Casey et al., 2023) has examined healthcare utilisation following CPT, reporting reductions in psychiatric triage service calls, episodes of care with mental health clinicians, hospital admissions, and total inpatient days.

However, no Australian study has examined the impact of CPT on primary or secondary healthcare services and medication use. Given the potential for PTSD treatment to reduce tertiary healthcare utilisation, understanding how CPT impacts use of primary and secondary care services following PTSD treatment represents a critical area to explore. Addressing these limitations through capturing full intervention costs and exploring downstream change in primary and secondary healthcare utilisation, provides a guide for PTSD researchers on what data needs to be collected in future PTSD research and what should be included in economic evaluations of PTSD treatments.

To address the gaps identified above, this chapter estimates the intervention delivery costs associated with providing Cognitive Processing Therapy (CPT) in a public health setting and explores primary and secondary healthcare utilisation pre- and post- CPT. The cost of delivering CPT was calculated to determine clinician investment costs and the per-client cost of therapy, providing an accurate estimate of the financial resources required for implementation in the Australian public healthcare system. Intervention costs included clinician time, training, and supervision, addressing a major limitation in previous evaluations, which have been unable to incorporate these costs. In the absence of a comparator or control group, changes in primary and secondary healthcare utilisation from pre- to post-intervention were assessed using a multiple-baseline interrupted time series (ITS) analysis. ITS is a robust quasi-experimental approach suited for evaluating interventions without randomisation, as it allows for the assessment of trends over time within a single group (Zhang et al., 2024). ITS offers several advantages over traditional pre-post comparisons as it can account for underlying pre-treatment trends, distinguishing the effect of CPT from natural fluctuations in service use over time, and identifying both immediate (step change) and long-term (slope change) effects, providing a more robust assessment of how treatment impacts use over time. While this statistical analysis is predominantly used to evaluate the impact of policy change, it has also been successfully applied in intervention-based research. For example, it has previously been used to evaluate a postnatal depression program (Hanbury et al., 2013) and more recently environmental modifications designed to reduce self-harm among adolescents in an

inpatient psychiatric ward (Reen et al., 2021), demonstrating its applicability to evaluating mental health interventions. As this was an exploratory study to provide information on potentially relevant change in costs, it was important to consider both mental health-related and non-mental health-related services and medications. Given evidence that CPT may influence mental health service use and medication use, we hypothesised a reduction in associated service use and costs from pre- to posttreatment. In contrast, no a priori hypothesis was made in relation to change in non-mental health-specific services due to mixed findings in Meyers et al. (2013) regarding their responsiveness to PTSD treatment. Capturing both costs and service utilisation is important because they can provide complementary insights into the impact of interventions. While costs may not always align with utilisation patterns due to factors such as funding or reimbursement rates, understanding both aspects allows for a more comprehensive evaluation of intervention effects. We aim to estimate the costs of delivering CPT in an Australian public healthcare setting and explore the downstream change in primary and secondary healthcare utilisation and cost. The methods, results, and discussion sections of this chapter will separately address intervention costs and healthcare utilisation in turn.

Methods

Intervention Delivery Costs

The cost of delivering CPT was estimated under two scenarios to reflect therapy costs as incurred in the trial (scenario B, as, outlined in chapter 4), and therapy costs if implemented within the Australian public healthcare system (scenario A). Costing assumptions were informed by established service delivery models, the results from our open trial outlined in chapter 4, and expert opinion from a researcher and clinical psychologist with 25 years experience in delivering PTSD treatment and facilitating numerous implementation studies in routine-clinical settings. For both scenarios, therapy costs included three categories: training, ongoing supervision and therapy delivery (see Table 5.1 for further details on these categories). The two scenarios differed in

supervision structure and workforce composition (as outlined below). Costs are reported in AUD2025.

Scenario A reflects standard practice in SA Health and the broader Australian public mental health setting, where supervision is provided internally (South Australia Health, 2024). It was assumed that therapy would be delivered by a mix of psychologists and social workers as these are the professions most commonly providing longer-term therapy in public services due to their workforce size and service scope (South Australia Health, 2022).

Scenario B represents trial conditions, where external expert supervision was provided. While external supervision may be accessed in public settings when internal expertise is insufficient or unavailable (South Australia Health, 2024), this is less common due to budget constraints. This scenario also reflects the mix of professional backgrounds of providers in the clinical trial, incorporating a multidisciplinary team, including psychologists, psychiatrists, social workers and mental health nurses, as detailed in detailed in Chapter 4.

Cost Valuation

Costs were assigned to clinician time using relevant published Australian public sector wage rates and included direct and indirect client time and attendance of training. Training costs were based on the required two-day CPT workshop, 13-hour online training module, and the therapy manual, using commercial rates from key provider charges available online. Internal supervision costs were estimated based on published public sector wage rates for supervision, and external supervision costs were informed by a clinician delivering CPT training and supervision (detailed below).

All costs were estimated from a healthcare system perspective. Per-client costs were calculated based on the observed average caseload (M = 3.43, SD = 1.87) in the trial. In the absence of published caseload benchmarks in this setting, clinician expertise was used to determine a feasible number of PTSD cases a clinician could manage within a standard clinical workload over the period of a year to inform a scenario analysis. Therefore, per-client costs were also calculated

for caseloads of 5 and 10 clients to assess the impact of varying service capacity. Moreover, training expectations for CPT is that for a clinician to be considered properly trained in CPT (i.e. acquire 'Provider Status' as per training guidelines) they had to have started at least 4 clients in the 6-month training/supervision period (CPT America, 2025; CPT Australia, 2025). Average hourly salary rates from publicly available sources were used to estimate costs for psychologists/Social Workers (AUD 48.26), mental health nurse (AUD 42.95), psychiatrists (AUD 119.69), registrar psychiatrists (AUD 69.63) and internal SA Health supervisors (AUD 57.12). Based on expert opinion that expert supervision would be provided by an Australian clinical psychologist recommended by CPT Australia for CPT training estimated to be AUD200.

CPT would be delivered at no cost to consumers in the Australian public healthcare system. Intervention costs that fall on the client such as travel time and opportunity costs of time were not considered.

Table 5.1

Descriptions of Costs Associated with the Delivering of Cognitive Processing Therapy in Australian Public Health Settings.

Training	Training costs were based on the minimum training expectation set by CPT Australia (CPT Australia, 2025) and their recommended training platforms including a two-day (16 hours) CPT workshop (inclusive of the training manual) and online CPTWeb training (13 hours). The recommended two-day workshop is provided by an Australian Clinical psychologist (with published costs of this program used here available online) and the online CPTWeb training provided by the Medical University of South Carolina (with published costs online; Medical University of South Carolina, 2025). This training expectation aligns with international training standards (CPT America, 2025).
Ongoing Supervision	The minimum training expectation set by CPT Australia includes 20 hours of group supervision consistent with international training expectations (South Australia Health, 2022). Group supervision is the preferred mode of supervision in SA Health due to the benefit of peer learning (supervision guide). While group supervision typically includes approximately 8 participants, an ideal group size of eight allows for more in-depth case discussions, particularly when clinicians are newly implementing CPT. Group supervision costs were therefore distributed among eight clinicians.
Delivering Therapy	
Direct client time	Direct client time refers to time spent in session with clients. A mean number of sessions for our ITT sample was 10.90 (SD = 5.82) and 15.16 (SD = 3.14) for completers. Therefore, we assumed that each client would receive 12 sessions of CPT to balance the typical treatment course while minimising the risk of underestimating costs.
Indirect client time	Indirect client time, referring to additional time spent on tasks outside of therapy sessions, was recorded through clinician-completed forms tracking time spent on these activities. This included CPT-related activities such as printing CPT-specific materials and reviewing the manual, excluding research-related tasks, and was estimated at 0.52 hours per session. Due to skewed data, the median time per session across 12 sessions in our open trial was used instead of the mean, as early sessions required more preparation while clinicians familiarised themselves with

CPT. Indirect client time decreased over the course of treatment, indicating improved efficiency. See Appendix F for a session-by-session time breakdown

Healthcare utilisation

Study Design

Multiple single group interrupted time series (ITS) analyses were conducted to examine changes in healthcare services and medication utilisation and associated costs in the 12 months before and after individuals received CPT. While there is no fixed minimum sample size recommendation for Interrupted Time Series (ITS) analysis, it is generally advised that multiple data points be collected before and after the intervention at each time point to ensure reliable trend estimation and minimise bias, which was achieved in the current sample (Bernal et al., 2017).

Data

Public healthcare services accessed by clients in the CPT open trial were linked from administrative Medicare records held by Services Australia, the Australian government agency responsible for delivering health, social and welfare services. Available services for linkage included those related to accessing publicly subsidised medical services including primary and secondary healthcare and those related to accessing publicly subsidised medications, detailed below. Data available captured the frequency and costs incurred by government associated with clients accessing services over a 12-month period prior to the commencement of CPT and for 12 months following treatment.

Medicare

As a brief reminder, Medicare is Australia's universal health insurance scheme, providing subsidised medical services through the MBS, and subsidised medication through the PBS to eligible Australians. Medicare subsidises a range of initiatives, including primary and secondary healthcare and prescription medications with additional services available for veterans through the Repatriation Medication Benefits Scheme (RPBS). RPBS provides subsidised medications to eligible veterans, war widows/widowers, and their dependents. It covers all PBS medications and includes additional medication for conditions common among veterans, such as chronic pain and mental health disorders.

Medicare subsidy rates vary across services impacting the out-of-pocket costs incurred to patients. Costs reported here relate to cost to government for each service. There are no out-of-pocket client costs for accessing CPT through public mental health services. The data analysed here represent administrative data held by Services Australia on medical services through the MBS and medication through the PBS and RPBS.

Medical Services

Medical services subsidised through the MBS include a wide range of medical, diagnostic, and allied health services. These include general practitioner (GP) consultations, referred specialist visits, diagnostic imaging, pathology tests, mental health care provided by referred psychologists or psychiatrists, and some surgical and therapeutic procedures provided in primary care. MBS items were categorised into those most relevant to mental health treatment using the same methodology as used by the Australian Institute of Health and Welfare (AIHW) in their report on the use of Medicare services and pharmaceuticals by mental health patients in Australia (Australian Institute of Health and Welfare, 2024). These items cover services provided by general practitioners, allied health providers, paediatricians, psychologists and psychiatrists. This administrative data does not record specific mental health condition that the individual is accessing the service for, other than for eating disorders, which have dedicated MBS item numbers due to their inclusion in specific funding initiatives, therefore, this categorisation relates to all mental health presentations. A detailed breakdown of these services categorised as mental health care is provided in Appendix G.

Medication Use

Subsidised prices are provided for medications listed on the PBS. Most PBS listed medications are dispensed through community pharmacies, but these are also accessible through private hospitals and eligible public hospitals for day patients or upon discharge (Australian Institute of Health and Welfare, 2024a). The PBS excludes over-the-counter medications, private prescriptions, or medicines provided to inpatients in public hospitals. Medication commonly prescribed for mental health conditions in Australia were identified using Anatomical Therapeutic

Chemical (ATC) codes for mental health conditions following the same methodology as used by the Australian Institute of Health and Welfare report on the Use of Medicare services and Medication by Mental Health Patients (Australian Institute of Health and Welfare, 2024b). ATC codes, developed by the World Health Organization, follow a hierarchical classification system to enable systematic identification and categorization of medications (Australian Institute of Health and Welfare, 2024c). Mental health related ATC codes include antipsychotics (N05A), anxiolytics (N05B), hypnotics and sedatives (N05C), antidepressants (N06A), and psychostimulants, including agents used for Attention-deficit/hyperactivity disorder (ADHD) and nootropics (N06B). These categories capture medications commonly prescribed for conditions such as schizophrenia, depression, PTSD, anxiety disorders, insomnia, and ADHD. See Appendix H for complete classification of mental health related ATC codes and specific PBS items within these. PBS and RPBS data were not analysed separately as both schemes share the same ATC codes and individuals eligible for RPBS also accessed PBS-listed medications

Statistical Analysis

Interrupted time series (ITS) analyses were conducted to examine the healthcare services and medication costs and utilisation for both mental health and non-mental health related services. These analyses were conducted for both the ITT and completer sample. Primary results are presented based on the ITT sample to ensure consistency with Chapter 4 and maintain sample size; completer analyses are provided in Appendix I. Records 12 months pretreatment and 12 months posttreatment were used to model trends and estimate the intervention's impact. Linear models were applied using the following general formula:

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 X_t T_t + \varepsilon_t,$$

Where:

- **Yt** represents each 30-day outcome (e.g., total costs of mental health related PBS scripts), measured at equally spaced 30-day intervals.

- **β0** indicates the baseline level of the outcome (i.e., cost or resource use) during the 12 months prior to commencing CPT
- **Tt** represents time in 30-day increments since the beginning of the study.
- **β1** reflects the trajectory or slope of the outcome variable during the pre-treatment period.
- **Xt** is a binary variable indicating the intervention period, coded as 0 for the pretreatment and 1 for the posttreatment.
- **β2** captures the immediate change in the outcome level (step effect) following the end of treatment, and
- **β3** reflects the change in the time trend (slope) over the post treatment period.
- **εt** is the random error term.

ITS analyses were conducted using RStudio (RStudio Team, 2023) using ordinary least squares (OLS) regression, and the Newey-West method to adjust standard errors for autocorrelation and heteroscedasticity that can impact ITS (Zhang et al., 2024). Time series were tested for stationarity using recommended methods including Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test (Hategeka et al., 2020).

A single counterfactual scenario was constructed for each outcome, based on the assumption that, in the absence of the intervention, outcomes would have continued to follow the trend observed in the 12-month pre-treatment period. This assumption is supported by evidence that PTSD typically follows a chronic course when left untreated, with spontaneous remission becoming increasingly unlikely after the first 3–7 years post-onset (Kessler et al., 2005; Steinert, 2015). Across participants receiving CPT in the current project, the average time since index trauma was 19.29 years (SD = 15.80), suggesting that most individuals had long-standing PTSD. It is therefore plausible that healthcare utilisation would have continued to follow the same pattern observed in the 12-month pre-treatment period. The estimated intervention effect was calculated by comparing the

observed post-treatment outcomes (cost, count) to the projected values under this counterfactual assumption.

In the absence of a universally agreed method for identifying outliers in interrupted time series analyses (e.g., Zhang et al., 2024), monthly box plots and interquartile ranges (IQR) were used to identify potential outliers. Retaining as many data points as possible is preferable in ITS analyses (Jandoc, 2015), therefore, a conservative approach was adopted. Each candidate outlier was examined individually to determine whether a specific health event contributed to the observed spike for a given time point (aggregated per month). If an observation was inconsistent with the typical pattern of use for the individual, it was removed. A modest number of outliers were removed across each model (<=2 monthly data points per model). Sensitivity analyses were conducted with and without the outliers. While the models were generally robust, mental health medical services analysis was sensitive to a single outlier observed in the month following treatment, linked to 13 episodes of care for a single participant related to transcranial magnetic stimulation (TMS) therapy resulting in a cost of AU$1500 for a single month. Consequently, this outlier was excluded, and all reported data are presented without outliers for consistency.

To quantify uncertainty, we applied a bootstrapping approach, drawing 1,000 resampled datasets with replacement and re-estimating for the ITS coefficients as well as the difference between the post-treatment and counterfactual outcome. The final impact estimates are presented as the mean effect with 95% confidence intervals.

Results

Intervention Delivery Costs

The estimated investment costs for implementing CPT within the Australian public healthcare system (Scenario A), including training and supervision, were AUD 3,461.08 per clinician, equating to AUD 1,265.69 per client based on a caseload of 3.43 clients per clinician (See Table 5.2). Scenario analyses for higher caseloads showed that per-client costs decreased to AUD 868.27 for a caseload of 5 and AUD 434.13 for a caseload of 10. Under trial conditions (Scenario

B; presented in Table 5.3), where external expert supervision and a multidisciplinary team provided treatment, clinician investment costs increased to AUD 4,097.09 per clinician, with per-client costs ranging from AUD 1,596.87 (caseload of 3.43) to AUD 547.72 (caseload of 10). In addition to delivery costs, indirect client time trended downward over the course of treatment. As a reminder, the session-by-session breakdown of indirect client time is provided in Appendix F.

Table 5.2

Scenario A: Breakdown of Costs for Delivering CPT.

	Hours	Rate (per hour)	Cost of clinician Investment	Cost Per Client Caseloads		
				3.43	5	10
Training						
Workshop						
Registration cost	-	-	895	260.93	179	89.50
Clinician time	16	48.26	772.16	225.12	154.43	77.22
Online training						
Access	-	-	58.54	17.07	11.71	5.85
Clinician time	13	48.26	627.38	182.91	125.48	62.74
Supervision						
Internal supervision	20	57.12	142.80	41.63	28.56	14.28
Clinician time	20	48.26	965.2	281.40	193.04	96.52
Delivering therapy						
Direct client time	12	48.26	-	168.83	115.82	57.91
Indirect client time	6.24	48.26	-	87.80	60.23	30.11
Total			3,461.08	1,265.69	868.27	434.13

Note. Scenario A conditions assume that treating clinicians are psychologists or social workers, with supervision provided by an SA Health supervisor.

Table 5.3

Scenario B: Breakdown of Costs for Delivering CPT.

	Hours	Rate ($ per hour)	Cost per clinician	Cost Per Client at Different Caseloads		
				3.43	5	10
Training						
Workshop						
Registration cost	-	-	895	260.93	179	89.50
Clinician Time	16	53.95	863.20	251.66	172.62	86.32
Online training						
Access	-	-	58.54	17.07	11.71	5.85
Clinician time	13	53.95	701.35	204.48	140.27	70.14
Supervision						
External supervision	20	200	500	145.77	100	50
Clinician time	20	53.95	1,079	314.58	215.80	107.90
Delivering therapy						
Direct client time	12	53.95	-	314.58	215.80	107.90
Indirect client time	6.24	53.95	-	87.80	60.23	30.11
Total			4,097.09	1,596.87	1,095.43	547.72

Note. Scenario B conditions reflect those of the open trial, involving a mix of professionals providing treatment, with the hourly rate calculated as a weighted average based on the proportion of each professional group delivering treatment. Supervision was provided by a CPT expert.

Healthcare utilisation

Of the 72 participants in the open trial, 63 consented to linking their MBS, PBS, and, where applicable, RPBS records. Table 5.4 presents descriptive statistics on utilisation and costs across healthcare services and medications for the 12 months before and after CPT in the ITT sample, with completer data available in Appendix H. An overview of the descriptive data is provided below, followed by the ITS results.

Table 5.4

Healthcare and Medication Access, Utilisation and Cost (2024AUD) 12 Months Pre and Post CPT.

		Before Treatment			After Treatment			
ITT sample	Number of clients who accessed at least one service or script (%)	Total number of service contacts or scripts	Total cost (AUD)	Mean cost per client (SD)	Total Number of service contacts or scripts	Total cost (AUD)	Mean cost per client (SD)	Number of clients with reduction in cost pre to post (%)
Services								
Mental health related	38 (60)							
Benefit paid		248	27,501	437 (687)	149	15,503	246 (489)	28 (44)
Non mental health related	62 (98)							
Benefit paid		2,090	112,235	1,782 (1931)	1,638	94,533	1,501 (1769)	39 (62)
Medication								
Mental health related	54 (86)							
Benefit paid		1,043	14,697	233 (425)	823	15,453	242 (554)	31 (49)
Non mental health related	54 (86)							
Benefit paid		1,511	42,810	680 (1228)	1576	44,785	710 (1258)	28 (44)
Total Medicare expenditure		4,892	197,243		4,186	170,274		

Descriptive statistics

Mental Health Related Care

Overall, there was a decline in mental health related Medicare services and costs following CPT, with 240 services recorded prior to CPT compared to 136 post-CPT associated with lower costs post-CPT from $26,510 to $13,921. Similarly, fewer prescriptions were recorded in the 12 months following CPT compared to the 12 months prior but there was a slight increase costs.

Non Mental Health Related Care

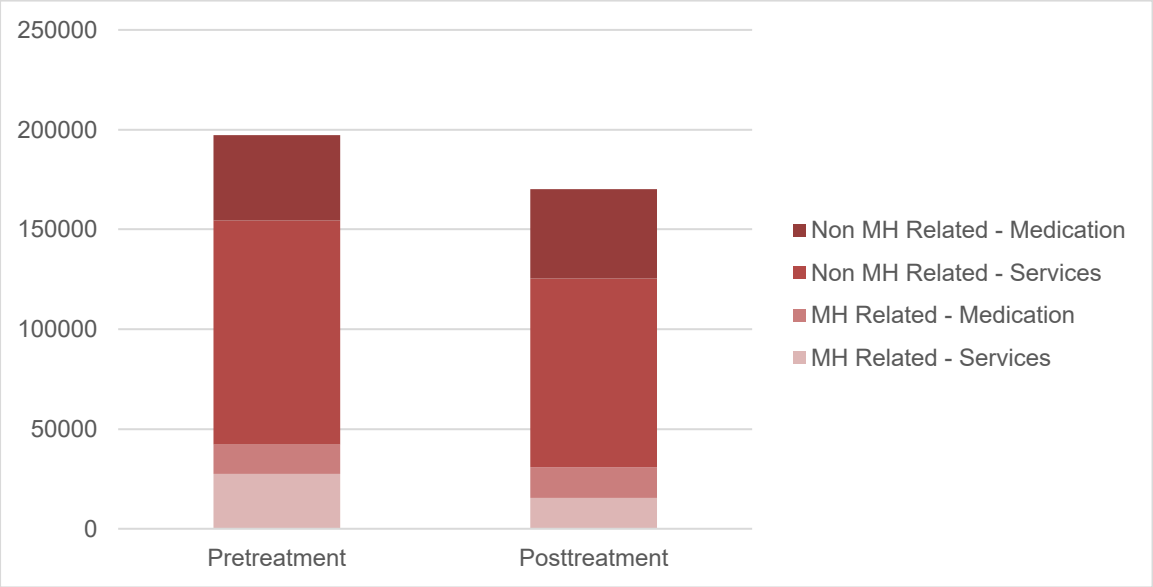
Overall, there was a decline in the number of non-mental health related services and their associated costs to both government and individuals in the 12 months post CPT compared to the same interval prior to CPT. There was very little change in the number of scripts before and after CPT, with slightly higher government expenditure and slightly lower individual contributions toward non mental health related scripts in the 12 months following CPT compared to the 12 months before CPT.

Overall Medicare Cost and Utilisation

Figures 5.1 and 5.2 display total Medicare costs and utilisation, respectively, before and after CPT treatment for Mental health and Non mental health data. The figures show that overall reductions in costs and utilisation were primarily driven by decreases in healthcare services rather than medication. Given the limitations of simple pre-post comparisons in accounting for underlying trends, an Interrupted Time Series (ITS) analysis was conducted to better distinguish the effect of CPT from underlying trends and confounders.

Figure 5.1

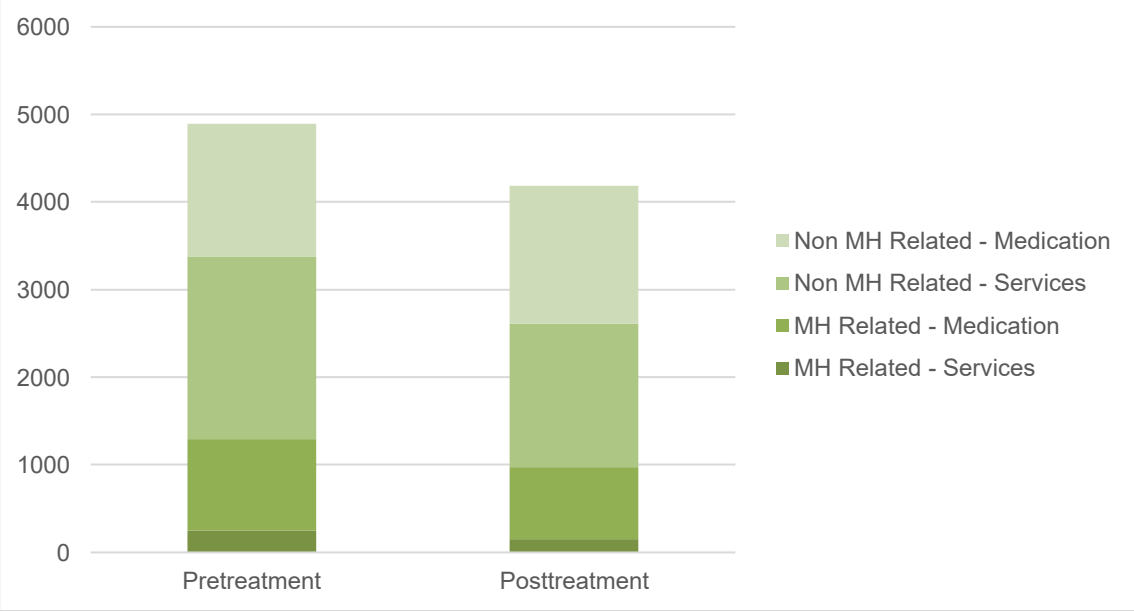
Total Medicare Costs 12 Months Pre and Post CPT Treatment.



Note. MH, Mental Health.

Figure 5.2

Total Medicare Utilisation (service contacts or number of scripts) 12 Months Pre and Post CPT Treatment.



Note. MH, Mental Health.

Interrupted Time Series (ITS) Analyses[4]

Mental health-related services

The results of the series of ITS analyses are summarised in table 5.7. The ITS analysis demonstrated a significant immediate reduction in mental health-related healthcare use and associated costs following CPT. Specifically, there was an immediate decrease of 0.62 episodes of care (β_2 = -0.61, 95% CI [-0.92, 0.30], $p < 0.01$), corresponding to a reduction of $85.39 in mental health service expenditures in the month after treatment (β_2 = -85.39, 95% CI [-120.78, -48.08], $p < 0.01$). However, there was no significant change in the post-treatment trajectory for either service use (β_3 = 0.02, 95% CI [-0.01, 0.05], p = 0.34) or costs (β_3 = 3.88, 95% CI [0.21, 6.99], p = 0.12), indicating that the initial reduction was maintained rather than continuing to decline further.

In contrast to healthcare services, medication costs for mental health-related medications did not significantly change post-treatment (β_2 = 25.16, 95% CI [4.17, 48.03], p = 0.06). The post-treatment trend also remained stable (β_3 = -1.64, 95% CI [-2.98, -0.21], p = 0.06). However, there was a significant immediate increase in mental health-related medication utilisation post-treatment, indicating an increase of 1.66 scripts filled the month after treatment (β_2 = 1.66, 95% CI [0.65, 2.81], $p < 0.01$). This was followed by a significant downward trend over time (β_3 = -0.14, 95% CI [-0.22, -0.07], $p < 0.01$).

Non-Mental Health-Related Services

For non-mental health-related healthcare services, no significant changes in costs were observed following CPT (β_2 = -$77.50, 95% CI [-175, 21.61], p = 0.25). Similarly, no significant change in healthcare service utilisation was observed (β_2 = -1.24, 95% CI [-2.51, 0.15], p = 0.23).

For non-mental health-related medication, there was a significant immediate increase in prescription volume (β_2 = 2.73, 95% CI [0.88, 4.79], p = 0.03), though the post-treatment trend

[4] Completer analyses yielded results consistent with those observed in the ITT sample. A table summarising descriptive statistics and ITS outcomes is provided in Appendix I.

change was not statistically significant (β_3 = -0.16, 95% CI [-0.28, -0.05], p = 0.07) suggesting this use remained stable overtime.

Table 5.5

ITS Analysis of Cost and Utilisation for Healthcare services and Medication Pre and Post CPT, Including Counterfactual Estimates.

Healthcare Cost		Coefficient (95% CI)	*p* value	Counterfactual and posttreatment estimated difference
Healthcare Services				
Mental health related				-6259.02 (-9,059, -3178)
Outcome 12 months before tx	$\beta 0$	64.04 (42.35, 80.22)	7.12	
Trend before tx	$\beta 1$	-120 (-3.36, 2.24)	0.52	
Level change post-tx	$\beta 2$	-85.39 (-120.78, -48.08)	<0.01**	
Slope change post-tx	$\beta 3$	3.88 (0.21, 6.99)	0.12	
Non mental health related				-5315 (-16,832, 7157)
Outcome 12 months before tx	$\beta 0$	159.78 (126.1, 195.9)	1.84	
Trend before tx	$\beta 1$	-1.82 (-6.80, 2.74)	0.60	
Level change post-tx	$\beta 2$	-77.50 (-175, 21.61)	0.25	
Slope change post-tx	$\beta 3$	3.80 (-2.90, 11.08)	0.45	
Medication				
Mental health related				-3636.56 (-5982, -1011)
Outcome 12 months before tx	$\beta 0$	14.21 (8.25, 20.83)	5.50	
Trend before tx	$\beta 1$	0.40 (-0.62, 1.39)	0.47	
Level change post-tx	$\beta 2$	25.16 (4.17, 48.03)	0.06	
Slope change post-tx	$\beta 3$	-1.64 (-2.98, -0.21)	0.06	
Non mental health related				
Outcome 12 months before tx	$\beta 0$	47.59 (26.88, 71.12)	<0.001***	-10,465.54 (-18, 995, -779)
Trend before tx	$\beta 1$	1.10 (-1.94, 4.02)	0.53	
Level change post-tx	$\beta 2$	67.17 (-6.80, 151.09)	0.16	
Slope change post-tx	$\beta 3$	-4.39 (-9.20, 0.27)	0.15	

Healthcare service utilisation		Coefficient (95% CI)	*p* value	Counterfactual and posttreatment estimated difference
Healthcare Services				
Mental health related				-127.20 (-153.50, -96.50)
Outcome 12 months before tx	$\beta 0$	0.49 (0.36, 0.62)	1.06	
Trend before tx	$\beta 1$	0.002 (-0.02, 0.02)	0.87	
Level change post-tx	$\beta 2$	-0.61 (-0.92, -0.30)	<0.01**	
Slope change post-tx	$\beta 3$	0.02 (-0.01, 0.05)	0.34	
Non mental health related				-326.00 (-483.40, -147.40)
Outcome 12 months before tx	$\beta 0$	2.90 (2.32, 3.40)	2.47	
Trend before tx	$\beta 1$	-0.02 (-0.10, 0.06)	0.71	
Level change post-tx	$\beta 2$	-1.24 (-2.51, 0.15)	0.23	
Slope change post-tx	$\beta 3$	0.04 (-0.06, 0.14)	0.58	
Medication				-650.45 (-771.4, -518.90)
Mental health related				
Outcome 12 months before tx	$\beta 0$	1.18 (0.84, 1.56)	2.33	
Trend before tx	$\beta 1$	0.04 (-0.02, 0.11)	0.14	
Level change post-tx	$\beta 2$	1.66 (0.65, 2.81)	<0.01**	
Slope change post-tx	$\beta 3$	-0.14 (-0.22, -0.07)	<0.01**	-172.94 (-409.5, 89.2)
Non mental health related				
Outcome 12 months before tx	$\beta 0$	1.79 (1.29, 2.31)	3.51	
Trend before tx	$\beta 1$	0.03 (-0.5, 0.11)	0.64	
Level change post-tx	$\beta 2$	2.73 (0.88, 4.79)	0.03*	
Slope change post-tx	$\beta 3$	-0.16 (-0.28, -0.5)	0.07	

Note. CI, Confidence Interval.

Counterfactual Scenario

The counterfactual scenario assumes that pre-treatment trends would have continued without intervention, and these estimates were compared to the actual observed post-treatment trends. Table 5.5 presents the estimated differences in costs and utilisation between the counterfactual and observed data. Results indicate that if pre-treatment trends had persisted, healthcare service use and associated costs—across both mental health and non-mental health domains—would have been higher over the 12-month post-treatment period compared to the CPT treatment.

Discussion

This study provides one of the first comprehensive estimates of the investment costs associated with using Cognitive Processing Therapy (CPT) in the Australian public healthcare system, alongside an evaluation of its impact on healthcare utilisation and costs. Training and supervision costs represented a significant portion of total investment, with per-client costs decreasing as clinician caseloads increased. While both costing scenarios produced comparable estimates, the model reflecting standard public healthcare delivery—where internal supervision was provided and psychologists or social workers delivered treatment—was associated with lower costs. Observed change in healthcare utilisation was primarily driven by reductions in mental health-related services following CPT, while medication use—across both mental health and non-mental health categories—showed a more variable pattern. These findings will now be discussed in turn, in relation to existing literature and their implications for the inclusion of these costs in future economic evaluations and service planning.

Intervention Delivery Costs

Our estimate of treatment costs for CPT provides an Australian-specific estimate incorporating clinician wages and service structures, ensuring relevance for budget impact assessments and economic evaluation in the Australian public health setting. Comparisons to previous evaluations remain challenging, as no published CPT-specific training cost estimates exist—certainly not within the models reviewed in Chapter 2. However, as discussed in Chapter 2,

Shearer et al. (2018) conducted a scenario analysis assessing the impact of including training costs for TF-CBT for children, a therapy with similar principles to CPT but with fewer structured training requirements. While the breakdown of training cost inputs was not reported, they found that incorporating these substantially increased the incremental cost-effectiveness ratio (ICER) from £2,205 to £16,187 per QALY (Shearer et al., 2018). Although the intervention remained within acceptable cost-effectiveness thresholds, it is unclear whether the same would apply to CPT, given differences in how these costs are considered in economic models. For example, Shearer et al. (2018) amortized training and supervision costs over five years, assuming an annual client caseload of 29, which aligned with their trial recruitment. However, in an Australian public health setting, potentially high staff turnover (Haywood et al., 2023) suggests that training and supervision costs could be incurred more frequently, rather than being amortized over an extended period. If these costs were incorporated into economic evaluations as ongoing expenses rather than spread over multiple years, they could substantially influence cost-effectiveness conclusions, potentially altering decisions about implementation. Therefore, it is critical that economic evaluations account for real-world service delivery conditions, including workforce retention and ongoing training needs, to ensure their findings remain policy-relevant.

A strength of this study is its inclusion of clinician preparation and administrative time, which has been cited as a barrier to adopting evidence-based treatments (Forbes et al.). Notably, preparation time declined across sessions, suggesting improved delivery efficiency with clinician familiarity. Moreover, a key source of uncertainty in our cost estimates was clinician caseload variability, with higher caseloads reducing per-client costs. Client recruitment difficulties in our open trial resulted in unutilised training investments, as some clinicians did not provide therapy. These costs are important to consider if examining implementation of CPT at scale as they could potentially reduce cost-effectiveness. Caseload variability was observed both within and across services, highlighting the need for future research to explore factors such as service preferences and referral pathways to improve delivery rates. Additionally, workforce capacity and staff turnover

data in public mental health settings would provide more accurate cost estimates and improve implementation planning. Collecting these data would enhance the quality and applicability of economic evaluations, ensuring that cost projections reflect real-world service delivery challenges. Targeted workforce planning and integrated referral pathways could enhance CPT implementation in public mental health settings. Establishing trauma-focused teams and structured referral systems—akin to South Australia's Borderline Personality Disorder Collaborative (BPDCo; South Australian Government, n.d.) and the NHS Talking Therapies for Anxiety and Depression program (previously known as IAPT; National Health Service England, n.d.)—could address these challenges by centralising training and supervision, ensuring consistent caseloads, and improving resource allocation efficiency. This model could enhance cost-effectiveness while supporting the sustained implementation of Cognitive Processing Therapy (CPT) in public mental health settings.

> Costing is a critical factor in implementation, particularly for public mental health settings operating under constrained budgets, where accurate cost estimates are essential for sustainable service delivery and policy decision-making (Bowser et al., 2021). Given the variability in implementation costs beyond direct service delivery, these should be incorporated into economic evaluations and budget impact analyses. Our findings suggest that some costs may decrease over time, but further research is needed to assess long-term implementation costs, particularly in the context of clinician turnover in public mental healthcare. Reducing costs over time could support broader adoption of CPT, especially if training efforts align with service demand and structured referral pathways improve clinician engagement and efficiency in delivering evidence-based PTSD treatments.

Healthcare Utilisation

There is limited research on how evidence-based PTSD treatments impact healthcare use, specifically primary and secondary care, and associated costs in Australia. As such, this exploratory study used an Interrupted Time Series (ITS) approach to examine change in service use and costs following CPT in a public health setting. This approach was used to capture within-participant

change over time given the absence of a comparator group, common to mental health intervention evaluation (Franklin et al., 2020). Our results indicated an immediate reduction in mental health-related service use and costs post-treatment, while medication use had an immediate increase before trending downward. In contrast, non-mental health services showed no significant changes in service use or costs, except for a sustained increase in medication utilisation post-treatment. Finally, compared to the counterfactual projection (i.e., if pre-treatment trends had continued), CPT was associated with cost savings and greater reductions in service use across all categories.

The immediate post-treatment decline in mental health-related healthcare utilisation and costs suggests that, on average, 0.60 fewer services were accessed, with an associated AUD85 cost incurred post-treatment across all individuals accessing care. However, the absence of a sustained downward trend indicates that further reductions in service use did not occur over time. Moreover, 40% of individuals did not any of the listed services in the intervals under study, possibly due to the financial barriers associated with accessing these streams of care, rather than a lack of clinical need. These findings are consistent with reports that the Better Access Initiative, which provides Medicare-subsidised mental health services through the Medicare Benefits Schedule (MBS), may be underserving disadvantaged populations (Pirkis et al., 2022). This is likely due to rising out-of-pocket costs for non-public services, such as GPs, psychologists, and psychiatrists, who are the primary providers of care under the Better Access Initiative (Pirkis et al., 2022). These findings raise questions regarding whether primary and secondary mental health services should be considered key cost components in economic evaluations of PTSD treatment in public healthcare settings. Clinically, these findings raise concerns about the continuity of care after treatment in public mental health settings. However, it is possible that clients continued mental health care through publicly funded community-based services, which were not captured in this study. Although some evidence suggests that publicly funded tertiary healthcare use decreases following CPT in Australian public health settings (Casey et al., 2023), further research is needed to track

service utilisation across all public healthcare sectors for a more comprehensive understanding of post-treatment service use.

Whilst mental health-related medication costs did not increase post CPT, there was an immediate increase of 1.66 prescriptions filled. One explanation for this is that individuals may have become more adherent to prescribed medications because of treatment—potentially reflecting increased motivation to maintain mental health gains or improved psychiatric monitoring within multidisciplinary teams. Prior research suggests that large reductions in PTSD symptoms are associated with higher adherence to antidepressant medication, highlighting the potential impact of PTSD treatment on pharmacological adherence (Salas et al., 2020). Given that most public mental health services include multidisciplinary teams with psychiatrist-led medication management (South Australia Health, 2022), it is possible that individuals were encouraged to continue pharmacological treatment as part of ongoing care, though this was not captured within the current study. While PTSD guidelines only recommended medication for those who do not fully respond to psychological therapies alone (Phoenix Australia, 2020), its continued use may reflect broader clinical considerations, such as the management of comorbid conditions.

The observed step increase in medication use was not associated with a step increase in medication costs, possibly due to increased scripts representing lower cost medication. Importantly, these findings highlight how funding structures and reimbursement policies can influence administrative costing data. While utilisation trends provide valuable clinical insights (e.g., informing clinicians about treatment impacts), cost remains the primary focus of economic evaluation. Providing utilisation data alongside costing data enhances applicability of findings by enabling international comparisons and allowing country-specific costing models to be applied to the data, ensuring findings remain relevant across different healthcare systems. This reinforces the importance of evaluating both utilisation and expenditure to generate more relevant and transferable evidence. Moreover, even if costs remain stable, reductions in service use can alleviate financial strain (e.g., fewer out-of-pocket expenses) and reduce patient burden (e.g., less time spent visiting

pharmacists) representing clinically relevant information. These findings highlight the value of capturing both cost and utilisation data to inform more comprehensive economic evaluations.

No significant changes were observed in the use or cost of healthcare for non-mental healthcare following CPT, consistent with prior work that reported that mental health interventions primarily affect mental health-specific service use rather than broader healthcare utilisation (Meyers et al., 2013). However, medication utilisation for non-mental health conditions increased by 2.73 prescriptions post-treatment. A possible explanation for these findings could be increased adherence. PTSD has been linked to lower adherence to medications for chronic medical conditions (Taggart Wasson et al., 2018), a notable consideration given the high rates of comorbid medical conditions in this cohort (see table 4.4, Chapter 4). Evidence suggests that individuals who experience greater PTSD symptom improvement are more likely to report higher adherence rates (Salas et al., 2020), a pattern also observed in other clinical populations. For example, reductions in depressive symptoms have been associated with improved medication adherence among cardiac patients (Bauer et al., 2012). CPT is designed to improve cognitive flexibility and reduce avoidance. This includes reducing biased cognitions and avoidance of emotions, memories, and objectively safe situations that provoke distress. It is plausible that PTSD symptom improvement may lead to better health management, including adherence to medical treatments, by equipping participants with healthier thinking patterns and improved coping to tackle other health issues. However, an increase in prescriptions does not necessarily indicate improved adherence. It may also reflect changes in prescribing practices, greater willingness to seek medical care, or increased provider attention to physical health needs following treatment.

A strength of this study was the use of interrupted time series (ITS) analysis, which provided a more rigorous assessment of healthcare utilisation changes following PTSD treatment. Thus, providing a detailed exploratory approach to inform subsequent approaches to analysis of healthcare data. Existing evaluations have predominantly relied on hierarchical linear modelling (HLM; Tuerk et al., 2015), linear mixed-effects modelling (LMM; Casey et al., 2023), repeated-measures

ANOVA (Tuerk et al., 2015, Meyer et al., 2013), or non-parametric pre-post-tests (e.g., Wilcoxon signed-rank tests; Meyer et al., 2013). While these methods estimate aggregate pre-post differences, they do not account for underlying trends or distinguish between immediate and sustained changes. In contrast, ITS offers a more robust framework by capturing both the initial step change and longer-term trajectory while adjusting for pre-existing trends (Bernal et al., 2016). This distinction is important as simple pre-post comparisons may overestimate long-term cost savings by failing to account for natural fluctuations in service use. Some outcomes remained stable over the 12-month post-treatment period, while others, such as medication use, showed a gradual decline, raising the question of whether this trend would have continued with longer follow-up. Future research should extend follow-up periods (e.g., 12, 18, and 24 months) to better differentiate short-term effects from long-term stabilisation or delayed changes.

Despite the advantages of ITS, the wide confidence intervals observed in both the ITS results and counterfactual estimates highlight substantial variability in cost and utilisation outcomes. Although bootstrapping improved estimate precision, some uncertainty remains. The inclusion of a control group—such as an untreated or treatment-as-usual comparison—would strengthen causal inferences by distinguishing intervention effects from broader system-wide trends. However, in implementation-based research, where control groups are often unavailable, particularly for mental health programs, ITS remains a more reliable approach than alternative pre-post methods due to its ability to adjust for pre-existing utilisation patterns and should be prioritised in future studies.

Several limitations should be acknowledged. First, the sample size was relatively small, particularly for mental healthcare related services, where a large proportion of individuals used no services before or after treatment. A larger dataset could enable subgroup analyses, allowing for examination of demographic or clinical predictors of cost changes (e.g., age, gender, PTSD severity). Second, the categorisation of healthcare and medication services must be considered. By considering all relevant services, this approach ultimately captures overall mental health service utilisation rather than PTSD-specific care. Under Medicare, access to most mental health services—

including GP visits, psychology, and psychiatry consultations—does not require a specific diagnosis to be recorded, making it impossible to isolate PTSD-related care. However, certain conditions, such as eating disorders, have dedicated MBS item numbers due to their inclusion in specific funding initiatives. This distinction allows for more precise identification of eating disorder-related care but is not available for PTSD or most other mental health conditions. This challenge in categorisation is particularly relevant for medication costs, as SSRIs are the first-line treatment for PTSD but are also widely prescribed for depression and anxiety disorders (Australian Institute of Health and Welfare, 2024). Given that 80% of the cohort had a mood disorder (e.g., depression, bipolar disorder) and 54% had an anxiety disorder, it is difficult to determine the extent to which medication use was specifically for PTSD rather than for the management of comorbid conditions. Additionally, the analysis was limited to Medicare-funded services, excluding tertiary care—where reductions have been observed following CPT treatment (Casey et al., 2023)—as well as private and community-based services.

In summary, this study provides preliminary evidence that evidence-based PTSD treatments, specifically CPT delivered in an Australian public health setting, are associated with reductions in mental health-related service use and costs. The lack of significant changes in non-mental health service use suggests that the impact of PTSD treatment is primarily confined to mental health care. These findings complement previous Australian research showing reductions in tertiary healthcare use following PTSD treatment, highlighting the need to consider service use across primary, secondary, and medication-related mental health care in future research. Further investigation is also required to assess whether these reductions extend to community-based services. Despite the limitations identified, this study contributes to the growing evidence on the economic benefits of PTSD treatment and highlights the importance of integrating both clinical and cost-related outcomes in mental health care research.

CHAPTER 6:

General discussion

This thesis aimed to improve our understanding and enhance the rigour, comparability, and policy relevance of economic evaluations of psychological PTSD treatments by addressing key limitations in the existing literature. Specifically, I investigated three critical areas: (1) the methodological quality and consistency of model-based economic evaluations through a systematic review, (2) the suitability of the AQoL-8D, a commonly used quality-of-life instrument, for PTSD economic evaluations, and (3) the clinical effectiveness of Cognitive Processing Therapy (CPT) within public mental health settings through an open trial to initiate documentation of key data needed for economic evaluation, including treatment costs and healthcare utilisation. By addressing these gaps, this thesis provides a foundation for more methodologically consistent economic evaluations that better reflect real-world clinical practice. Strengthening the intersection between clinical and economic perspectives will support more reliable evidence to inform funding decisions, ensuring that PTSD treatments are evaluated in a way that captures both their clinical effectiveness and economic impact within the Australian healthcare context. Ultimately, it is hoped these efforts will lead to system and policy improvements that will result in greater access to and uptake of evidence-based PTSD treatments, ensuring that individuals receive effective care supported by robust economic evidence.

Summary of Findings

In Chapter 2, a systematic review was conducted to explore model structures and inputs of model-based economic evaluations of PTSD treatments, highlighting substantial methodological variability across studies. Differences in model structures, cost inputs, and outcome measures limited comparability and relevance to decision-makers. A major finding was the frequent omission of key implementation costs, including training and supervision, as well as inconsistent approaches to the conceptualisation of PTSD and characteristics relevant for economic evaluations (i.e., natural course of PTSD symptoms, treatment pathways, and measurement of outcomes) within the model.

These limitations highlight the need for greater collaboration with clinicians to define appropriate model structures and parameters for economic evaluations of PTSD treatments. Strengthening this engagement can support the development of more standardised and clinically relevant economic models, ultimately improving the consistency and applicability of future evaluations.

The psychometric study detailed in Chapter 3 evaluated the suitability of the AQoL-8D to capture change in PTSD symptoms, providing critical information in relation to its appropriateness for economic evaluations. The findings indicated that while the AQoL-8D captured several aspects of PTSD, it was less responsive to treatment-related changes compared to the PCL-5. This raises concerns about the adequacy of this instrument in PTSD research and highlights the need for further validation of GPQoL measures in this population, as well as comparisons across disorders to assess their relative sensitivity of capturing treatment change. The findings suggest that economic evaluations relying solely on QALY outcomes, informed by GPQoL measures, may risk underestimating the benefits of PTSD treatments, potentially leading to an underestimation of positive economic outcomes for delivering these treatments. Nonetheless, these instruments remain the gold standard for measuring quality of life—and thus QALYs—in economic evaluations, but these findings highlight the need for ongoing refinement and further investigation to enhance their sensitivity and accuracy, particularly in PTSD populations.

The open trial examined the clinical effectiveness of CPT and investigated key data for economic evaluation, including treatment costs and healthcare utilisation, within the Australian public mental health system (Chapters 4 and 5). Significant reductions in PTSD symptoms and improvements in quality of life were observed, adding further support to existing evidence (Casey et al., 2023; Forbes et al., 2012; Öst et al., 2023) for its implementation in routine care. In light of the omission of previous research reporting important types of clinical outcomes (highlighted in Chapter 2,) the study also examined relapse rates, revealing that those who demonstrated a treatment response (i.e., reliable reduction of symptom change) or achieved good end-state

functioning post-treatment did not relapse, whereas 25% of individuals who simply fell below the cut-off used as the diagnostic threshold at posttreatment had probable PTSD at follow-up. The treatment seeking sample in the open trial were characterised by significant complexity, reflected in the utility values which indicated they had extremely low scores at baseline relative to values reported for those with PTSD in prior Australian economic evaluations (Gospodarevskaya & Segal, 2012; Mihalopoulos et al., 2015), though treatment-related improvements were comparable. In line with the aims of this thesis, costs related to delivering therapy and health utilisation were captured. The cost analysis identified that clinician caseloads, supervision structures, and professional roles as key cost determinants, emphasising the need for strategic investment to enhance the long-term cost-effectiveness and scalability of CPT within the public healthcare system. Changes in healthcare utilisation were primarily driven by reductions in mental health-related services following CPT, while medication use—across both mental health and non-mental health categories—showed a more variable pattern. Despite this variability, these findings highlight that Medicare-funded services should be accounted for in economic evaluations of PTSD cohorts in Australia. The broader implications of key findings from my program of research will now be discussed with further recommendations for the field.

Methodological Learnings and Implications

This thesis highlights the need for greater standardisation in PTSD economic evaluations, which can be addressed through the development of a reference model —a structured economic framework that defines key assumptions, cost components, and treatment pathways specific to PTSD, to improve consistency and comparability across evaluations. Without a structured framework, inconsistencies in model structures, cost components, and variability in the assumed trajectory of PTSD will lead to unreliable cost-effectiveness estimates, limiting their use in real-world decision-making. Health technology assessment bodies, such as the National Institute for Health and Care Excellence (NICE), Pharmaceutical Benefits Advisory Committee (PBAC), Medical Services Advisory Committee (MSAC) have recognised reference models as essential for

improving comparability, transparency, and reliability in economic evaluations (Australian Government Department of Health, 2017; Lee et al., 2024; Pharmaceutical Benefits Advisory Committee, 2016). My findings from Chapter 2 offer a starting point for developing such a model, which should assist in advancing the PTSD field in future evaluations. For example, by identifying the range of structural assumptions and parameter inputs used across existing economic models, these findings can inform a structured Delphi process for clinicians and health economists to achieve consensus on best practice modelling approaches, as seen in other health conditions —an approach successfully applied in other health conditions, such as Chronic Obstructive Pulmonary Disease (Tabberer et al., 2017), frailty (Haji Ali Afzali et al., 2019), and multiple myeloma (Gonzalez-McQuire et al., 2019). Presenting the minimum and maximum ranges of key model parameters and structures in iterative rounds of expert consultation would facilitate the development of a clinically and economically robust reference model. Engaging clinicians in this process is essential, as it ensures that economic evaluations align with real-world treatment pathways, ultimately supporting more consistent and policy-relevant assessments of PTSD interventions.

Another key issue identified in this thesis was the limited sensitivity of the AQoL-8D in capturing PTSD-related treatment effects, raising questions about its suitability for economic evaluations in this population. While this study did not include direct comparisons with other GPQoL measures, the AQoL-8D was designed to be more responsive to general mental health outcomes compared to other GPQoL measures (Maxwell et al., 2016; Richardson et al., 2014). Its limited sensitivity to PTSD-related changes raises broader concerns about the adequacy of GPQoL measures for this population. As such, future research should explore whether modifying existing instruments or developing new preference-based measures could better capture PTSD treatment effects in economic evaluations. One potential solution is the use of *bolt-on* approaches, where condition-specific items are appended to existing instruments to improve their sensitivity—an approach that has been explored in relation to depression and general mental health concerns (Rencz & Janssen, 2024) as well as physical conditions such as vision and hearing problems (Yang

et al., 2015; Finch et al., 2021), but no studies have yet examined PTSD-specific adaptations. However, bolt-on approaches are limited in their comparability across disorders, which may limit their broader applicability. To address this issue, an alternative approach is the use of instruments specifically developed for mental health populations. One such example is the Recovering Quality of Life measure (ReQoL; Keetharuth et al., 2018) which was designed to capture domains that are meaningful to individuals recovering from mental health conditions, including activity, hope, belonging and relationships, self-perception, well-being, autonomy, and physical health. As such, this measure may offer improved sensitivity to PTSD-related change and other complex mental health presentations. Continued research is needed to evaluate these options and ensure that QALY-based outcomes meaningfully capture treatment benefits for individuals with PTSD.

Advancing such measurement research will take time; in the interim, a dual-reporting approach is suggested. Economic evaluations should present both condition-specific effectiveness metrics (i.e., cost-effectiveness analysis) alongside QALY-based outcomes (i.e., cost-utility analysis) to capture both clinical impact and broader economic value. Given that GPQoL measures currently represent the best available method for deriving QALYs - and that efforts to improve their sensitivity will take time - their continued use remains the most viable option for generating economic outcomes. By using GPQoL measures alongside more sensitive, condition-specific measures, this approach maintains methodological rigour and practical relevance, supporting informed decision-making. This approach also improves the digestibility of findings for clinicians and service managers who may be less familiar with utility-based measures and their interpretation. Ultimately, this dual approach ensures results are not solely dependent on GPQoL measures that may underrepresent treatment benefits in people severely affected by PTSD, while further research advances the field toward more sensitive and standardised measures for PTSD economic evaluation.

A long-term objective for the field should be to increase the number and quality of PTSD economic evaluations, however in the meantime, a critical first step is ensuring that relevant data are systematically collected by the clinical research community. By embedding key economic

variables (e.g., GPQoL measures, healthcare utilisation data) into routine clinical trials and observational studies, future evaluations can be conducted retrospectively or serve as a data source for economic models. Over time, this will enable a more detailed understanding of PTSD treatment outcomes, capturing variations in response, cost-effectiveness, and service needs across different PTSD cohorts, ultimately strengthening the evidence base to inform economic evaluations. Chapter 4 and 5 offer a framework for clinical researchers and clinicians to use when considering the collection and reporting of economic data, a framework that was not readily available in the context of PTSD at the outset of this thesis.

Importantly, documenting the broader methodological challenges encountered in Chapters 4 and 5 may help guide future studies examining the economic aspects of PTSD treatment, particularly regarding the difficulties in collecting healthcare administrative data. The fragmentation of healthcare funding across different levels of government (e.g., federal, state, and territory governments, as well as private and community-based services; Peiris et al., 2024) is mirrored in disparate healthcare data systems, where Medicare-funded services, public hospital records, and community mental health services are stored in separate databases, each with distinct, and at times, challenging, accessibility pathways, as well as varied ethical and regulatory requirements. While federal-funded Medicare service data (outlined in Chapter 5) can be accessed through Services Australia in a *relatively* straightforward fashion, obtaining publicly funded healthcare data through state and territory governments requires multiple departmental approvals, ethical clearances, and extensive administrative processes. This makes comprehensive data collection and analysis of healthcare utilisation particularly challenging. Additionally, high costs and long wait times often exceed typical grant funding periods, limiting researchers' ability to integrate these data into economic evaluations.

Given the challenges in accessing administrative healthcare data, self-reported healthcare utilisation data may serve as a pragmatic alternative. However, its accuracy in mental health populations is mixed, with studies reporting varying levels of agreement with administrative records

across different mental health conditions and measures (Garcia et at., 2023 Short et al., 2009). Researchers must weigh this trade-off, but given the limited research in this area, self-report remains a valuable avenue of data collection. Several self-report health utilisation instruments exist, including the Client Service Receipt Inventory (CSRI; Beecham & Knapp, 2001) and the Trimbos/iMTA questionnaire for Costs associated with Psychiatric illness (TiC-P; Bouwmans et al., 2013), which are both widely used in economic evaluations; however, they can be time-consuming. Given that response rates are a persistent challenge in clinical research, particularly in public health settings, participant burden must be considered (Franklin et al., 2020). Future research should explore optimising self-report health utilisation tools for mental health populations, particularly in settings where access to administrative data remains a barrier in Australia.

Regardless of how economic data is collected, this thesis reiterates the importance of systematically gathering and reporting data that can be used in economic evaluations. Aligning economic findings with real-world clinical decisions can further improve their relevance for resource allocation and service planning (Bowser et al., 2021). While economic research on mental health conditions such as depression is more advanced—with more than four times the number of model-based economic models (Haji Ali Afzali et al., 2012; Kolovos et al., 2017)—criticisms persist regarding how depression is defined and the extent to which clinical factors are accurately incorporated into economic models (Kolovos et al., 2017). The PTSD field can learn from other fields and the findings from this thesis can serve as an important catalyst for improving on PTSD-specific economic evaluations, highlighting the need for closer collaboration between clinicians and health economists. To advance this field, clinicians, service managers and clinical researchers should involve health economists at a projects or initiative's inception, to effectively integrate economic perspectives into treatment evaluations. Likewise, health economists must proactively engage with clinical teams—whether through formal collaboration or consultative input—to ensure economic models accurately reflect real-world clinical practice and patient experiences. By strengthening collaboration between clinicians and health economists, the ultimate goal is to ensure

that economic data translates into meaningful improvements in PTSD care. For example, in South Australia, targeted investments—such as funding for the Statewide Eating Disorder Service (SEDS) and the Borderline Personality Disorder Collaborative (BPD Co)—demonstrate that health service funding for condition-specific mental health disorders is achievable when backed by strong advocacy and evidence. These targeted investments in South Australia suggest that specialised trauma services could be possible; however, building strong effectiveness and economic arguments will be critical to support their development.

Concluding Remarks

In summary, clinicians, service leaders, clinical researchers and health economists are key drivers of reform, and economic evaluations can be a powerful tool in strengthening the case for increased investment in PTSD treatment. Together, findings from these studies illustrate the critical methodological challenges as well as opportunities for improving economic evaluations of PTSD treatments in the future. Despite the limitations outlined across each chapter, these findings provide a strong foundation for advancing the methodological rigour and applicability of PTSD economic evaluations. Strengthening collaboration between clinicians and health economists, developing a standardised reference model, improving the sensitivity of GPQoL measures, and embedding economic data collection into routine clinical research are argued to be key next steps in advancing the field with the ultimate goal of improving the quality of PTSD treatment. This thesis significantly contributes to this effort by demonstrating CPT's effectiveness in routine care in Australia while capturing key, often neglected, economic variables, bridging the gap between clinical practice, clinical research, and health economics in the area of PTSD research. By improving the methodological quality, comparability, and policy relevance of PTSD economic evaluations, it is hoped that thesis, along with future publications, will provide a strong foundation for future research that will directly inform funding decisions, service planning, and, ultimately, better access to evidence-based care for individuals living with PTSD.

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APPENDICES

Appendix A

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	✓
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	✓
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	✓
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	✓
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	✓
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	✓
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	✓[a]
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	✓
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	✓
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	✓
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	✓
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	✓
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	N/A

Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	N/A
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	N/A
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	N/A
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	N/A
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N/A
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	N/A
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	N/A
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	✓
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	✓
Study characteristics	17	Cite each included study and present its characteristics.	✓
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	✓
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	N/A
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	✓
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	✓

	23b	Discuss any limitations of the evidence included in the review.	✓
	23c	Discuss any limitations of the review processes used.	✓
	23d	Discuss implications of the results for practice, policy, and future research.	✓
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	✓
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	X
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	✓
Competing interests	26	Declare any competing interests of review authors.	✓
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	✓

[a] Due to the extensive number of databases searched, an example search strategy is provided in Appendix B.

Appendix B

Example Systematic Review Search Terms: Scopus.

TITLE-ABS-KEY ((((cost* W/2 (effectiv* OR utility* OR utilities OR identificat* OR benefit OR consequence* OR comparison* OR minimis* OR minimiz* OR reduct* OR "health care" OR benefit* OR "health-care" OR benefit)) OR (economic* W/3 (model* OR analy* OR stud* OR evaluation* OR health OR evalulat*)) OR markov OR price OR pricing OR "discreet event simulation" OR "micro-simulat*" OR microsimulat* OR "micro simulat*" OR "monte carlo" OR "monte-carlo" OR (decision W/2 (tree OR analy* OR model*))) AND ("posttraumatic" OR "PTSD" OR "stress disorders" OR "traumatic event" OR "post trauma*" OR "post-trauma*" OR "C-PTSD" OR "CPTSD"))) AND PUBYEAR > 1999 AND PUBYEAR < 2026 AND (EXCLUDE (SUBJAREA , "ENGI") OR EXCLUDE (SUBJAREA , "COMP") OR EXCLUDE (SUBJAREA , "BIOC") OR EXCLUDE (SUBJAREA , "NURS") OR EXCLUDE (SUBJAREA , "ENVI") OR EXCLUDE (SUBJAREA , "MATH") OR EXCLUDE (SUBJAREA , "ARTS") OR EXCLUDE (SUBJAREA , "MATE") OR EXCLUDE (SUBJAREA , "PHYS") OR EXCLUDE (SUBJAREA , "ENER") OR EXCLUDE (SUBJAREA , "CENG") OR EXCLUDE (SUBJAREA , "AGRI") OR EXCLUDE (SUBJAREA , "CHEM") OR EXCLUDE (SUBJAREA , "IMMU") OR EXCLUDE (SUBJAREA , "EART") OR EXCLUDE (SUBJAREA , "VETE") OR EXCLUDE (SUBJAREA , "DENT")) AND (LIMIT-TO (DOCTYPE , "re") OR LIMIT-TO (DOCTYPE , "ar"))

Appendix C

Quality Assessment According to Philips Checklist.

Item of quality assessment	Study											
	Abdalla et al.	Avanceña et al.	Cohen et al.	Gospodarevskaya & Segal.	Hogan et al.	Marseille et at[a]	Marseille et al[b]	Mavranezouli et al (b)	Mavranezouli et al (c)	Mihalopoulos et al.	Shearer et al.	Lebenbaum & Hassan
S1. Statement of decision problem/objective	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
S2. Statement of scope/perspective	partial	yes	partial	partial	yes	yes	yes	yes	yes	partial	yes	yes
S3. Rationale for structure	partial	partial	partial	yes	partial	partial	partial	yes	yes	partial	yes	yes
S4. Structural assumptions	partial	yes	partial	yes	partial	yes	yes	yes	yes	partial	yes	partial
S5. Strategies/comparators	partial	yes	partial	yes	yes	yes	yes	yes	yes	partial	yes	partial
S6. Model type	yes	yes	yes	yes	no	yes	yes	yes	yes	no	yes	yes
S7. Time horizon	partial	yes	partial	yes	partial	yes	yes	partial	partial	partial	partial	Partial
S8. Disease states/pathways	partial	partial	partial	partial	partial	partial	partial	partial	partial	partial	partial	Partial
S9. Cycle length	no	no	no	no	n/a	no	no	yes	yes	n/a	yes	No
D1. Data identification	no	partial	no	yes	no	partial	partial	yes	yes	partial	yes	partial
D2. Data modelling	partial	partial	partial	partial	partial	partial	partial	partial	partial	partial	partial	
D2.a. Baseline data	yes	partial	yes	yes	yes	partial	partial	yes	yes	yes	partial	Yes
D2.b. Treatment effects	partial	partial	partial	yes	partial	partial	partial	yes	yes	partial	partial	partial
D2.c. Costs	no	partial	no	partial	yes	partial	partial	partial	partial	partial	yes	Yes
D2.d. Quality of life weights (utilities)[*]	n/a	yes	n/a	yes	yes	partial	yes	yes	yes	partial	partial	Partial
D3. Data incorporation	no	partial	partial	yes	partial	partial	partial	yes	yes	yes	yes	partial
D4 Assessment of uncertainty	no	no	no	no	no	no	no	no	no	no	no	no
D4.a. Methodological	no	yes	no	no	no	yes	yes	no	no	no	no	yes

D4.b. Structural	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	partial	yes
D4.c. Heterogeneity	yes	no	yes	yes	no	no	no	no	no	no	no	yes
D4.d. Parameter	no	yes	no	yes	yes	yes	yes	partial	partial	partial	yes	yes
C1. Internal consistency	no	no	no	no	no	no	no	yes	yes	no	no	yes
C2. External consistency	yes	yes	yes	yes	no	partial	yes	yes	yes	yes	no	yes
% Yes	26	48	26	65	35	39	48	65	65	22	48	52
% No	35	17	30	17	30	17	17	13	13	22	22	9
% Partial	35	35	39	17	30	43	35	22	22	52	30	39
% N/A	4	0	4	0	4	0	0	0	0	4	0	0

Appendix D

Bilcke et al.'s (2011) Uncertainty Checklist.

Checklist Item	Study											
	Abdalla et al.	Avanceñaet al.	Cohenet al.	Gospodarevskaya &	Hogan et al.	Marseille et at A	Marseille et al B	Mavranezouliet al[a.]	Mavranezouliet al[b.]	Mihalopouloset al.	Shearer et al	Lebenbaum & Hassan
1a. Does the model incorporate all relevant aspects of the disease and intervention?	No	No	No	No	No	No	No	No	No	No	No	No
1b If not, is the effect on the results of any omissions discussed?	No	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes
2a. Is an overview of sources of uncertainty given that includes uncertainty around methodological choices, model structure choices, quality of evidence and uncertainty in parameter values?	No	Yes	No	No	No	Yes	No	No	No	No	No	No
2b. If not, is the effect on the results of any omissions discussed?	No	N/A	No	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes
3a. Do results present probabilistic distributions for all combinations ("scenarios") of plausible methodological choices, nonparameterizable structural choices/assumptions, and parameters for which no probability distribution could be specified?	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes

3b. If not, are probabilistic distributions presented for the 2 scenarios most and least in favor of the intervention?	Yes	N/A	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes	N/A
4a. Is an overview given of how much each of the sources of uncertainty influences the results for all the scenarios described above?	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
4b. If not, is an overview given of how much each of the sources of uncertainty influences the 2 scenarios most and least in favor of the intervention?	Yes	N/A	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes	Yes

Appendix E

Table 1

Estimated means and standard errors for posttraumatic stress symptoms, depression severity, and health-related quality of life (N = 36, treatment completers) over time.

	Pretreatment *M* (*SE*)	Posttreatment *M* (*SE*)	Follow-up *M* (*SE*)	Pre-Post *g* (CI_{95})	Pre-FU *g* (CI_{95})	Post-FU *g* (CI_{95})	Main effect *F*(df)
PCL-5	53.30 (1.42)	26.07 (2.35)	30.68 (2.88)	3.01 (2.01, 4.23)	2.59 (1.76, 3.42)	-0.32 (-0.56, -0.08)	46.25 (2, 29.50)***
DASS-D	25.84 (1.34)	13.02 (1.46)	15.42 (1.59)	1.56 (1.02, 2.10)	1.27 (0.80, 1.73)	-0.27 (-0.57, 0.03)	4.80 (2, 28.02)***
AQoL Psychometric[a]	44.95 (1.60)	54.77 (2.32)	55.74 (2.58)	-1.00 (-1.57, -0.43)	-1.59 (-2.06, -1.12)	-0.07 (-0.37, 0.23)	28.00 (2, 27.93)***
AQoL Utility[a]	0.29 (0.02)	0.41 (0.03)	0.44 (0.03)	-0.98 (-1.46, -0.49)	-1.22 (-1.71, -0.73)	-0.16 (-0.47, 0.15)	56.77 (2, 29.95)***

Note. PCL-5 = PTSD Checklist for DSM-5; DASS-D = 21-item Depression Anxiety Stress Scale, Depression subscale. AQoL-8D = Assessment of Quality of Life – 8 Dimensions. *F* = main effect of time.

[a] An increase in scores indicate an improvement in quality of life or capabilities.

* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 2

Dichotomous Treatment Outcomes at Posttreatment and 6-Month Follow-Up for PCL-5 and DASS-D for treatment completers.

	Below probable diagnostic threshold	Treatment Response	Good end state functioning
PCL-5			
Posttreatment	58.82% (20/34)	58.82% (20/34)	32.35% (11/34)
6-Month FU	58.33% (14/24)	54.17% (13/24)	25.00% (6/24)
DASS-D			
Posttreatment	N/A	41.18% (14/34)	41.76% (14/34)
6-Month FU	N/A	20.83% (5/24)	12.50% (3/24)

Appendix F

Indirect Client Time (minutes) across CPT sessions.

Session Number	N (clients)	Minimum	Maximum	Mean	SD
Session 1	60	0.0	135.0	48.97	26.03
Session 2	58	11.0	90.0	38.02	21.44
Session 3	54	5.0	70.0	31.57	16.85
Session 4	50	10.0	80.0	31.08	19.34
Session 5	49	0.0	65.0	29.16	16.97
Session 6	43	0.0	70.0	28.93	17.95
Session 7	43	10.0	85.0	28.7	20.13
Session 8	42	10.0	115.0	31.64	26.68
Session 9	41	10.0	85.0	30.1	21.94
Session 10	37	10.0	70.0	25.92	16.88
Session 11	35	5.0	60.0	24.4	15.55
Session 12	34	10.0	80.0	28.65	17.49
Session 13	16	10.0	45.0	21.81	11.65
Session 14	14	10.0	60.0	26.0	16.1
Session 15	11	5.0	60.0	23.91	15.7
Session 16	9	5.0	31.0	18.11	9.02
Session 17	7	5.0	35.0	21.0	11.03
Session 18	5	10.0	31.0	19.2	9.26
Session 19	2	25.0	25.0	25.0	0.0
Session 20	1	20.0	20.0	20.0	-
Session 21	1	20.0	20.0	20.0	-
Session 22	1	25.0	25.0	25.0	-
Session 23	1	25.0	25.0	25.0	-
Session 24	1	20.0	20.0	20.0	-
Session 25	1	25.0	25.0	25.0	-

Appendix G

Mental Health-Related Medication Benefits Schedule (PBS) Groups, ATC Codes, and Descriptions

Type of Medication	Drug Group	ATC Code	Typical Uses	Mechanism
Antipsychotics	N05A	N05AA01, N05AC01, N05AE05, N05AH03, N05AH04, N05AH05, N05AX08, N05AX12, N05AX16	Used to manage schizophrenia, bipolar disorder, psychotic episodes, and delusional disorders.	Reduce excessive brain activity, particularly in areas linked to hallucinations, delusions, and agitation. Help stabilize mood and behaviour.
Anxiolytics	N05B	N05BA01, N05BA04, N05BA12	Treat anxiety disorders, panic attacks, and generalized anxiety. Sometimes used for muscle relaxation or alcohol withdrawal.	Help calm the brain by reducing overactivity, leading to relaxation and reduced feelings of tension or worry.
Hypnotics and Sedatives	N05C	N05CD02, N05CD07	Primarily prescribed for insomnia, anxiety-related sleep disturbances, and pre-operative sedation.	Promote sleep and relaxation by slowing down brain activity and calming the body.
Antidepressants	N06A	N06AA02, N06AA04, N06AA09, N06AA10, N06AA12, N06AB03, N06AB04, N06AB05, N06AB06, N06AB08, N06AB10, N06AG02, N06AX, N06AX03, N06AX11, N06AX16, N06AX18, N06AX21, N06AX23	Treat major depressive disorder, generalized anxiety disorder, PTSD, and chronic pain conditions like fibromyalgia.	Improve mood by balancing brain chemicals like serotonin and norepinephrine, which affect emotions and energy levels.
Psychostimulants, agents used for ADHD and nootropics	N06B	N06BA02, N06BA04, N06BA07, N06BA09, N06BA12	Commonly prescribed for ADHD, narcolepsy, and off-label for cognitive enhancement or fatigue management.	Enhance focus and alertness by improving brain signals responsible for attention and energy. Can also support better memory and learning.

Note. Sourced from Australian Institute of Health and Welfare (2024)
Table X

Mental Health-Related Medicare Benefits Scheme (MBS) Providers, Services and Corresponding MBS Item Numbers

Provider type	Item group	MBS Group	MBS item numbers
Psychiatrists	Initial consultation new patient	Group A08	134(a), 296, 297, 299
		Group A40 (T)	92437, 92466(a), 92477(a), 92506(a)
	Patient attendances	Group A08	136(a), 138(a), 140(a), 142(a), 144(a), 146(a), 148(a), 150(a), 152(a), 288(T)(a), 291, 293, 294(T), 300, 302, 304, 306, 308, 310, 312, 314, 316, 318, 319, 320, 322, 324, 326, 328, 330, 332, 334, 336, 338, 353(T)(a), 355(T)(a), 356(T)(a), 357(T)(a), 358(T)(a), 359(T)(a), 361(T)(a), 364(a), 366(a), 367(a), 369(a), 370(a)
		Group A40 (T)	91827, 91828, 91829, 91830, 91831, 91837, 91838, 91839, 91840(a), 91841(a), 92435, 92436, 92461(a), 92462(a), 92463(a), 92464(a), 92465(a), 92475(a), 92476(a), 92501(a), 92502(a), 92503(a), 92504(a), 92505(a)
	Interview with non-patient	Group A08	157(a), 158(a), 159(a), 348, 350, 352
		Group A40 (T)	92458, 92459, 92460, 92498(a), 92499(a), 92500(a)
	Case conferencing	Group A15	855, 857, 858, 861, 864, 866
	Eating Disorders Treatment Plan preparation and review	Group A36	90260, 90262(T)(a), 90266, 90268(T)(a)
		Group A40 (T)	92162, 92166(a), 92172, 92178(a)
	Electroconvulsive therapy	Group T01	153(a), 340(a), 886(a), 14224

	Repetitive Transcranial Magnetic Stimulation (rTMS)	Group T01	14216, 14217, 14219, 14220
	Psychiatrist services - Other: Assessment and treatment of pervasive developmental disorder (PDD)	Group A08	289
		Group A40 (T)	92434, 92474(a)
	Psychiatrist services - Other: Group psychotherapy	Group A08	154(a), 155(a), 156(a), 342, 344, 346
		Group A40 (T)	92455, 92456, 92457, 92495(a), 92496(a), 92497(a)
General practitioners	Mental Health Treatment Plan preparation and review	Group A07	272, 276, 277, 281, 282
		Group A20	2700, 2701, 2702(a), 2710(a), 2712, 2715, 2717, 2719(a)
		Group A40 (T)	92112, 92113, 92114, 92116, 92117, 92118, 92119, 92120, 92122, 92123, 92124(a), 92125(a), 92126, 92128(a), 92129(a), 92130(a), 92131(a), 92132, 92134(a), 92135(a)
		Group A42	93400(a), 93401(a), 93402(a), 93403(a), 93404(T)(a), 93405(T)(a), 93406(T)(a), 93407(T)(a), 93408(T)(a), 93409(T)(a), 93410(T)(a), 93411(T)(a), 93421(a), 93422(T)(a), 93423(T)(a), 93431(a), 93432(a), 93433(a), 93434(a), 93435(T)(a), 93436(T)(a), 93437(T)(a), 93438(T)(a), 93439(T)(a), 93440(T)(a), 93441(T)(a), 93442(T)(a), 93451(a), 93452(T)(a), 93453(T)(a)

Mental Health Treatment service	Group A07	279, 894(T)(a), 896(T)(a), 898(T)(a)
	Group A20	2713
	Group A30	2121(a), 2150(a), 2196(a)
	Group A40 (T)	92115, 92127, 92121, 92133
3 Step Mental Health Process	Group A18	2574(a), 2575(a), 2577(a), 2578(a)
	Group A19	2704(a), 2705(a), 2707(a), 2708(a)
Eating Disorder Treatment Plan preparation, review and service	Group A36	90250, 90251, 90252, 90253, 90254, 90255, 90256, 90257, 90264, 90265, 90271, 90272, 90273, 90274, 90275, 90276, 90277, 90278, 90279(T)(a), 90280(T)(a), 90281(T)(a), 90282(T)(a)
	Group A40 (T)	92146, 92147, 92148, 92149, 92150, 92151, 92152, 92153, 92154(a), 92155(a), 92156(a), 92157(a), 92158(a), 92159(a), 92160(a), 92161(a), 92170, 92171, 92176, 92177, 92182, 92184, 92186, 92188, 92194, 92196, 92198, 92200
Focussed Psychological Strategies	Group A07	283, 285, 286, 287, 309, 311, 313, 315, 371(a), 372(a), 941(a), 942(a)
	Group A20	2721, 2723, 2725, 2727, 2729(T)(a), 2731(T)(a), 2733(a), 2735(a), 2739, 2741, 2743, 2745
	Group A39	

			91283(a), 91285(a), 91286(a), 91287(a), 91371(T)(a), 91372(T)(a), 91721(a), 91723(a), 91725(a), 91727(a), 91729(T)(a), 91731(T)(a)
		Group A40 (T)	91818, 91819, 91820, 91821, 91842, 91843, 91844, 91845, 91859, 91861, 91862, 91863, 91864, 91865, 91866, 91867
		Group A41	93287(a), 93288(a), 93291(a), 93292(a), 93300(a), 93301(T)(a), 93302(T)(a), 93303(a), 93304(T)(a), 93305(T)(a), 93306(a), 93307(T)(a), 93308(T)(a), 93309(a), 93310(T)(a), 93311(T)(a)
	Family Group Therapy	Group A06	170, 171, 172, 996(a), 997(a), 998(a)
		Group A07	221, 222, 223
	Electroconvulsive therapy	Group T10	20104
Clinical psychologists	Psychological Therapy Services	Group M06	80000, 80001(T)(a), 80002, 80005, 80006, 80010, 80011(T)(a), 80012, 80015, 80016, 80020, 80021(T), 80022, 80023, 80024, 80025
		Group M17	91000(a), 91001(a), 91005(a), 91010(a), 91011(a), 91015(a)
		Group M18 (T)	91166, 91167, 91168, 91171, 91181, 91182, 91198, 91199
		Group M25	93312(a), 93313(a), 93330(a), 93331(T)(a), 93332(T)(a), 93333(a), 93334(T)(a), 93335(T)(a)
		Group M27	93375(a), 93376(a)
		Group M16	82352, 82353(T)(a), 82354, 82355, 82356(T)(a), 82357, 82358, 82359

	Eating Disorder Psychological Treatment Service	Group M18 (T)	93076, 93079, 93110, 93113
Other psychologists	Focussed Psychological Strategies	Group M07	80100, 80101(T)(a), 80102, 80105, 80106, 80110, 80111(T)(a), 80112, 80115, 80116, 80120, 80121(T), 80122, 80123(T), 80127, 80128(T)
		Group M17	91100(a), 91101(T)(a), 91105(a), 91110(a), 91111(T)(a), 91115(a)
		Group M18 (T)	91169, 91170, 91174, 91177, 91183, 91184, 91200, 91201
		Group M26	93316(a), 93319(a), 93350(a), 93351(T)(a), 93352(T)(a), 93353(a), 93354(T)(a), 93355(T)(a)
		Group M28	93381(a), 93382(a)
	Enhanced Primary Care	Group M03	10968
	Eating Disorder Psychological Treatment Service	Group M16	82360, 82361(T)(a), 82362, 82363, 82364(T)(a), 82365, 82366, 82367(T)
		Group M18 (T)	93084, 93087, 93118, 93121
	Psychology health service - Other	Group M11	81355

		Group M29	93512(a), 93535(a)
		Group M30	93557(a), 93590(a)
	Psychology health service - Other: Assessment and treatment of PDD	Group M10	82000, 82015
		Group M18 (T)	93032, 93035, 93040, 93043
Allied health providers	Focussed Psychological Strategies - Occupational Therapist	Group M07	80125, 80126(T)(a), 80129, 80130, 80131, 80135, 80136(T)(a), 80137, 80140, 80141, 80145, 80146(T), 80147, 80148(T), 80152, 80153(T)
		Group M17	91125(a), 91126(T)(a), 91130(a), 91135(a), 91136(T)(a), 91140(a)
		Group M18 (T)	91172, 91173, 91185, 91186, 91194, 91195, 91202, 91203
		Group M26	93322(a), 93323(a), 93356(a), 93357(T)(a), 93358(T)(a), 93359(a), 93360(T)(a), 93361(T)(a)
		Group M28	93383(a), 93384(a)
	Focussed Psychological Strategies - Social Worker	Group M07	80150, 80151(T)(a), 80154, 80155, 80156, 80160, 80161(T)(a), 80162, 80165, 80166, 80170, 80171(T), 80172, 80173(T), 80174, 80175(T)
		Group M17	91150(a), 91151(T)(a), 91155(a), 91160(a), 91161(T)(a), 91165(a)

		Group M18 (T)	91175, 91176, 91187, 91188, 91196, 91197, 91204, 91205
		Group M26	93326(a), 93327(a), 93362(a), 93363(T)(a), 93364(T)(a), 93365(a), 93366(T)(a), 93367(T)(a)
		Group M28	93385(a), 93386(a)
	Enhanced Primary Care	Group M03	10956
	Mental Health service	Group M11	81325
		Group M29	93506(a), 93529(a)
		Group M30	93551(a), 93584(a)
	Eating Disorder Treatment Service	Group M16	82350, 82351(T)(a), 82368, 82369(T)(a), 82370, 82371, 82372(T)(a), 82373, 82374, 82375(T), 82376, 82377(T)(a), 82378, 82379, 82380(T)(a), 82381, 82382, 82383(T)
		Group M18 (T)	93074, 93092, 93095, 93100, 93103, 93108, 93126, 93129, 93134, 93137
Paediatrician	Eating Disorder Treatment Plan preparation and review	Group A36	90261, 90263(T)(a), 90267, 90269(T)(a)

	Group A40 (T)	92163, 92167(a), 92173, 92179(a)

Note. Sourced from Australian Institute of Health and Welfare (2024) (a) = Item discontinued, (T) = Telehealth item

Appendix H

Mental Health-Related Medication Benefits Schedule (PBS) Groups, ATC Codes, and Descriptions

Type of Medication	Drug Group	ATC Code	Typical Uses	Mechanism
Antipsychotics	N05A	N05AA01, N05AC01, N05AE05, N05AH03, N05AH04, N05AH05, N05AX08, N05AX12, N05AX16	Used to manage schizophrenia, bipolar disorder, psychotic episodes, and delusional disorders.	Reduce excessive brain activity, particularly in areas linked to hallucinations, delusions, and agitation. Help stabilize mood and behaviour.
Anxiolytics	N05B	N05BA01, N05BA04, N05BA12	Treat anxiety disorders, panic attacks, and generalized anxiety. Sometimes used for muscle relaxation or alcohol withdrawal.	Help calm the brain by reducing overactivity, leading to relaxation and reduced feelings of tension or worry.
Hypnotics and Sedatives	N05C	N05CD02, N05CD07	Primarily prescribed for insomnia, anxiety-related sleep disturbances, and pre-operative sedation.	Promote sleep and relaxation by slowing down brain activity and calming the body.
Antidepressants	N06A	N06AA02, N06AA04, N06AA09, N06AA10, N06AA12, N06AB03, N06AB04, N06AB05, N06AB06, N06AB08, N06AB10, N06AG02, N06AX, N06AX03, N06AX11, N06AX16, N06AX18, N06AX21, N06AX23	Treat major depressive disorder, generalized anxiety disorder, PTSD, and chronic pain conditions like fibromyalgia.	Improve mood by balancing brain chemicals like serotonin and norepinephrine, which affect emotions and energy levels.
Psychostimulants, agents used for ADHD and nootropics	N06B	N06BA02, N06BA04, N06BA07, N06BA09, N06BA12	Commonly prescribed for ADHD, narcolepsy, and off-label for cognitive enhancement or fatigue management.	Enhance focus and alertness by improving brain signals responsible for attention and energy. Can also support better memory and learning.

Note. Sourced from Australian Institute of Health and Welfare (2024)

Appendix I

Healthcare and Medication Access, Utilisation and Cost (2024AUD) 12 Months Pre and Post CPT for the completer sample (N=36)

	Before Treatment			After treatment			
Completer Sample	Total number of service contacts or scripts	Total cost (AUD)	Mean cost per client (SD)	Total Number of service contacts or scripts	Total cost (AUD)	Total number of service contacts or scripts	Total cost (AUD)
Services							
Mental health related							
Benefit paid	179	20,228	562 (819)	108	12,316	342 (575)	19 (53)
Non mental health related							
Benefit paid	1,257	69,356	1927 (1833)	958	55,631	1545 (1760)	22 (61)
Medication							
Mental health related							
Benefit paid	506	4,236	118 (137)	386	3,816	106 (202)	18 (50)
Non mental health related							
Benefit paid	607	16,265	451 (875)	600	19252	535 (1065)	14 (39)
Total Medicare expenditure	2,541	109,094		2,039	89,433		

ITS Analysis of Cost and Utilisation for Healthcare services and Medication Pre and Post CPT, including counterfactual estimates.

Cost		Coefficient (95% CI)	*p* value	Counterfactual and posttreatment estimated difference
Healthcare Services				
Mental health related				-6192.81 (-8865, -3501)
Outcome 12 months before tx	$\beta 0$	68.45 (44.30, 94.35)	7.12	
Trend before tx	$\beta 1$	-0.64 (-4.74, 3.55)	0.52	
Level change post-tx	$\beta 2$	-98.03 (-151.81, -47.92)	<0.05*	
Slope change post-tx	$\beta 3$	4.14 (0.44, 8.80)	0.12	
Non mental health related				18,970 (10173, 28082)
Outcome 12 months before tx	$\beta 0$	185.13 (146.6, 233.8)	1.56	
Trend before tx	$\beta 1$	-6.23 (-12.83, -0.44)	.14	
Level change post-tx	$\beta 2$	-85.28 (-204.57, 39.24)	0.29	
Slope change post-tx	$\beta 3$	7.05 (-1.06, 16.78)	0.25	
Medication				
Mental health related				-3210 (-4488, -1556)
Outcome 12 months before tx	$\beta 0$	6.65 (2.07, 11.35)	<0.01**	
Trend before tx	$\beta 1$	0.54 (-0.31, 1.57)	0.27	
Level change post-tx	$\beta 2$	23.69 (4.52, 48.09)	0.12	
Slope change post-tx	$\beta 3$	-1.69 (-3.23, -0.42)	0.06	
Non mental health related				
Outcome 12 months before tx	$\beta 0$	32.33 (13.50, 54.53)	<0.01**	-6069.68 (-10, 573, -873)
Trend before tx	$\beta 1$	0.84 (-1.78, 3.78)	0.57	
Level change post-tx	$\beta 2$	37.27 (-32.98, 121.26)	0.37	
Slope change post-tx	$\beta 3$	-2.77 (-7.58, 1.67)	0.30	

Count		Coefficient (95% CI)	*p* value	Counterfactual and posttreatment estimated difference
Healthcare Services				

Mental health related				-85.51 (-106.90, -62.84)
Outcome 12 months before tx	β_0	0.58 (0.40, 0.76)	5.95	
Trend before tx	β_1	0.002 (-0.02, 0.03)	0.87	
Level change post-tx	β_2	-0.71 (-1.24, -0.32)	<0.01**	
Slope change post-tx	β_3	0.02 (-0.01, 0.06)	0.34	
Non mental health related				12.78 (-118.42, 154.08)
Outcome 12 months before tx	β_0	3.19 (2.54, 3.99)	2.44	
Trend before tx	β_1	-0.06 (-0.17, 0.02)	0.32	
Level change post-tx	β_2	-1.35(-3.23, 0.46)	0.34	
Slope change post-tx	β_3	0.08 (-0.05, 0.22)	0.46	
Medication				
Mental health related				-355.72 (-446.50, -259.80)
Outcome 12 months before tx	β_0	0.93 (0.54, 1.36)	1.04	
Trend before tx	β_1	0.04 (-0.03, 0.12)	0.25	
Level change post-tx	β_2	1.49 (0.29, 2.74)	0.06	
Slope change post-tx	β_3	-0.13 (-0.22)	0.02*	
Non mental health related				101.53 (-30.60, 240.70)
Outcome 12 months before tx	β_0	1.31 (0.85, 1.76)	1.80	
Trend before tx	β_1	-0.01 (-0.07, 0.06)	0.82	
Level change post-tx	β_2	2.43 (0.44, 4.64)	<0.01**	
Slope change post-tx	β_3	-0.12 (-0.24, 0.02)	0.05	

Note. CI, Confidence Interval.