The Economics of Health Care in Prisons

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Declaration:

I, Rachael Hunter confirm that the work presented in my thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

ABSTRACT

People in prison experience poorer health than their peers in the community (Seena Fazel & Baillargeon, 2011). Access to health care in prisons though can be challenging. The nature of the prison environment, where it is the responsibility of the prison to facilitate access to health care, but also to restrict a person's movement, means that there are fewer supply and demand signals. It is the role of decision makers then to guide health care access in prisons, with the need to balance the right to health care for people in prison and the high cost and inefficiencies in delivering health care to this complex group. One method to quantify this is economic evaluations. The aim of this thesis is to define the characteristics of health and the health care market as they relate to prisons and the implications of these characteristics for evaluating the efficiency of delivering health care in prisons.

This is achieved through identifying the aims and objectives of health care and prison, and identifying areas of market failure. An analysis of community mental health funding and the number of people sentenced to prison further explores market failure related to prisons. Data from Engager, a randomised controlled trial of an intervention for common mental health problems in prisons, is used for a trial based economic evaluation, the methods for which were informed by a systematic review of economic evaluations in prisons, an analysis to determine the key predictors of cost in prison and an analysis of the reliability and validity of preference based measures.

This thesis finds that health care interventions related to mental health and prisons are likely to be inefficient. Governments need to prioritise addressing the social determinants of health to reduce the risk of intermediate outcomes such as poor mental health and substance misuse.

IMPACT STATEMENT

Very little research has been done on health economics in prisons and hence a key impact of this work has been making clear the major priorities and methods for this area of research. Another key purpose has also has been to increase my visibility as a researcher working on prison health economics. I have presented work associated with my thesis at 4 national and 1 international conference in order to educate people further on health economics in prisons and the importance of the area.

A particular contribution of this work has been to make clear the methods for conducting economic evaluations in prisons, including the challenges for data collection and analysis. My analysis of the Engager trial is the first economic evaluation of a common mental health intervention in prison, and based on the results of my systematic review, the study is one of only a handful of economic evaluations alongside trials in prisons. As a result it sets out for other researchers working in this area what a high quality economic evaluation of a prison intervention should look like. My paper published in the European Journal of Health Economics has been used as a template for other people conducting economic evaluations of prison interventions, such as the PhACT trial, which I am a member of the trial steering committee for. It also feeds into the dialogue regarding the National Institute for Health and Care Excellence (NICE) reference case being purely health and personal social services, providing more evidence for taking a multi-sectoral approach outside of public health.

My work has also led to other collaborations and engagement. I have formed relationships with the Ministry of Justice looking at COVID in prisons, including how this may relate to wastewater testing. I'm also doing work with the UK Health Security Agency to determine the cost-effectiveness of TB screening in prisons. For the past five years I have been working with King's College London as a co-applicant on a grant looking at cancer care in prisons. In 2022 I worked with ProBono Economics to provide advice to the prison charity Revolving Doors on the evidence for preventing people from entering prison in the first place. Overall my aim is to increase my work looking at how to intervene as early as possible in the determinants of health to reduce inequalities, and to demonstrate how this can reduce prison numbers, something which is this work has been building towards.

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This analysis forms an essential part of the Engager study and hence was conceived of by the study team. I wrote the first draft and final version of the Health Economics Analysis Plan, was solely responsible for the analysis of the data, wrote up the results and wrote all versions of the paper and chapter. Advice and oversight was provided by Prof Richard Byng and Dr Rob Anderson as part of standard trial processes. The paper was significantly improved following comments and advice from anonymous peer reviewers.

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Chapter 8

5. **e-Signatures confirming that the information above is accurate** (this form should be co-signed by the supervisor/ senior author unless this is not appropriate, e.g. if the paper was a single-author work)

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4th August 2023

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As this thesis has formed a part of my life for such a long time now, I have a number of people to thank who have provided me with so much wonderful advice, guidance, support… and data.

I would firstly like to thank my supervisors, Prof Nick Freemantle and Prof Steve Morris for their continued, unwavering support and for staying with me on this very, very, very long journey. Thank you for attending the many meetings and continuing to believe in me. That you have never lost faith in me has meant so much. Thank you also to Prof Irwin Nazareth who was my line manager and mentor through most of this process and gave me the flexibility to work on this alongside my other projects.

I want to thank my partner, Dr Matthew Franklin, for being there for me through all of this. In the whole time we've known each other I've never not been doing my PhD, and I do apologise for that! Thank you for putting up with my continued absence as I soldiered on with completing this, and making sure I had the time and support to finally get it done.

Particular thanks need to go to Prof Richard Byng for having me along on the Engager project, as otherwise this thesis either would not exist, or be on a very, very different topic. It was serendipitous that we bumped into each other all those years ago at a primary care conference in Granada. My appreciation as well to the whole Engager team, with special mention to Dr Rob Anderson and Dr Tim Kirkpatrick, as without your assistance again, this PhD also would not exist. And to all of the participants in the Engager and COCOA studies, as without your consent to participate and cooperation with providing data, many chapters of this thesis would be missing.

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This PhD is dedicated to my daughter, Alice, who came into this world in the middle of it. Ironically you gave me the time and head space to focus on getting large percentages of this work done.

AUTHOR CONTRIBUTION STATEMENT

Chapter 1, 2 & 9: I conceived of and wrote these chapters.

Chapter 3: The original idea for the chapter came from my supervisors and was developed in collaboration with Prof Jeff Round. All versions of the chapter have been written by me. This chapter was presented at HESG and hence has been modified based on discussant and attendee feedback.

Chapter 4: This study was conceived of and written by me. Data were obtained from publicly available sources. This chapter was presented at HESG and hence has been modified based on discussant and attendee feedback.

Chapter 5: The systematic review was conceived of and written by me. All searches and data extraction were conducted by me. This chapter was presented at HESG and hence has been modified based on discussant and attendee feedback.

Chapter 6: I conceived of the idea, designed the analysis, analysed the data and wrote the chapter. Data were provided by the COCOA study.

Chapter 7: I conceived of the idea, designed the analysis, analysed the data and wrote the chapter. Data were provided by the Engager study. Aspects of the chapter are inspired by a paper led by myself and co-authored by Professors Gianluca Baio, Steve Morris, Nick Freemantle and Jeff Round and Dr Thomas Butt. This chapter was presented at HESG and hence has been modified based on discussant and attendee feedback.

Chapter 8: This analysis forms an essential part of the Engager study and hence was conceived of by the study team. I wrote the first draft and final version of the Health Economics Analysis Plan, was solely responsible for the analysis of the data, wrote up the results and wrote all versions of the paper and chapter. Advice and oversight was provided by Prof Richard Byng and Dr Rob Anderson as part of standard trial processes. The following people were co-authors on the published paper, and hence provided comments and advice: Tim Kirkpatrick, Charlotte Lennox, Fiona Warren, Rod S. Taylor, Jenny Shaw, Mark Haddad, Alex Stirzaker, Mike Maguire. The paper was significantly improved following comments and advice from anonymous peer reviewers.

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1 INTRODUCTION

1.1 A summary of the issue

Worldwide there are over 11 million people in prison, with the United States of America (USA) having the highest rate of incarceration at 629 per 100,000 of the population and a total prison population of 2 million (Fair & Walmsley, 2021). In His Majesty's Prison and Probation Service (HMPPS), covering England and Wales in the United Kingdom (UK), in December 2022 there were 81,806 people in prison, 96% of which were men (Ministry of Justice & His Majesty's Prison and Probation Service, 2023). Throughout this thesis I have used the term prison to mean a place of detention for the purpose of either punishment or for those awaiting trial. Although within the UK the term "prison" is used consistently, in other countries terms such as jail and correctional facility are also used and can potentially house different populations. For example, in the USA the term jail is used for short-term incarceration, particularly for people awaiting trial. For simplicity I have used the singular term "prison" to represent a range of different groupings of people incarcerated in a place of detention unless a specific distinction is warranted. For the UK, prisons only includes adults, which is defined as those aged 21 and over, with people younger than 21 going to young offender institutions (Ministry of Justice & His Majesty's Prison and Probation Service, 2023). Young offender institutions and places of detention purely for immigration purposes have been excluded from this thesis given the different needs of these populations. In the USA the definition of minor and practices for their sentencing and detention differ by state, with some states sentencing children as young as 13 to life in prison (Equal Justice Initiative, 2008). As a result, for the USA, it is not always possible to separate out children and young adults from the adult correctional estate.

Adults in prison experience poorer physical and mental health compared to their peers in the general population (Seena Fazel & Baillargeon, 2011) with higher rates of mental health problems (Fazel, Hayes, Bartellas, Clerici, & Trestman, 2016), substance misuse problems (Fazel, Bains, & Doll, 2006) and a higher prevalence and incidence of blood borne viruses (BBVs) such has human immunodeficiency virus (HIV) and hepatitis (Wirtz, Yeh, Flath, Beyrer, & Dolan, 2018) and other communicable diseases including Tuberculosis (TB) (Velen & Charalambous, 2021), something I will go into in detail in Chapter 2. Physical health care needs are also greater in the prison populations, including higher rates of diabetes and

cardiovascular disease compared to non-incarcerated peers of a similar age (Herbert, Plugge, Foster, & Doll, 2012). Due to these factors, combined with poor access to health care in the community, people in prison have higher mortality rates than their non-incarcerated peers (Fazel & Baillargeon, 2011). There is no upper age limit for people in prison and the combination of poor health and the aging prison population has increased the demand for end of life care in prisons (McParland & Johnston, 2019), although compassionate release can be granted where the suffering imprisonment causes is greater than the deprivation of liberty intended by punishment (Ministry of Justice & His Majesty's Prison and Probation Service, 2022). As a result, delivering health care to this population presents the health and criminal justice system with challenges, both in terms of logistics as well as the significant resources required to meet the needs of this population.

1.2 Aim and objectives of the thesis

The aim of this thesis is to define the characteristics of health and health care as it relates to prisons and the implications of these characteristics for evaluating the efficiency of delivering health care in prisons.

The objectives of this thesis are to:

1. Conceptualise the characteristics of supply and demand for health care markets in prisons in the context of the aims and objectives of providing health care in prison.
2. Identify areas of market failure in providing health care in prisons and actions that governments can take to overcome these.
3. Explore a case-study of market failure and prisons; mental health funding and prison numbers.
4. Summarise the evidence base for health economic evaluations in prison to inform the work of the thesis. This will be achieved by conducting a systematic review of economic evaluations in prisons and summarising the quality of papers using the Drummond 10 point checklist (Drummond, Sculpher, Claxton, Stoddart, & Torrance, 2015).
5. Identify the key health care costs and predictors of costs for people in prison.
6. Identify suitable outcomes to use in health economic evaluations in prisons.
7. Conduct a full economic evaluation of a prison intervention based on the Engager trial.

1.3 Outline of the thesis

To provide a context for evaluating the allocative efficiency of delivering health care in prisons, in chapter 2 I will set out in more detail the characteristics of the prison population, how it relates to other similar populations in the community and what this says about the determinants of ill health. This is then contrasted with the challenges associated with the provision of health care in prison and how this relate the characteristics of a perfect market in Chapter 3. Leading on from this is Chapter 4 where I present an analysis looking at how funding in another area of health care, mental health, can have an impact on the number of people entering the prison system.

To explore the issue of allocative efficiency in prisons, in chapter 5 I report the results of a systematic review of the economic evaluations that have been conducted in prisons to determine the quantity and quality of the literature. A second aim is to inform the methods of a full economic evaluation of a mental health prison intervention that is described in chapter 8. The aim of chapter 6 and chapter 7 are also to inform the conduct of the economic evaluation, looking at the key predictors of costs for people in the criminal justice system in chapter 6 and suitable outcome measures to calculate quality adjusted life years (QALYs) for prison interventions in chapter 7.

Although a large proportion of literature on the efficiency of delivering health care in prisons is based in the USA, partially due to their high incarceration rate and hence the high cost of providing care to this population, as will be detailed in Chapter 5 and 6, the focus of this thesis will be health care provided in HMPPS, which covers prisons in England and Wales. The issue of private prisons in England and Wales and the provision of health care in these prisons will be touched on, but not discussed in detail. Scotland and Northern Ireland are not specifically included as the responsibility for both prisons and health care is devolved to the respective assemblies (Cabinet Office, 2019). The health care provided in prisons in Wales is slightly more complex case within HMPPS given that the responsibility for health care is also devolved to the Welsh Assembly and hence there are some small differences in health care provision between English and Welsh prisons (Cabinet Office, 2018). Health care in non-private prisons in England has been the responsibility of the National Health Service since 2006, transferring from the then Prison Service due to concerns with the quality of care provided (Hayton & Boyington, 2006). Since 2013 a National Partnership Agreement has been in place that sets

out NHS England's responsibility for commissioning health care in all prisons (NHS England, 2022).

1.4 Efficiency and the cost of health care in prison

In the mid 1990's the US National Institute for Justice noted that health care costs in prisons were growing at a faster rate than any other correctional cost (McDonald, 1995). This was partly attributed to the growing health care need associated with the rising prevalence and incidence of BBVs, particularly among injecting drug users. Similar reviews were also commissioned by the UK government due to concerns regarding increased pressure on limited financial resources (Watson, Stimpson, & Hostick, 2004). More recent commentaries have noted the rising cost of prison health care in older prison populations, as the prison population that is over 55 continues to represent a larger proportion of the total prison population (Maschi, Viola, & Sun, 2013; Psick, Simon, Brown, & Ahalt, 2017). The rising cost of providing health care in prisons has resulted in an increased interest in identifying interventions that make the best use of limited resources. Within England the current policy imperative is being led by the National Institute of Health and Care Excellence (NICE) who published guidance on managing the physical health of people in prison and the mental health of people in contact with the criminal justice system, although only the latter includes an assessment of the cost-effectiveness of different interventions (National Institute for Health and Care Excellence (NICE), 2016, 2017).

The health of people in prison is a complex one with divergent views within society about the rights of people in prison to access health care. The key consideration that underpins the rights of people in prison to access to health care equivalent to that available in the community is that for those sentenced to prison the purpose of prison is the removal of liberty as punishment: reduced access to health care sits outside of that purpose, potentially contravening the human right of freedom from cruel or inhuman treatment or punishment (Maschi et al., 2013; Senior & Shaw, 2011). The implications of this are discussed further in chapter 3. The cost of health care in relation to people in prison is discussed further in Chapters 5-6.

Overall policy and decision makers want evidence on efficiency: they want to know the best way to allocate finite system resources to achieve their goals. At its most basic, efficiency is a ratio of inputs (labour, costs, assets, consumables) to outputs (numbers treated or health gain) (Palmer & Torgerson, 1999). Within the context of allocative efficiency, deciding

whether or not to implement an intervention based on the aim of maximising the health of the population (Culyer, 2014), economic evaluation is a widely accepted methodology for quantifying the costs and consequences of competing interventions and policy options in the context of a finite budget (Drummond et al., 2015). In the UK, His Majesty's (HM) Treasury's Green Book sets out the methodology for the evaluation of government funded programmes. It specifically recommends the use of cost-benefit analysis (CBA), the monetary valuation of all costs and consequences of an intervention compared to current practice, for the evaluation of programmes over cost-effectiveness analysis (CEA), the cost per outcome gained of one intervention compared to another (HM Treasury, 2022). This is due to the more restrictive nature the single outcome being captured in CEA and reported as part of this analysis. Health care though is a noted exception given the difficulty of assigning monetary values to health outcomes. Instead, the recommended methodology is combining information about mortality and morbidity into a single unit called a quality adjusted life year (QALY), so as to calculate the incremental cost per QALY gained of an intervention compared to current practice. The calculation of QALYs is based on the estimation of utility scores and multiplying them by time, and hence is called cost utility analysis (CUA). This is to be done in a standardised way so as to allow for the comparison of costs and consequences across programmes of work and disease areas in health care (Drummond et al., 2015; Hunter et al., 2015; National Institute for Health and Care Excellence, 2022).

Economic evaluations are common in health care: as of March 2015 the economic evaluations database (EED) maintained by the Centre for Review and Disseminations (CRD) had over 17,000 listings (Centre for Reviews and Dissemination, 2023). Several systematic reviews have been conducted of studies that report costs and consequences associated with interventions that either reduce criminal behaviour or illicit substance misuse, where a potential environment for the delivery of the intervention is prison. They have found a paucity of studies (259 economic evaluations of opiate dependence treatment in 2007 (Doran, 2008) and 61 economic evaluations of interventions to reduce criminal behaviour in 2006 (Marsh, 2010). A 2014 systematic review of the cost-effectiveness of peer delivered interventions in prisons found only one economic evaluation. The small number of economic evaluations in this area is generally linked to limited research and evidence in the

area, partially due to the challenges of conducting research in a prison environment (South et al., 2014). The reviews also note poor methodology associated with the economic evaluations: costs and outcomes are rarely collected in a systematic way and the paucity of randomised control trials conducted in prison means that the measure of effectiveness of the intervention are based on questionable data (Farrington, Petrosino, & Welsh, 2001).

In summary, people in prison represent a significant burden of disease, and as a result providing health care for this population has significant financial implications. There is limited evidence though on how best to use limited resources to provide health care in prisons and achieve the optimal outcomes for society, whatever they are determined to be. Economic evaluation is likely to present the best method for providing better information to decision makers on what is the most efficient way to provide health care for people in prison.

2 EPIDEMIOLOGY OF PEOPLE IN PRISON

2.1 Aim of the chapter

As described in Chapter 1, people in prison experience worse physical and mental health than their peers in the community. The aim of this chapter is to provide more detail on the physical and mental health needs of the population and identify overlaps with other hard to reach groups. This leads on to a discussion of the determinants and interrelated factors that have a negative impact on health, increase the need for health care and chances of incarceration to prison.

2.2 Methods

2.2.1 *Search strategy*

A rapid review of the literature was conducted in January, 2023 based on the search strategy and results from the systematic review described in Chapter 5. PubMed was searched using the terms prevalence, chronic disease, mental health and infectious disease to cover the epidemiology of health and jail, prisoners, criminal and homeless persons. The search terms were selected to cover a range of marginalised populations that may overlap with the prison population. Papers were restricted to high-income countries, adults and only papers published in the last 10-years. Papers of interest that fell outside of the PubMed search were identified from the systematic review in Chapter 5 and from references. Government websites were searched to determine routine sources of information on the characteristics and health of the prison population specifically in relation to HMPPS. The websites of prison related interest groups and charities were searched for related grey literature.

2.2.2 Synthesis of information

The results of the search have been summarised below and divided into physical health, mental health, and substance misuse. Systematic reviews and more recent evidence were given preference in regard to the reporting of statistics.

The different determinants of ill health were synthesised into a descriptive diagram based on work by the World Health Organisation on the determinants of health (World Health Organisation, 2023).

2.3 Results

2.3.1 Search results

1,216 studies were identified in the review, with 56 included for full-text screening as they potentially provided epidemiological data on prisons, people with serious mental illness or substance misuse or homeless populations. Overall 21 of the studies have been included in the summary below. The remaining evidence was obtained from government websites, interest groups or the systematic review described in Chapter 5.

2.3.2 Description of prison population

As described in Chapter 1, worldwide there are approximately 11 million people in prison, although exact numbers are hard to determine as for some countries, such as the Democratic People's Republic of Korea, no official statistics are available (Fair & Walmsley, 2021). As noted, the USA has the largest prison population for any country as well as the highest rate of incarceration, standing at 2 million and 629 per 100,000 respectively, although over the past few years that number and rate have been decreasing (Fair & Walmsley, 2021). The country with the next largest prison population is China, with a prison population of 1.69 million, not including pre-trial and other forms of detention, followed by 811,000 in Brazil. Rwanda and Turkmenistan have the next highest rates of incarceration at 580 and 576 per 100,000 of the population respectively (Fair & Walmsley, 2021). England and Wales sits at 110 in the world with a rate of 143 people in prison per 100,000 of the population (Fair & Walmsley, 2021).

Countries with the lowest rate of people in prison (<70 people per 100,000) include Germany, Netherlands, Iceland and Finland in Europe, Japan, Afghanistan, Pakistan, India and Bangladesh in Asia, over half the countries where data are reported in Africa and war torn countries such as Syria in the Middle-East (Fair & Walmsley, 2021). This suggests that although in higher income countries a strong welfare state and a focus on non-custodial sentences and rehabilitation corresponds with lower rates of imprisonment, for lower and middle income countries it may potentially be a marker of a destabilised government and limited resources.

The prison population is a highly transient group: for HMPPS in December 2022, 12% of the prison population was on remand (awaiting trial) and over 60% of new receptions for the

past quarter were sentenced to less than 6-months (Ministry of Justice & His Majesty's Prison and Probation Service, 2023). They are also relatively young, with only 17% of the prison population being over the age of 50, compared to 38% in the general population, although the proportion over 50 is steadily increasing (Ministry of Justice & His Majesty's Prison and Probation Service, 2023).

2.3.3 Physical health needs of the prison population

The nature of the prison environment and characteristics of the population mean that communicable diseases are more prevalent in prisons than other environments. The combination between the high prevalence of injecting drug users in prison and the high prevalence of BBVs in this group presents particular problems. Of those tested in prison, 8% are positive for the hepatitis C virus (HCV), 1.5% for the hepatitis B virus (HBV) and 0.6% for the human immunodeficiency virus (HIV), with HIV and HBV rates being similar to positive test rates in primary care (1.4% HBV positive and 0.8% HIV positive), but HCV in prison being four times the rate in primary care (2.0% HCV positive in primary care) (Public Health England, 2014). Injecting drugs make up the majority of HCV cases, with approximately 50% of people in prisons being injecting drug users (Nakitanda, Montanari, Tavoschi, Mozalevskis, & Duffell, 2020). In the US 17.3% of people in prisons are HCV positive and 30% of HCV positive people spend at least a year in prison (He et al., 2016). Given the high rates of BBV, the level of testing is still low, particularly for HCV (Nakitanda et al., 2020).

Characteristics of the prison environment such as overcrowding, increased contact with infected individuals and poor ventilation can all increase the risk of infectious disease transmission (Kowada, 2013). High risk behaviours such as tattooing and sexual contact without protection in addition to injecting drug use and needle sharing also increase the risk of disease. Tuli et al (2009) reported that 18% of men in prison reported sexual intercourse with other men while incarcerated, compared to 7% of the same cohort when in the community. A number of high risk behaviours are also banned in the prison regime, and in some prisons sexual contact is a criminal offence (Leibowitz, Harawa, Sylla, Hallstrom, & Kerndt, 2013) so the behaviour is generally hidden from view making prevention and harm reduction measures challenging to implement. Attempts to put harm reduction measures in place can also be met with resistance by major stakeholders, such as prison staff, for

example making needle exchange available for injecting drug users. In addition, the higher prevalence of other health problems that compromise the immune system, for example HIV or illicit drug use can increase the risk of contracting other diseases such as TB (Jones & Schaffner, 2001; Kowada, 2013).

Non-communicable diseases are also more prevalent for people in prison, with any exposure to incarceration being a greater contributor to physical ill-health and mortality than the duration of time spent in prison (Schnittker & John, 2007). Heart-disease (Herbert et al., 2012), type 2 diabetes (Gray et al., 2021) and cancer (Oladeru et al., 2022) are all more prevalent in prison populations than in the community, contributing to higher mortality during imprisonment and years after release. The exact causal mechanisms for this though are unclear, particularly given that people in prison tend to have pre-existing risk factors prior to incarceration. It has been proposed though that incarceration itself may act as a chronic stressor, putting additional strain on cardiovascular and immune systems, in addition to ongoing social marginalisation following release (Massoglia & Remster, 2019). A poor diet and a lack of physical exercise while in prison may further impact on the risk of physical health problems (Collins & Thompson, 2012).

Poor access to healthcare while in prison and directly after release may also have an impact on physical health and increased mortality. Although there is limited evidence of worse care for people in prison in the US for chest pain (Winter, 2011) asthma and other respiratory illnesses can be poorly managed while in prison, in some instances being the main cause of preventable death (Ha & Robinson, 2011). An increased mortality risk for cancer while in prison has been linked with a poorer access to care in a state-wide study using the Connecticut Tumour registry, (Oladeru et al., 2022) and a study I am currently contributing to using National Cancer Registration and Analysis Service (NCRAS) in England, (Davies et al., 2023). In the Connecticut study, cancer mortality risk was particularly pronounced shortly after release, which was hypothesised to be due to reduced access to healthcare insurance in the community compared to prison in the US (Oladeru et al., 2022). The universal health care coverage provided by the NHS in England may potentially mitigate this risk, but further evidence is required.

2.3.4 Mental health needs of the prison population

The relationship between mental health and the criminal justice system is complex and multi-dimensional, where people with mental health problems are more likely than their peers to be involved at all stages, including being a victim, with 15% of people with mental health needs in England having been a victim of crime in the preceding 12 months (Hart, De Vet, Moran, Hatch, & Dean, 2012). They are also three times more likely to have been found guilty of a crime prior to their first contact with psychiatric services compared to matched population controls (Stevens et al., 2012). This is potentially due to the relationship between substance misuse and mental health: substance misuse can increase the risk of mental illness and mental illness can increase the risk of substance misuse, particularly in the form of self-medication. Substance misuse alone though can increase the probability of contact with the criminal justice system (see section 2.3.5). Even people accused of a crime have a higher rate of mental illness than their peers in the community, with a health and justice administrative database study in Manitoba, Canada, finding a rate ratio of 1.4 to 3.6 of mental disorders for people accused of a crime compared to the community (Hensel et al., 2020).

The largest psychiatric morbidity survey conducted on people in prisons in England and Wales (3,142 participants with fully completed interviews) found that 90% of people in prison have some form of mental health problem, including drug dependence and common mental health problems such as depression, anxiety and sleep disorders (Singleton, Gatward, & Meltzer, 1998). There is a higher prevalence of serious mental illness (SMI) in prisons than in the general population: a systematic review found that on average, world-wide, the prevalence of psychosis in the prison population is 3.7% (Fazel and Seewald 2012) compared to an annual prevalence of 0.5% in the general population in England (Kirkbridge et al 2012). A recent screening study in an English prison found that 3% of the prison population developed first episode psychosis within two weeks of reception to prison (Jarrett et al., 2016). Personality disorders are also more prevalent in prison, with 78% of male remand prisoners, 64% of male sentenced prisoners and 50% of women in prison screening positive for a personality disorder with antisocial personality disorder being the most common (Singleton et al., 1998). This is compared to 13.7% of the general population having any personality disorder (McManus, Bebbington, Jenkins, & Brugha, 2016).

2.3.5 Substance misuse

Substance misuse is an important issue for the prison estate given that increased availability can have a negative impact on the safety and security of the prison environment, something which is discussed further in section 5.4.4 below. As a result prisons tend to monitor substance misuse regularly. In HMPPS random mandatory drug tests (RMDT) are conducted monthly, with the aim of covering 5% to 15% of the prison estate (His Majesty's Prison and Probation Service, 2022). In 2019/2020, of the 54,047 tests administered 10% were positive for illicit drugs, with 53% of the positive tests being for cannabis and 20% for opiates (and positive test for both being possible) (His Majesty's Prison and Probation Service, 2020). The prevalence of illicit drug use in prisons as measured by RMDT though is unlikely to be a true reflection of drug dependence in the population. This is partially because RMDT is not perfectly random and may miss the prevalence of opiate use in particular by a factor of two due to the small amount of time that the drug stays in the body (Gore, Bird, & Strang, 1999). It is also because prisons put in place policies to reduce the supply of drugs in prisons, as well as treatment and other harm reduction initiatives to reduce demand (van Dyken et al., 2014). In the year before coming into prison 41% of remand and 23% of sentenced women report opiate dependence. For men it is slightly lower, with 26% remand and 18% sentenced reporting opiate dependence the year before coming into prison (Singleton et al., 1998). These figures can vary widely between studies though, with a systematic review finding that between 10% and 61% of men in prison have drug dependence and between 30% and 69% of women in prison have drug dependence (S. Fazel, Yoon, & Hayes, 2017). Alcohol problems are also common in prisons: in a Scottish sample of remand prisoners 73% were identified as having an alcohol misuse disorder based on the Alcohol Misuse Disorders Identification Test (AUDIT) screening tool, with 43% being identified as dependent (Graham, Heller-Murphy, Aitken, & McAuley, 2012). Worldwide the prevalence of alcohol use disorder was 24% in prisons, with significant heterogeneity (S. Fazel et al., 2017).

In additional to causing problems within prison environment, substance misuse is also problematic given injecting drug use and its relationship with communicable diseases, as discussed above in section 2.3.3 and being highly correlated with mental illness, with substance misuse being more common in people with schizophrenia spectrum disorders (Hunt, Large, Cleary, Lai, & Saunders, 2018) and major depression (Lai, Cleary, Sitharthan, &

Hunt, 2015). Co-occurring mental and substance misuse, or dual diagnosis, is 20-times higher in prison populations than in the community for substance misuse occurring with non-affective psychosis, and twice as prevalent for major depression in prison compared to the community. People in prison with dual diagnosis also have a higher risk of worse treatment outcomes compared to their peers with only drug dependence or mental health (Baranyi, Fazel, Langerfeldt, & Mundt, 2022). Opiate dependence by itself increases the risk of death in prison as well as on release, with a 3 to 8 fold risk of drug related death two weeks after release from prison (Merrall et al., 2010).

The relationship between substance misuse and prison in many instances is straight forward: the reason that the person is in prison is because they committed a drug related offence. For some people who are imprisoned for drug related offences though, such as the trafficking or production of drugs, they may have no history of drug use themselves. In Europe, 18% of people are in prison for a drug related offence (European Monitoring Centre for Drugs Drug Addiction, 2022). Substance misuse can also be highly related to crime, with many people in prison with drug dependence being there for non-drug related crimes, with drug dependence being most prevalent in people arrested for acquisitive crime (Singleton et al., 1998). For some people substance misuse may start in prison, with a 2002 study in England and Wales finding that a quarter of people in prison who took heroin, did so for the first time while in prison (Boys et al., 2002). A recent 2020 study in Norway though found that only 3% of the sample initiated drug use in prison, although only 2% had used heroin during the current incarceration (Bukten et al., 2020). The reasons for drug dependence and substance misuse and its relationship with crime is multifactorial: the reason for being in prison is unrelated to the drug use, but drug use has risk factors in common with other factors that increase the risk of being in prison such as lack of employment, economic uncertainty, poor housing and a negative family environment (K. Dolan, Farrell, & Moghaddam, 2018).

2.3.6 Comparison with homeless populations

Homelessness is a complex problem with a range of social, individual, and economic factors influencing the risk of becoming homeless. It is also nebulous in that it includes not just people who are roofless or without a home, but also people without regular accommodation such as

those living in shelters or with family and friends. Further to this, *Housing Exclusion* in the European Union and *at risk of homelessness* in the UK includes situations where the housing is inadequate or insecure *(*Fazel, Geddes, & Kushel, 2014). Between October to December 2022, 72,550 households in England were assessed as homeless or at risk of homelessness, up by 4.7% compared to the previous year (Department for Levelling Up Housing and Communities, 2023). Homelessness is considered within this chapter in that it strongly intersects with the prison population: a survey of newly sentenced prisoners found that 15% were homeless prior to prison, compared to 3.5% of the general population, with 37% of newly sentenced prisoners stating that they would need help finding accommodation on release (Williams, Poyser, & Hopkins, 2012). Homelessness also has close links with mental health in that the increase in the homeless population in the 1980's was attributed to moving much of mental health care from inpatient facilities and into the community (Fazel et al., 2014). The homeless population is also similar to the prison population in terms of high physical and mental health needs compared to their peers in the community.

Although not as prevalent as in the prison community, a systematic review incorporating 39 publications estimated that 76.2% of the homeless population have a mental health problem, with the most common being substance misuse (21.7%; 95% confidence interval (CI) 13.1% to 31.7%) and alcohol misuse (36.7%: 95% CI 27.7% to 46.2%). Schizophrenia spectrum disorders are more prevalent in the homeless than prison population, with 12.4% (95% CI 9.5% to 15.7%) of homeless people having some form of schizophrenia spectrum disorder (Gutwinski, Schreiter, Deutscher, & Fazel, 2021).

The prevalence of communicable diseases is also high in the homeless population, although estimates vary significantly across studies: 4% to 36% HCV positive; 0% to 21% with HIV, up to 8% with TB and between 17% and 30% are HBV positive (Fazel et al., 2014).

Overall, homeless individuals are frequent users of health care services, particularly emergency services, with a significant degree of this explained by substance misuse and unintentional injuries including falls (Fazel et al., 2014).

2.3.7 Prison and it's relationship with the social determinants for health

The increased incidence and prevalence of infectious diseases, combined with the negative environment surrounding prison, increase the risk of physical disease, mental illness and

substance misuse. These factors result in an increased mortality rate associated with incarceration. Kajeepeta et al (2021) conducted a retrospective longitudinal analysis of the relationship between county jail incarceration and all-cause mortality in the US between 1987 and 2017. They found that for every additional 1 per 1000 people incarcerated, this resulted in between a 1% and 6.5% increase in all-cause mortality in the subsequent year across the whole community. To explain the increased all-cause mortality rate they developed a conceptual model to link the social, medical and environmental determinants of poor health and how they are exacerbated by prison incarceration. A key component of this is not just the negative prison environment, but also the relationship between race and negative psychosocial and economic outcomes, reflecting the compounding systemic discrimination faced by Black and other non-white Americans in the US (Kajeepeta et al., 2021). In New York for example, by the age of 38, 26.8% of Black men and 16.2% of Latino men have been jailed. This is in contrast to 3% of white men. High rates of repeated incarceration is particularly prevalent among Black men in areas with higher levels of poverty (Western, Davis, Ganter, & Smith, 2021).

Based on the process used by Kajeepeta et al (2021), and the World Health Organisation social determinants of health (World Health Organisation, 2023) Figure 1 sets out the social determinants of intermediate factors that may influence final outcomes such as prison, insecure housing and hospital. Within Figure 1, the final outcome of “poor health” is a broad term to encapsulate any poor health, including both physical and mental health. Studies suggest that a likely cause of serious mental illness is unemployment and lack of affordable housing (Lurigio, 2011), with being homeless before prison further increasing the risk of developing psychosis while in prison (Jarrett et al., 2016). This suggests that the development of serious mental illness can be influenced by modifiable social determinants of health. Substance misuse is also highly related to housing, with studies showing that improved access to housing reduces the risk of substance misuse (Fitzpatrick-Lewis et al., 2011). Poor health, both physical and mental health, then can have a negative feedback loop on the social determinants as it may reduce access to employment and influence housing.

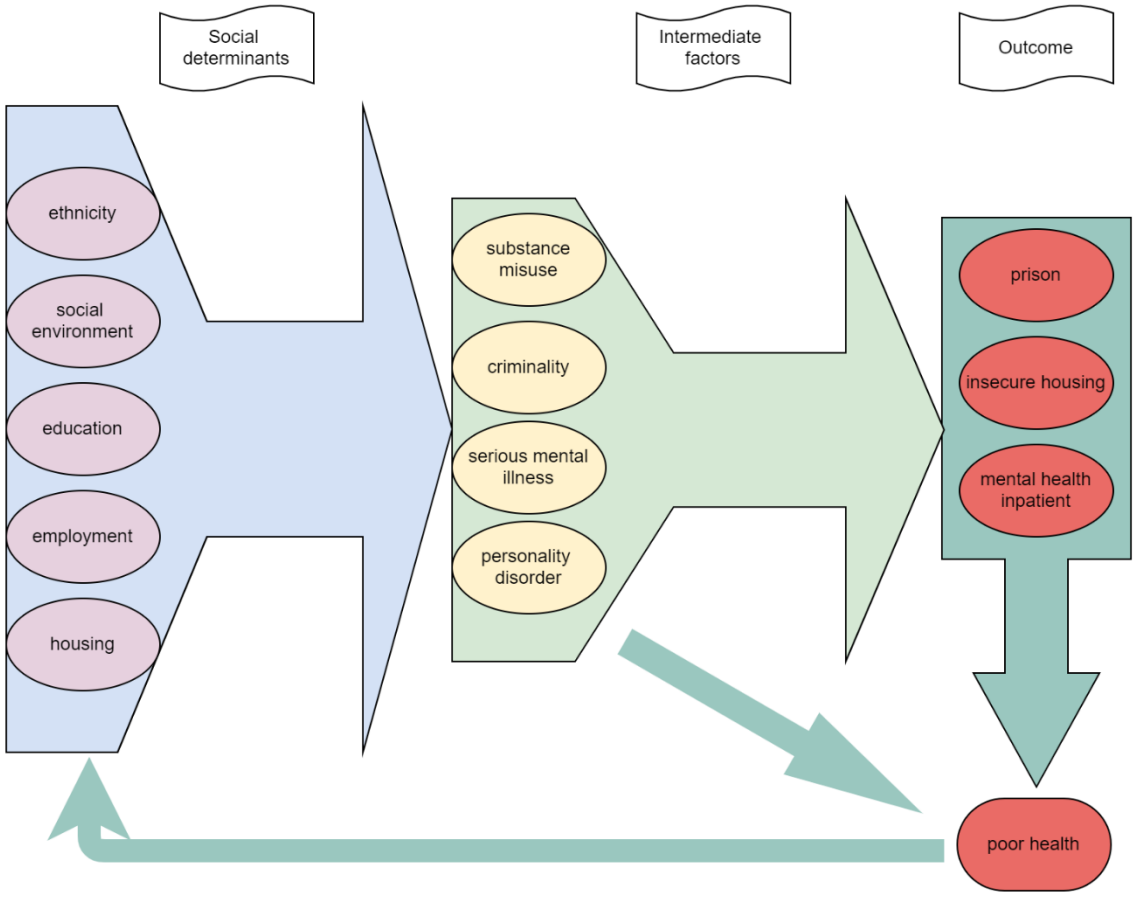


Figure 1: Conceptual diagram of hypothesised mechanism to explain the association between social determinants of health, intermediate factors and outcomes

2.4 Discussion

People in prison experience severe health inequalities compared to their peers in the community. The reasons for this, as described in section 2.3.6, are potentially due to a number of modifiable social determinants of health, although limited data in this area means that casual mechanisms of health inequalities seen for people in prison remain unclear (Massoglia & Remster, 2019). Most interventions, and the focus of this thesis, look to influence outcomes by intervening in intermediate factors or at the outcome stage. Intermediate factors, such as the treatment of mental ill health in particular, are explored further in Chapter 4, looking at the relationship between mental health funding and the number of people sentenced to prison. Chapter 8 looks at an intervention for common mental health problems in prison.

This thesis will draw together the evidence base that some of these interventions, although necessary, are inefficient. Further research and evidence though is needed on interventions to reduce inequalities at the stage of the social determinants of health, focusing on housing, education, employment and social cohesion.

Inequalities in the social determinants of health that lead to negative intermediate outcomes are likely to become more prevalent and costly in the near future as the average age of the prison population increases. This will partially come as a result of people in prison experiencing decrements to their health roughly equivalent to being 15 years older than the equivalent person in the community. The prevalence of dementia is also likely to increase as people in prison have a number of risk factors that increase the risk of dementia including poor mental health and substance misuse (Maschi et al., 2013). Add to that the additional factor that a nationwide cohort study from Sweden found that long prison sentences combined with mental health and substance misuse problems further increase the risk of dementia in older adults (Solares et al., 2023) and dementia and social care provision in prisons is likely become a key issue in the coming years.

The findings of the review in this chapter add further evidence to a rapid review done by Public Health England in 2016 evaluating improvement in health outcomes for prison health care services delivered by the NHS. From the limited studies they identified the evidence also pointed towards the need for addressing the social determinants for health outside or prison as well as inside prison in order to improve health and well being. Prevention at an early age from ending up in the criminal justice system was particularly highlighted, as well as the negative impact that neglecting people in prison can have on wider communities (Leaman et al., 2016).

Compared to other populations, the health of people in prison has been poorly studied. The literature currently focuses on gathering evidence regarding the health of people in prisons with very few trials evaluating interventions to address the problems identified. Further studies are needed to fully explore the causal relationship between the social determinants of health, intermediate factors such as mental health and substance misuse, how these further increase the risk of incarceration, or other forms of housing that further exacerbate any already underlying health problems.

3 SUPPLY AND DEMAND FOR HEALTH CARE IN PRISON.

3.1 Aim of the chapter

The aim of this chapter is to set out the characteristics of the market for health care in prisons. This is then contrasted with the characteristics of a perfect market and hence why market failure in the provision of prison health care is even more likely than health care delivered in the community.

3.2 Introduction.

As set out in Chapter 2, people in prison experience a multitude of health inequalities. As a result delivering health care to this population presents the health and criminal justice systems with challenges, both in terms of the logistics of delivery as well as the significant resources required to meet the needs of this population. As has been stated in chapter 1, a multitude of fiscal concerns over recent years, particularly for government budgets, has meant that there is increasing interest in how to meet the health care needs of the prison population more efficiently.

Additional reasoning might be required though to justify health care provision in prison given that providing health care in prisons is potentially inefficient and not in tune with the purpose of prison, the purpose of prison being the removal of liberty as punishment for a crime and the safety of the general public. This chapter will firstly set out where inefficiencies and market failure in providing health care in prison occur, particularly where the objectives and outcomes associated with prison do not fit with the objectives and intended outcomes of health care. This is contrasted with where some efficiencies may exist i.e. where the objectives of prison overlap with intended or unintended outcomes from health care interventions. Inefficiencies and market failure are not limited to health care in prisons though, and there is recognition of the problem of resource allocation and how to achieve the maximum benefit to society across most health care related markets (Donaldson & Gerard, 1993). As a result this chapter will also provide reasoning for why resources should be allocated to health care related activities in prison highlighting how these differ in prisons to other health care markets.

As has been stated, providing health care to people in prison represents a significant cost to society, one that has been steadily rising in developed countries such as the USA and UK (McDonald, 1995; Watson et al., 2004). This rise in costs can partially be attributed to a

steadily increasing prison population, but mainly due to an increased cost per incarcerated individual as prison health care costs have increased at a greater rate than any other prison related cost, with a median increase in health care costs in US states of 13% between 2007 to 2011 peaking in 2009 at $8.2 billion US dollars. This is compared to a median 10% increase over the same time period in other per person prison costs (Pew Charitable Trust & John D and Catherine T MacArthur Foundation, 2014). This relatively greater increase in costs for health care in prisons has partially been attributed to an aging prison population, as the prison population that is over 55 continues to represent a larger proportion of the total prison population (Maschi et al., 2013; Psick et al., 2017), but also improved detection and treatment of communicable diseases, substance misuse and mental illness in prisons (Pew Charitable Trust, 2017).

3.3 Inefficiency in the production of health in prison

The purpose of prison can broadly be defined as the protection of society through the deterrence of criminal activity and the incarceration of those likely to commit more crimes. Other purposes include rehabilitation, also with the aim of preventing further crimes and retribution for crimes committed (Avio, 1998).

Healthcare can have many goals, including maximising health related quality of life, either of the individual including patients' experience of healthcare, or of populations as a whole, all of this to be delivered within a finite budget. As stated in Chapter 1, allocative efficiency is about whether to implement a new health care technology and if implemented the volume of delivery to maximise the health of the population (Culyer, 2014). Health maximisation, particularly as defined as health related quality of life (HRQoL, see 7.2.2 for more details) though does not neatly fit with the aims of prison, given that prison can be bad for your health, including poor diet, less opportunity for exercise and increased risk of contracting communicable diseases, as detailed in Chapter 2. This was highlighted in the current global pandemic of the novel coronavirus outbreak (COVID-19), where incarceration was a key risk factor of death from COVID-19: the death rate from COVID in prisons in HMPPS was 3.3 (95% CI 2.7 to 3.9) times the rate of death of their peers of the same age and sex in the community (Braithwaite, Edge, Lewer, & Hard, 2021).

These factors combined suggest that allocating scarce resources to activities that occur within an environment that has a negative impact on health may actually result in a net loss

of health to society. This can be shown using the production function for health as shown in which depicts the maximum out-put of health given a combination of health care inputs. Assuming the prison has some components to it that have a negative impact on health, by increasing the resources spent in prison (A0) on health care by one unit (n to n+1), moving from B to C on the production function, and comparing that to if exactly the same intervention with the same health care inputs were delivered in the community (A1), moving from D to E, although the marginal increase in health is potentially similar(ΔHC-B~ΔHD-B), the non-health care inputs in the health production function mean that the maximum health people in prison can realise is unlikely to be as high that in the community. For example, for two people who both have type II diabetes, and both receive the same health care inputs of medication and lifestyle advice, the person in the community will have more health due to, for example, better living arrangements, more freedom to move around and partake in exercise, better mental health and a lower risk of contracting communicable diseases. This assumption may be overstating the causal impact of prison on health, but is something that can be tested as part of an economic evaluation, where the health outcome is that of the QALY, and will be explored further in chapter 5, chapter 7 and chapter 8.

Maximising health from health care resources may potentially result in differential health between community and prison populations. This may be resolved by moving people out of prison and into the community, however, this presents a number of logistical problems as the reduction of the size of the prison estate is not straight forward. The number of people in prison is a result of a (i) the numbers of crimes committed; (ii) laws and the sentencing practices of judges; and (iii) the number of people already in prison and the length of their sentence. Diversion from prison and increasing the use of community sentences for people who pose limited threat to society has continued to be the most evidence based way to reduce the size of the prison estate though (Clear & Schrantz, 2011).

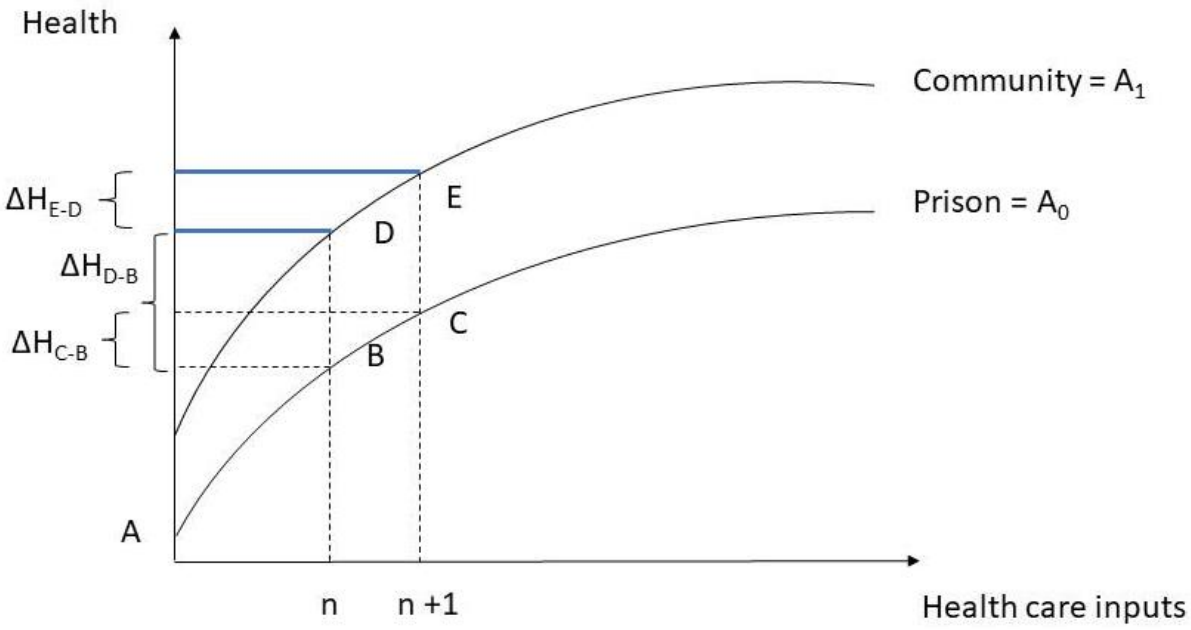


Figure 2 Production function for health - prison compared to community

The argument against the allocative efficiency of health care resources in prison also is not entirely true if we allow for health care funding to achieve outcomes other than health. In particular there are overlaps between the outcomes achieved by some health care interventions and the aims of prison, particularly the aim of preventing crime. This, and a related methodology, is something that has been argued for in a recent paper looking at a system wide approach to valuing opportunity costs and benefits (Vallejo-Torres, 2023). The treatment of substance misuse is an example where health and prison outcomes overlap and hence efficiencies beyond health can be achieved. Substance misuse is a health care issue given that a predominant treatment strategy for opiate addiction in high income countries is the prescription of opiate maintenance therapy, usually methadone or buprenorphine, by a medical professional (Department of Health, 2007). It is also a medical issue given its negative impact on health, including increased risk of BBVs for injecting drug users, increased mortality rates and an increased prevalence of mental illness as set out in Chapter 2.

Illicit drug use is also a criminal justice issue given that it is by definition illegal, as well as being more prevalent in criminal justice than the general population (see section 2.3.5). It also represents a significant cost to both health and criminal justice budgets: the current

opioid crisis in the US was estimated to have had a cost to the economy of over $1 trillion US dollars in 2017. The majority of this (85%) was as a result of a monetised valuation of quality and years of life lost. The estimated cost to the criminal justice system for opioids alone though was $14,819 million. This is in stark contrast to the significantly lower amount spent on treatment of $3534 million, 10% of which is private out of pocket spending (Florence, Luo, & Rice, 2021).

The situation is similar in England and Wales: the societal cost of illicit substance misuse is £20 billion per year. Funding for treatment though only represents a small percentage of that cost. The ring fenced pooled treatment budget for substance misuse treatment was £467 million in 2012/13. This decreased by 14% between 2014/15 to 2017/18 and became subject to wide local variation when treatment funding moved into the public health grant, making Local Authorities responsible for commissioning substance misuse treatment (Black, 2020).

There is strong evidence though that the treatment of substance misuse is an efficient use of public money. A systematic review of economic evaluations of pharmacological treatment for opioid use disorder published in 2021 found evidence that treatment with buprenorphine in particular reduces health care resource use and criminal justice costs as well as increasing health related quality of life (Onuoha et al., 2021). The longitudinal prospective cohort study, National Treatment Outcomes Research Study (NTORS), which recruited patients from drug misuse treatment programmes in England in 1995, found that at 2-years post recruitment, for every pound invested in drug treatment yields between 9.5 and 18 pounds in benefit, depending on the assumptions made. The majority of this cost saving was in reduced criminal justice activity, with increased health care costs (Godfrey, Stewart, & Gossop, 2004). A summary of the evidence of the cost-effectiveness of prison based substance misuse treatment is presented in section 5.4.4 of the systematic review. Overall, prison drug treatment appears to be cost-effective, even to the extent that it results in similar costs and benefits to community treatment (Warren et al., 2006). This would suggest that the health production functions seen in Figure 2 may overlap for community and prison for substance misuse treatment.

As was described in 2.3.4., there is a complex relationship between mental health and criminal justice. Although inpatient health care treatment makes up the majority of the cost of treating SMI, criminal justice system costs make up a significant percentage of the total cost of disease for schizophrenia (Ascher-Svanum, Nyhuis, Faries, Ball, & Kinon, 2010). A range of programs for people in prison with mental illness has found a decrease in prison costs as a result of diversion from prison to mental health systems (Clark, Ricketts, & McHugo, 1999; Forrester et al., 2009; Robst, Constantine, Andel, Boaz, & Howe, 2011). Although cost-saving to the criminal justice system, the evidence suggests that mental health diversion programmes result in an increased cost to health care (Schucan Bird & Shemilt, 2019). For mental health treatment outside of SMI though the evidence is less clear. Treatment for personality disorders in prison, for example, has been relatively unsuccessful. The dangerous and severe personality disorder (DSPD) programme in the UK is an example of a programme with an aim breaching both health and criminal justice systems: rehabilitation of prisoners with personality disorder, addressing both mental illness and offending. The outcomes of the programme though were equivocal, partially due to the challenges associated with conducting research in prisons (Tyrer et al., 2009). The results of the economic evaluation found it was also unlikely to be cost-effective (Barbara Barrett & Tyrer, 2012). For wider common mental health problems there is very limited evidence on how cost-effective interventions in prison are, something which is explored further in the economic evaluation in Chapter 8.

Another area requiring more evidence is whether increasing the resources available for mental health treatment in the community can result in reduced costs to the prison estate, something that is explored further in Chapter 4.

Although some health care interventions have outcomes that overlap with the aim of prison and hence their provision in prison can be justified, the relationship between health and offending is not always clear. Programmes of work that address social needs on release from prison, such as housing, education and employment, also interact with health outcomes, where better social services improve health outcomes. These same programmes may also reduce recidivism (Clear & Schrantz, 2011). As a result, it can be hard to disentangle the causal relationship between improved health and social outcomes and a reduced risk of re-offending and hence justify the provision of a range of health care

programmes in prison. Other health care programmes may not influence re-offending at all and hence other reasons are required for justifying funding their provision in prisons.

3.4 Equity, ethics and duty of care

The second reason for providing health care in prison is that of an ethical imperative and a duty of care. People in prison are overrepresented by some of the most vulnerable and marginalised populations in society including the homeless, ethnic minorities, people with drug dependence and people with mental illness as detailed in Chapter 2. Placing these people in custody places a duty of care on the state.

To this end there are a range of country specific and international assertions about the "equivalence of care" that should be available to people in prison. This refers to an agreement that people in prison should have access to the same quality of care as that which would have been available to them if they were in the community. This principle of equivalence has been cited in UN and WHO documents on prison health (Maschi, Viola, & Sun, 2013) and is upheld in the USA in the 8th amendment of the constitution (Niveau, 2007). Within the English prison and health care systems policy states that the health care available to people in prison is to comply with clinical excellence and best practice (NHS England, 2022). That prisons should provide adequate treatment has also been brought before the High Court in the UK , when a class action suit brought by prisoners alleged that they were subjected to inhuman and degrading treatment as a result of not receiving adequate access to treatment for addiction. The case came to a total cost of £3.5 million, with the prison and health service agreeing to pay out but with no admission of liability (Dyer, 2011). Similarly in the US a $17.5 million class-action lawsuit was successfully filed against the State of Oregon alleging cruel and unusual punishment for the cessation of HCV treatment (Tan, Joseph, & Saab, 2008). Both these cases provide a clear message that it is expected that people in prison have access to adequate clinical care otherwise health care and the prison service risk legal and financial ramifications.

Access to an equivalence of care is not always possible in a prison environment and any environment where law enforcement or coercion may occur, or where access to or choice of health care is limited. Within the criminal justice environment specifically, people may be coerced to choose specific treatment options, particularly in regards to the treatment of substance misuse, as is the case with drug courts, or access to mental health treatment

because they are mandated, as is the case with mental health court diversion programmes. They may also choose a treatment option because the facilities available to them with that treatment option are preferable to prison, such as therapeutic communities for the treatment of substance misuse. In this sense prison and the circumstances prior to imprisonment may take away some aspects of choice and equity of care.

Other areas where equity might intentionally be missing is making specific medical treatments available to people in prison that may be subject to abuse. In England some treatments for opiate addiction that are available in the community are not available in prison for security reasons (Department of Health 2007).

3.5 Externalities and spill over

Within the areas of substance misuse and mental health in section 3.3 I discussed the relationship between treatment provision and prison costs, in that reduced provision, both in prison and the community, may result in increased costs to the criminal justice system. There may be other areas though where prisons have specific characteristics that result in negative spill over effects if not adequately addressed.

The most obvious of these is the need to address communicable diseases while people are in prison. The nature of the prison environment and characteristics of the population mean that communicable diseases are more prevalent in prisons than other environments as discussed in 2.3.3. If not addressed before release, then untreated communicable disease represents a public health problem for the community as well. Hence a key issue for prisons is the prevention, identification and treatment of communicable diseases and such actions are likely to increase the net health of society. The evidence for if this is always cost-effective is something that is explored in Chapter 5.

An additional externality is the impact that imprisonment and health can have on housing and employment following release from prison. Baron et al (2013) found that mental health problems plus imprisonment presents an additional barrier to obtaining employment outside of the barrier of previous imprisonment alone.

Imprisonment can also have an impact on family members left behind in the community. Although there can be some pro-social impact in the case where the incarcerated person was a source of distress to the family, overwhelming the effect is negative as partners are

left with the economic and emotional burden of raising a family while the other partner is in prison, ultimately having a negative impact on the mental health of the partner and children (Wakefield & Powell, 2016), with the children of incarcerated parents being two and half times more likely to develop SMI (Clear, 2008; Murray & Farrington, 2008). Wider impacts on the children of incarcerated parents include increased risk of behaviour problems, unhealthy weight, special education placement and poor educational attainment, resulting in a negative, lifelong impact (Wakefield & Powell, 2016). For the minority of parents where there is a positive impact on the children of incarceration, this is predominately as a result of the incarcerated parent having health problems that would benefit from improved access to treatment, such as serious mental illness or substance misuse (Wakefield & Powell, 2016). For women who are imprisoned and give birth while in prison, there is a significant negative mental health impact on the woman and their infant. For the women who are primary care givers of a child, and where there is no family support to look after their child(ren) there is the ongoing cost to society of foster care (Forrester, Hopkin, Bryant, Slade, & Samele, 2020).

3.6 Quality, efficiency and access to health care in prison

Having established that people in prison should have health care made available to them, not just because they have a right to, but also that providing the care may result in a net gain to society, the next problem becomes how best to provide this care so as to meet the tripartite aims of health care: patient choice, quality of care and efficiency of delivery (Berwick, Nolan, & Whittington, 2008). The nature of prison is such that incarcerated individuals have very little control over the care they receive or the clinicians that they have access to. In English prisons, the health care delivered in prison is commissioned by NHS England and includes primary care, mental health, substance misuse, dental, eye care and maternity care in women's prisons (NHS England, 2023). Although sometimes delivered by a single organisation, in most circumstances care is delivered by a mix of NHS and private organisations, with the health care staff in the prison being employees of these agencies. Having care delivered by a number of agencies can sometimes result in fragmented care, poor communication and poorer outcomes including death (UK Parliament, 2021). How to access health care can differ by prison, but commonly a system is in place for the person in prison to request an appointment for a given concern or condition. If a referral to

secondary care is made this will require liaison between the prison and the secondary care provider for the person to attend the appointment, either by escort, or in some instances remotely via telehealth. This though differs by the security level of the prison, with people in lower security and open prisons able to request a release on temporary license, which grants them leave away from the prison to attend things like doctor appointments.

In the US the health care provided to people in prison is generally the responsibility of the prison, with care commonly commissioned from private organisations. Distance to the nearest hospital can be a significant issue in the US, with it being common for prisons to be approximately a 2-hour drive from the nearest hospital (Brunicardi, 1998).

Overall though the person in prison has no choice in health care provision other than what is available, creating an imbalance of power towards the organisation or clinician providing the care. A natural monopoly is hence in place, as there is generally only one source of health care available to people in prison. This restricted access to care may have negative implications on the quality and efficiency of the care provided, as there is no incentive for health care providers in prison to improve the quality of the care they provide. As a result it is up to the legislature to step in and ensure the health care provided meets the needs of the population. In the English NHS this is done through the Care Quality Commission being responsible for monitoring, inspecting and regulating the quality of health care provided in prisons (NHS England, 2022).

There is a further problem in regard to the allocation and access to resources for care. In most countries the arm of government responsible for budgeting for the provision of public services is different to the arm responsible for deciding the type and length of prison sentence - the legislature sets the prison budget, but it is the courts that set the nature of the sentence and the number of prison days. As a result, the organisation of the criminal justice system is such that resources will always be allocated inefficiently. If the spending for health care in prisons comes from the criminal justice budget, the type and quantity of health care delivered may compete with day-to-day security costs.

In the US there is a legal requirement that health care is provided in correctional facilities. For non-Federal prisons the cost of correctional health care falls directly within the budget for other correctional spending in the state or city or county in which the facility is located

(Spaulding et al., 2013). As identified above, health care spending then needs to be weighed against the costs required to maintain security in prisons. Of particular concern are patients with chronic diseases with expensive treatment regimens, such as HIV and HCV, that are proportionally more prevalent in prisons. Some of these people may be funded through Medicaid in the community but are no longer eligible once in prison. One proposal has been that prisons should be reimbursed the cost of these treatments through health care funding. This could potentially result in improved access to treatment in prison and overall a reduction in costs to society of treatment (Venters 2016). Ensuring health care provided in prison closely links in with health care services provided later in the community can also ensure that there is less wastage in the system, as any treatment that is started in prison is continued in the community, particularly for things such as substance misuse and treatment for infectious diseases (Spaulding et al., 2013).

Within England and Wales the problem of the tension between spending on health care and security within prisons has been solved by separating the prison and health care budgets, such that since 2006 the funding for prison health care sits outside of the criminal justice system and with the NHS (Hayton & Boyington, 2006; Senior & Shaw, 2011). Although this reduces the tension between spending on day-to-day prison activities and health care, the tension then becomes one of spending the limited health care budget in prison or moving some of the spending into the community. As a result, if the prison health care budgets are not ring fenced there is a risk that the spending could move to outside the prison. An additional issue is that NHS budgets are calculated based on a formula related to the population in their area. In addition to having a greater health need than their peers in the community, people in prison commonly come from out of area. As a result it is important that separate funding be identified for prison health care spending given the greater level of need for this group of the population.

Prior to 2013 in England and Wales, in some private prisons, companies had previously been contracted to provide prison and also the health care within the prison. Given the market failures noted above this is unlikely to result in the optimal outcome, given the different aims of prison and health care. Any private provider of prisons tasked also with providing health care will have more reasons to allocate their resources towards activities directly

associated with incarceration of individuals and less with health care given their conflicting aims. As a result they are unlikely to meet any of the additional conditions given above.

The assertion that equivalent health care should be available to people in prison regardless of the cost though may not necessarily be upheld *a priori*. Instead, similar to health care in the community, need, demand and supply need to be considered (Rodriguez Santana et al., 2023) and the same rules of allocative efficiency that apply to health care in the community should be applied to health care in prisons, noting the specific circumstance and characteristics of the population. This is related then to Figure 2, where if we define need as a health deficit that exists due to a need for health care (Rodriguez Santana et al., 2023), the efficient allocation of resources would allocate similar resources to populations with similar need – meaning people in prison attain lower health than people in the community. If need though is defined as a need for health, the question becomes slightly different and falls more into the realms of equity concerns and how to shift the health frontier for people in prison up to that of people in the community. Rodriguez Santana et al. (2023) also highlight that "need as the capacity to benefit" may be a qualitatively different question for marginalised groups, and that extra measures need to be put in place to address the vertical equity in outcomes gap that we see in Figure 2. This is because some non-health care inputs, particularly the social determinants of health such as housing and education, may be more powerful determinants of total health than health care inputs when determining the maximum health that a person can achieve. Although there may be some treatments that are more cost-effective to provide in the community compared to prison the treatment or how the treatment is delivered may need to be augmented for the prison environment so as to increase the cost-effectiveness. What is also important is that systems beyond health care need to be considered in economic evaluations in prison when determining the total maximum health output given the potential strength of their impact on total health production.

As a result, the competing needs across criminal justice and health mean that it is hard to make an argument for any economic evaluation conducted in prison though to be from a purely health care or criminal justice perspective, instead with the widest perspective possible being preferred, something which is discussed further in Chapter 5.

3.7 Conclusion

Prison health care, like most other health care markets, is susceptible to market failure. There is a number of reasons for providing health care in prison though including that some health care interventions result in outcomes consistent with the aims of prison and that not treating people in prison may actually result in a net loss to society given the externalities, particularly those associated with communicable diseases. The most important component though is the ethical and moral consideration that imprisonment is the removal of liberty for crimes committed, that good health is a fundamental human right and the duty of care of the state to look after vulnerable populations whose freedom to access health care they have removed. Providing the health care that people in prison need though may still be full of inefficiencies and idiosyncrasies that may require further examination before the best solution is determined that meets the conflicting needs of the prison, the individual and maximising the health of the population with limited resources. This is the motivating reason for Chapter 5, a systematic review of economic evaluations of prison interventions, to determine what the key issues are when looking at efficiency in delivering prison health care and how to address them.

A further aspect of market failure is that prisons costs and the number of people in prisons can be dependent on health care interventions provided in the community, for example substance misuse treatment. In the next chapter, Chapter 4, I examine if there is a relationship between health care spending in the community on mental health care and the number of people sentenced to prison.

4 THE IMPACT OF CHANGES IN MENTAL HEALTH FUNDING IN ENGLAND ON THE NUMBER OF PEOPLE SENTENCED TO PRISON

4.1 Aim of the chapter

As set out in Chapter 3, there is a number of inefficiencies in the delivery of health care in prison, particularly due to the nature of the prison environment as well as the funding arrangements. A further market failure may occur as prison numbers are commonly determined by factors outside of the control of the criminal justice system. Although the number of people entering and leaving prison can be determined by a function of the police, laws and the courts, things outside of the criminal justice system may also contribute to the number of people sent to prison. As was briefly touched on in Chapter 2, there is also likely to be a number of common determinants of prison and poor mental health that mean that the two populations can overlap. The aim of this chapter is to explore the role that funding for mental health treatment might play in the number of people sentenced to prison.

4.2 Introduction

In 1939 Lionel Penrose, a British psychiatrist, published evidence of the inverse relationship between mental health inpatient beds and the number of people in prison based on a cross-sectional analysis of Europe; as the number of inpatient beds in the community reduces the number of people in prison increases (Penrose, 1939). He proposed that by increasing inpatient bed numbers, you would in turn reduce criminality and hence prison numbers. This inverse relationship between mental health inpatient beds and prison numbers has become known as Penrose's Law and has been shown time and again across time and countries (Hartvig & Kjelsberg, 2009; Mundt et al., 2015). Penrose's view that deinstitutionalisation causes criminality though has not been universally accepted, with some studies showing that the effect is modulated by the role of the economy, where both prison numbers and inpatient psychiatric beds might be driven by broad economic factors (Lamb, 2015). Overall Penrose's law should be questioned in that it hypothesises a potentially harmful view of the link between criminality and people with serious mental illness: that if there are not enough beds to restrict people with serious mental illness they are more likely to go out and commit crime. Others though have seen it more as evidence of inpatient psychiatric beds and prison places being substitutes in that both offer structure, housing and food to vulnerable populations (Lamb, 2015). Overall though, there is some evidence of the link between psychosis and criminality, with one in five people who present

to mental health services having a previous history of criminal conviction, compared to 8.3% in the general population (Stevens et al., 2012).

Following a number of scandals in mental health institutions in the 1970s and a growing agreement that the institutionalisation of people with mental illness was morally questionable as well as against human rights, the UK started a process of moving mental health inpatient care into the community. This process started in earnest in the 1980's, and over time has resulted in a focus on providing mental health care predominantly in the community, with inpatient beds being reserved for the most severe patients. As a result the care of people with mental health problems can be seen as something that should be delivered in the community and Penrose's Law may be less relevant. What has not been examined though is the relationship between funding for mental health services and prison numbers. Given that the majority of mental health care should now be provided in the community, one would expect that additional funding relative to need should result in better mental health outcomes. Improved mental health treatment is linked with improved outcomes in housing, education and employment (Taylor Salisbury, Killaspy, & King, 2017). Within the economic theory of crime, crime rates increase when the potential utility from illegal activity is greater than the utility from legal activity, for example where one can make more money through selling drugs than from a full-time job. Or where the effort required to make the same amount of money is less through illegal avenues than legal ones (Freeman, 1999). The potential mechanism for mental health treatment then reducing crime would be through facilitating financial stability, with mental instability being highly correlated with unemployment. Unfortunately this theory says nothing about the role of violent crime, something associated with severe mental illness. For the reduction of violent crime the main mechanism for reductions in crime would be through high quality treatment and the systems that surround it (regular monitoring of individuals, liaison with criminal justice systems) as well as increasing the emotional stability and functioning of individuals.

Since the austerity measures put in place in 2010 by the Conservative and Liberal Democrat coalition government in the UK mental health funding saw funding in real terms decrease by 1% in 2010/2011. This has translated to a 48% decrease in the number of people who received mental health care (Docherty & Thornicroft, 2015). This disinvestment has not been consistent across areas, with disinvestment levels being determined by Clinical

Commissioning Groups (CCGs). The same level of disinvestment has not been seen in physical health services (Docherty & Thornicroft, 2015).

The aim of this analysis is to use the fact that mental health funding fell between 2010/2011 and 2013/2014, but fell differentially by area, to explore the relationship between mental health funding and the number of people sentenced to prison. Funding data have been obtained from Programme Budgeting data and the number of people sentenced to prison from court data.

4.3 Methods

4.3.1 Data

4.3.1.1 Programme Budgeting Data

Since 2003 Primary Care Trusts (PCTs), the precursors to CCGs and now Integrated Care Boards (ICBs), have been required to submit information on what they spend on 23 broad categories of illnesses according to primary diagnosis (based on ICD-10 codes) for all items of NHS expenditure. This includes expenditure on acute care (inpatient and outpatient care), community and primary care and medication. In 2013 following the 2012 Health and Social Care Act PCTs were replaced by CCGs who were also required to make Programme Budgeting returns. Publicly available Programme Budgeting data are available in the Spend and Outcomes tool (SPOT) which covers the years 2009/2010 until the year 2013/2014 (Public Health England, 2018) and includes the programme budget spend per head of population by CCG. Reporting of programme budgeting data changed in 2013/2014 relative to previous years and hence only up until 2012/2013 has been used. These were adjusted using the Health and Social Care Inflation Index so that spend per head of population is reported in 2014/2015 GBP for all years (Curtis & Burns, 2020). Descriptive statistics for the Programme Budgeting data are presented in Table 1.

The programme budgeting cost areas included for mental health funding are Psychosis, Substance Misuse and other Mental health funding.

Mental health funding is likely to by highly correlated with funding for other areas of health care and there is evidence that improved access to health care in the United States of America (USA) can reduce criminal behaviour, particularly for violent crime (He & Barkowski,

2020). To test if the effect we see with mental health funding is potentially due to decreases in the health care budget as a whole we use a Programme Budgeting cost area, coronary heart disease, an area of spend that is of a similar per head of the population to that of mental health funding, but that is likely to be unrelated to mental health or criminal activity through improved mental health is used as a counterfactual.

The SPOT tool also includes CCG outcomes, including the number of people per 100,000 of the CCG population with an open Adult Mental Health Care Spell in NHS funded adult specialist mental health services and the number of people on a care programme approach (CPA), a personalised package of mental health care for people with SMI. These data are only available for the year 2014/2015.

Table 1 Descriptive Statistics – Programme Budgeting

Variable	CCGs n	Mean	Std. Dev.	Min	Max
Psychosis spend CCG spend per person in 2014/2015 GBP (used to calculate the independent variable $\Delta R^{Psychosis}$)					
2009/2010	176	43.18	32.32	5.78	127.87
2010/2011	176	30.94	30.05	4.86	144.91
2011/2012	176	46.15	39.13	5.72	283.07
2012/2013	176	38.23	23.71	3.98	121.22
All mental health spend CCG spend per person in 2013/2014 GBP (used to calculate the independent variable $\Delta R^{Other\ MH}$)					
2009/2010	176	214.33	30.23	150.30	303.92
2010/2011	176	218.16	37.62	108.81	353.10

2011/2012	176	219.02	33.70	132.46	315.77
2012/2013	176	217.62	32.82	154.50	366.54
Substance misuse spend CCG spend per person in 2013/2014 GBP (used to calculate the independent variable $\Delta R^{Substance\ misuse}$)					
2009/2010	176	19.24	9.01	4.15	49.81
2010/2011	176	22.06	10.98	5.03	65.47
2011/2012	176	23.52	9.71	5.00	55.95
2012/2013	176	23.67	10.17	5.27	69.28
Coronary heart disease spend CCG spend per person in 2013/2014 GBP (used to calculate the independent variable ΔR^{CHD})					
2009/2010	176	47.21	12.65	22.90	125.32
2010/2011	176	42.79	10.65	18.77	81.59
2011/2012	176	39.16	8.64	18.79	67.78
2012/2013	176	32.49	8.37	14.49	65.45
People in contact with mental health services in 2014, per 100,000 (individual level covariate – *i)*	176	2276.05	770.65	737.65	6038.10
People on CPA in 2014, per 100,000 (individual level covariate – *i)*	176	523.64	347.52	13.31	1747.93

4.3.1.2 Prison intake numbers

Although one could arguably look at the number of people going into prison over time to determine the impact that changes to NHS spending on mental health might have on prison numbers, prisons that commonly take people directly from court, called local prisons, are not evenly dispersed geographically and the receiving prison may not reflect where the person is originally from. This is particularly the case when prisons are at capacity, which was the case during this time, as the closest prison may not have a place free and hence the person is moved to a prison even further away. Information on which CCG or local authority the person going into prison came from is not readily available. What is available is court sentencing data reported by Police Force Areas (PFA), with the local court more likely being a better reflection of a persons likely place of residence. These data are available from 2007 up until present. Quarterly data are reported on the number of people sentenced or remanded into custody (people that go to prison while they await sentencing) by court type, sentencing type and type of crime (Ministry of Justice, 2019b). Only adults have been included in the analysis, with sentencing for juveniles and young adults excluded.

Programme Budgeting data are reported by UK financial year, which runs from April to April each year. As court data are reported by quarter, the sentencing data could be edited to correspond with the financial years. Sentencing data with a 1 year lag, i.e. people sentenced 1-year after the financial year, was also created.

The population by PFA in 2010 (Home Office, 2011), the most recent year available, was used to calculate the number of people sentenced to prison per 100,000 of the population (see Table *2*).

4.3.1.3 Police numbers

The number of people sentenced to prison may also be a function of the number of people employed by the police, as reductions in the number of police may result in a reduction in the number of people that can be caught and processed for committing crimes. Table *2* reports the total full time equivalent (FTE) number of police staff employed in each PFA as published in police workforce statistics (Home Office, 2023).

Table 2 Statistics by PFA

Variable	PFAs n	Mean	Std. Dev.	Min	Max
Number of adults sentenced to prison per 100,000 of the population (used to calculate dependent variable Δy sentenced)					
2009/2010	37	130.46	34.18	56.08	211.90
2010/2011	37	138.46	37.28	63.03	203.50
2011/2012	37	142.80	40.77	70.74	222.85
2012/2013	37	133.70	37.57	69.38	209.71
2013/2014	37	133.88	40.36	72.70	206.32
2014/2015	37	133.15	40.13	65.55	204.14
Number of adults suspended sentence per 100,000 of the population (used to calculate dependent variable Δy suspended sentence)					
2009/2010	37	67.68	20.37	27.96	114.82
2010/2011	37	71.87	22.09	24.49	113.04
2011/2012	37	71.25	22.54	29.32	117.84
2012/2013	37	66.52	20.88	32.17	116.59
2013/2014	37	78.09	23.13	43.23	126.18

2014/2015	37	84.06	23.61	50.33	125.99
Number of adults community sentence per 100,000 of the population (used to calculate dependent variable Δy community sentence)					
2009/2010	37	201.52	63.55	115.59	413.31
2010/2011	37	207.63	64.63	99.97	417.92
2011/2012	37	199.65	61.73	109.91	394.32
2012/2013	37	170.48	49.03	101.30	319.25
2013/2014	37	154.31	46.37	89.51	292.10
2014/2015	37	139.52	41.41	83.03	249.51
FTE staff per PFA (group level covariate - *j*)					
2009/2010	37	5485.72	8252.75	1214.20	52515.28
2010/2011	37	5244.81	7947.99	1258.99	50576.68
2011/2012	37	4953.42	7566.70	1200.12	48185.25
2012/2013	37	4817.32	7241.63	1168.45	46130.08
2013/2014	37	4731.74	7066.32	1145.78	45016.76

4.3.1.4 LSOA deprivation indices

Data on LSOAs including deprivation indices (index of multiple deprivation (IMD)) and crime were obtained from the Office of National Statistics. LSOA statistics for 2015 were used

(Office for National Statistics, 2015). The values used are the average LSOA IMD score for the CCG, with a mean IMD score of 21 and a standard deviation of 8.5.

4.3.2 Mapping CCGs to Police Force Areas

Files are available that map CCGs (Office for National Statistics, 2017) and PFAs (Office of National Statistics, 2016) to LSOAs. Based on this PFAs and CCGs can be mapped to each other with the LSOA as the link. Overall LSOAs are nested in CCGs which are nested in PFAs and boundaries line up (see Figure 3). A key issue though is that London Metropolitan is a single PFA which covers 32 CCGs. As a result, the London Metropolitan Police Force and its associated CCGs were dropped from the analysis.

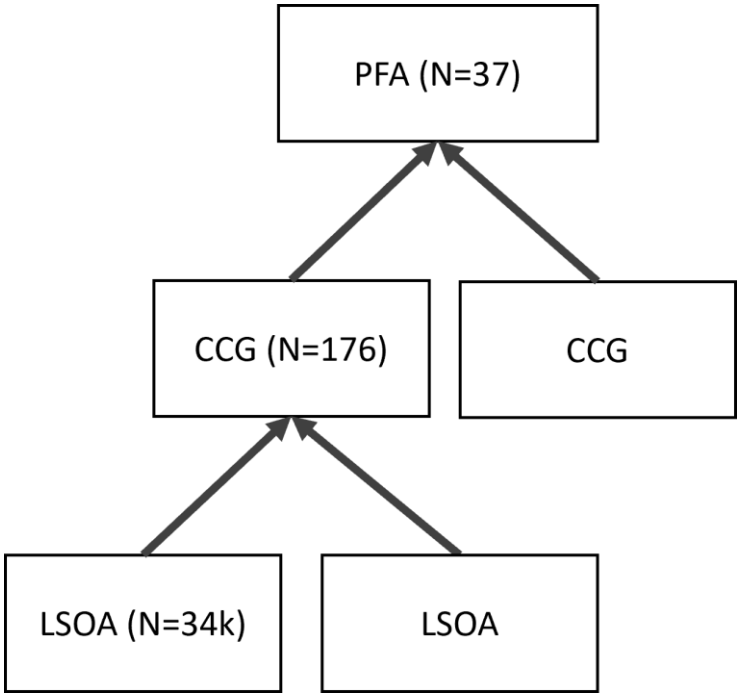


Figure 3 Nesting of lower layer super output areas (LSOA) within clinical commissioning groups (CCG) within police force areas (PFA)

4.3.3 Analysis

Given that there is nesting of CCGs within PFAs, and that there will be variation in funding within CCGs over time and between CCGs, but also variation in sentencing within PFAs and between PFAs a mixed linear multi-level model was used. A linear model was possible because although funding and sentencing data are positively skewed, year on year

differences were normally distributed. The most basic level of the model is specified as follows:

$$\Delta y_j = \alpha + \beta.\Delta R_{ij} + \beta_i + \beta.t_j + t_{ij} + u_i + \in_{ij}$$

Where *i* and *j* denote the individual CCG nested within a PFA group respectively. The dependent variable (Δy_j) is the change ($y_{jt} - y_{jt-1}$) per 100,000 of the population year on year in the number of people sentenced to prison. The per 100,000 of the population number is calculated based on PFA sentencing data and mapped to the specific CCG. The multi-level model allows for the analysis to be grouped at the PFA level.

The independent variable (ΔR) is the change in funding ($R_{it} - R_{it-1}$) per head of population for the Programme Budgeting cost area year on year for each individual CCG. CCG has also been included as an individual level variable nested in PFA in the analysis. Year (t_{ij}) is included as a fixed effect. The covariate β_i represents CCG level covariates. These are consistent over time. $\beta.t_j$ is the PFA level covariate and varies over time. The error terms are captured by u_i for the individual error and $\in_{ij}$ for the intercept error. A 1-year lag analysis was also conducted, where the change in the number of people sentenced per 100,000 of the population Δy_j was included in a model for the change in Programme Budget for the previous year ($\Delta y_j = y_{jt-1} - y_{jt-2}$; $\Delta R = R_{it} - R_{it-1}$) .

A potential confounder (IMD) of LSOA level deprivation was included in the model as both funding and the number of people sentenced to prison are likely to be influenced by LSOA deprivation indices. Deprivation indices are a summary score made up of a range of components including crime, health, housing and employment. A range of models including each of the components of deprivation separately as well as the deprivation index summary score were tested. The likelihood ratio test was used to determine the best covariates to use. Including deprivation as a single summary average score performed better than separating it out into its specific components, including a specific component for crime. The IMD for 2015 was used. IMD by LSOA was averaged across CCGs and is included in the model within β_i.

Other covariates tested for inclusion in the model were the number of cases of mental illness per 100,000 of the population and the number of people on the care programme

approach as being potentially correlated with both psychosis funding and the number of people entering prison and is included in the model within β_i. The number of police officers in a given PFA in each year was also included, given this could influence the number of people arrested and sentenced and is included in the model as a time varying effect $\beta . t_j$.

A range of model structures and covariance matrices was tested to determine the best model fit based on the log likelihood, with a higher log likelihood preferred. The model that provided the best fit was a two level model, nesting CCGs in PFAs with random effects for programme budget spend per head of the population for the CCG and number of police officers for PFA with an unstructured covariance matrix. Year, number of cases per 100,000 of the population of mental illness and the number of people on the care programme approach and average IMD index for the CCG were included as covariates in the fixed effect component of the model. Number of cases per 100,000 of the population of mental illness and the number of people on the care programme approach were not included in the models for the programme budget spend unrelated to mental health.

Models were calculated for psychotic disorders ($R^{\Delta Psychosis}$), substance misuse ($R^{\Delta Substance\ misuse}$), Other mental health disorders ($R^{\Delta Other\ MH}$) and the comparator of coronary heart disease ($R^{\Delta CHD}$) Programme Budgeting cost areas, with coronary heart disease used to test if there was any relationship between sentencing and logically unrelated health care funding. This was done for the number of people per 100,000 of the population (i) sentenced to prison; (ii) given a suspended sentence; and (iii) given a community sentence. The different types of sentences have been broken up to test the hypothesis of the impact of funding on the number entering prison and hence if prison is a substitute for mental health care, which will only be reflected by impact on (i) sentenced to prison. Suspended and community sentences are to evaluate the relationship between spending on mental health treatment and crime rather than if prison acts as a substitute for mental health treatment.

A sensitivity analysis looking at a 2-year lag was also included ($\Delta y_j = y_{jt-2} - y_{jt-3}$; $\Delta \mathrm{R} = R_{it} - R_{it-1}$).

The analysis was conducted in STATA v17 (StataCorp LLC, 2022).

4.4 Results

The average spend per head of population adjusted to 2014/2015 values and adjusting for deprivation in psychosis, substance misuse, other mental health and coronary heart disease programme budgeting areas are shown in Figure *4*, Figure *5*, Figure *6* and Figure *7*.

As hypothesised, the psychosis programme budget saw a significant decrease in spending in 2010/2011, although spending increased to similar levels in the following years. Substance misuse though saw an increase in spending in 2010/2011 and 2011/2012 but remained stable in 2012/2013. Spending for coronary heart disease saw a significant year on year decrease across all years. There were no significant changes over time for other mental health spending.

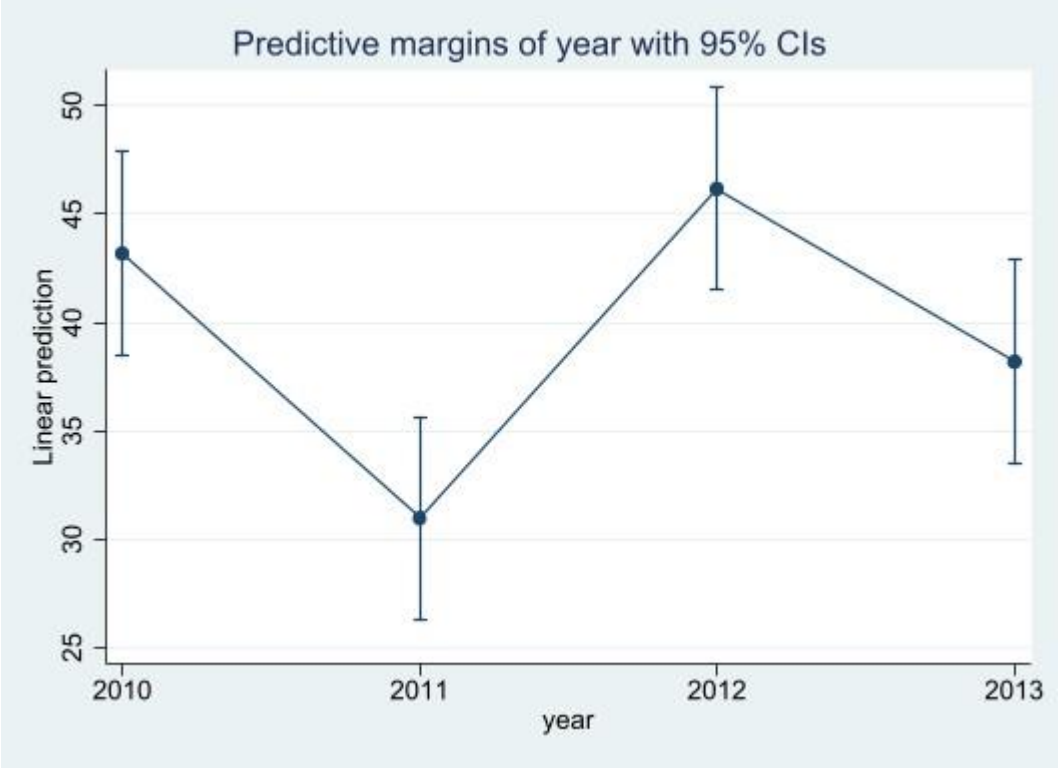


Figure 4 Psychosis spend per head of population from 2009/2010 to 2012/2013 adjusted for deprivation and in 2014/2015 values.

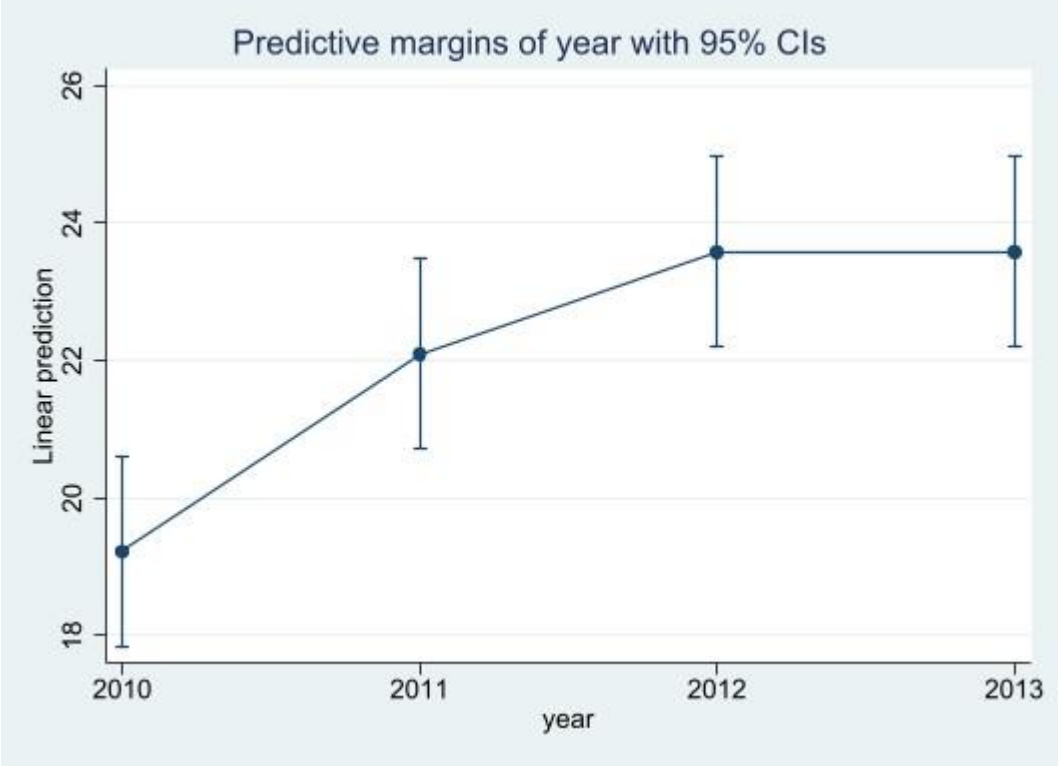


Figure 5 Substance misuse spend per head of population from 2009/2010 to 2012/2013 adjusted for deprivation and in 2014/2015 values.

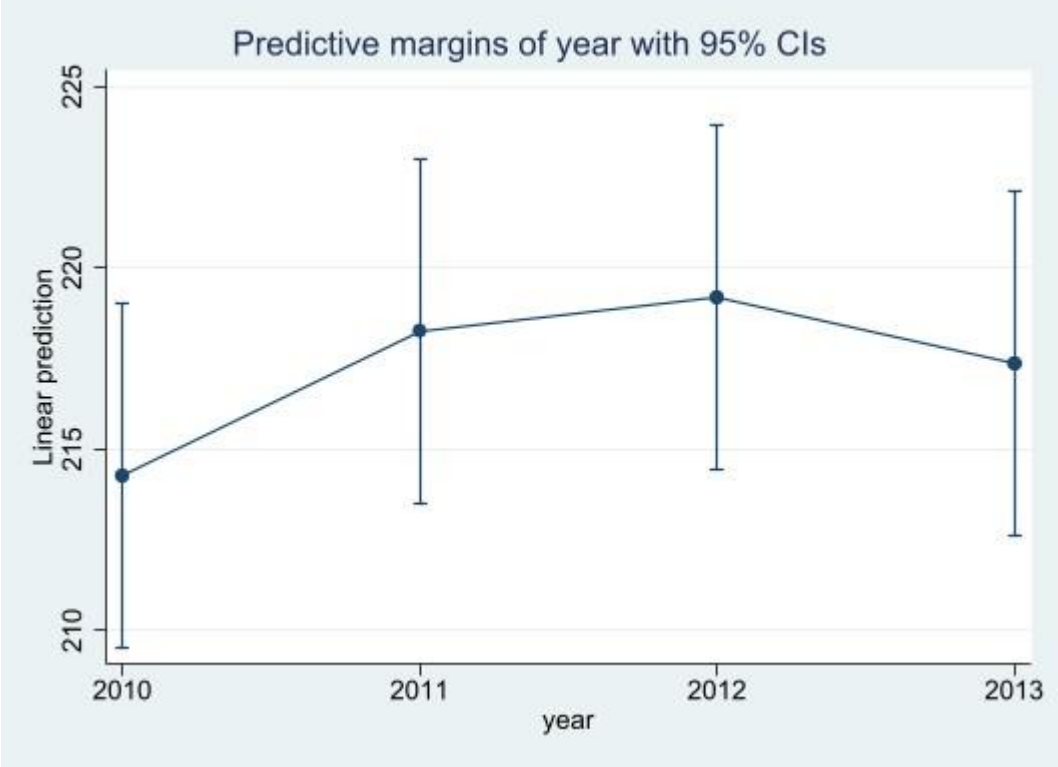


Figure 6 Other mental health disorders spend per head of population from 2009/2010 to 2012/2013 adjusted for deprivation and in 2014/2015 values.

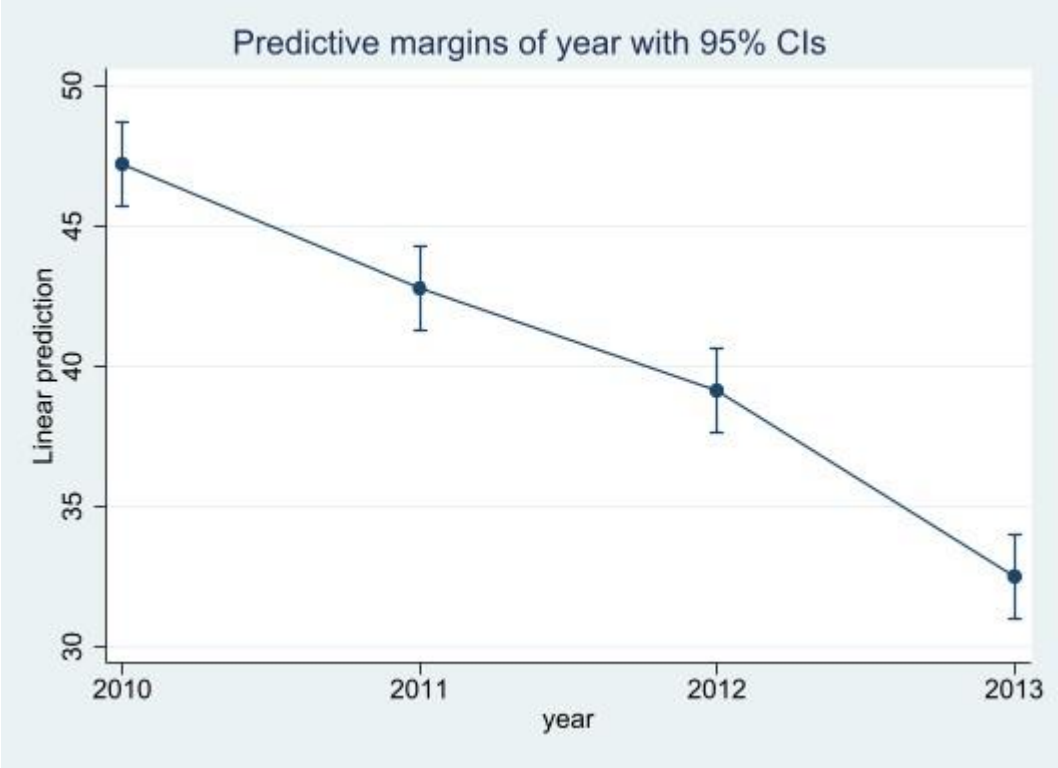


Figure 7 Coronary heart disease spend per head of population from 2009/2010 to 2012/2013 adjusted for deprivation and in 2014/2015 values.

The number of people per 100,000 of the population sentenced to prison, given a suspended sentence and given community sentences from 2009/2010 to 2013/2014 is reported in Figure *8*, Figure *9* and Figure *10*. There was a significant increase in the number of adults per 100,000 of the population sentenced to prison in 2010/2011 and 2011/12, with the changes in 2012/2013 and 2013/2014 not being significantly different to 2009/2010. Suspended sentences saw a significant increase in 2013/2014 only. Community sentences saw a significant decrease in 2012/2013 and 2013/2014.

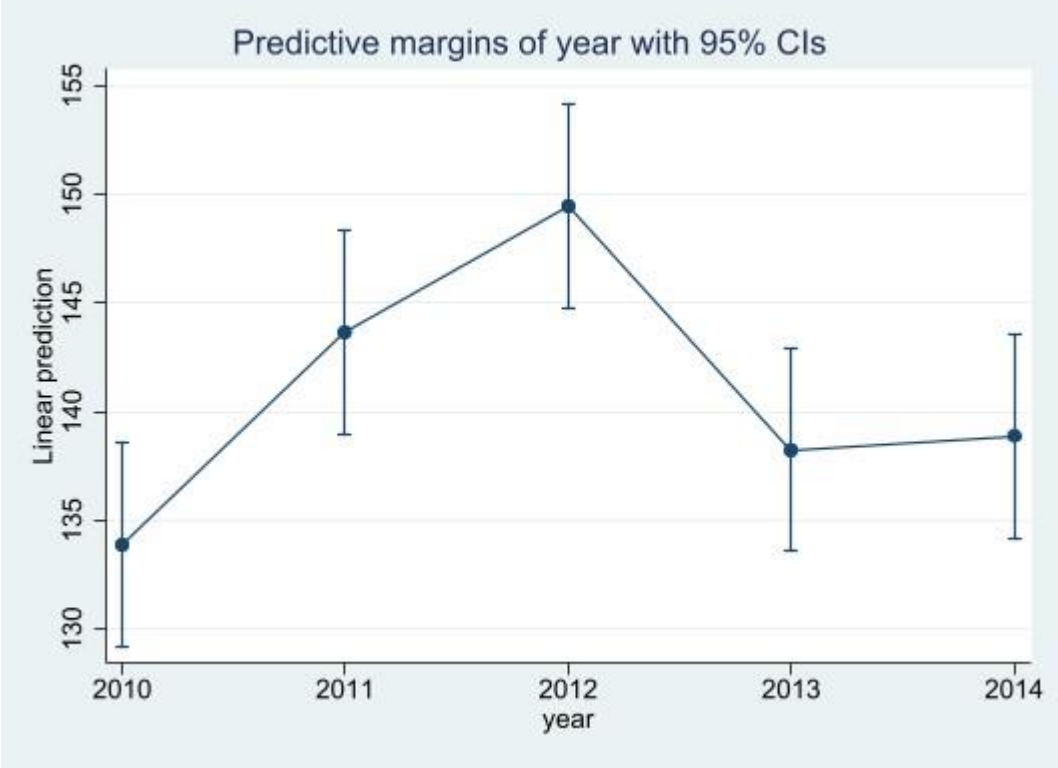


Figure 8 People sentenced to prison per 100,000 of the population 2009/2010 to 2013/2014.

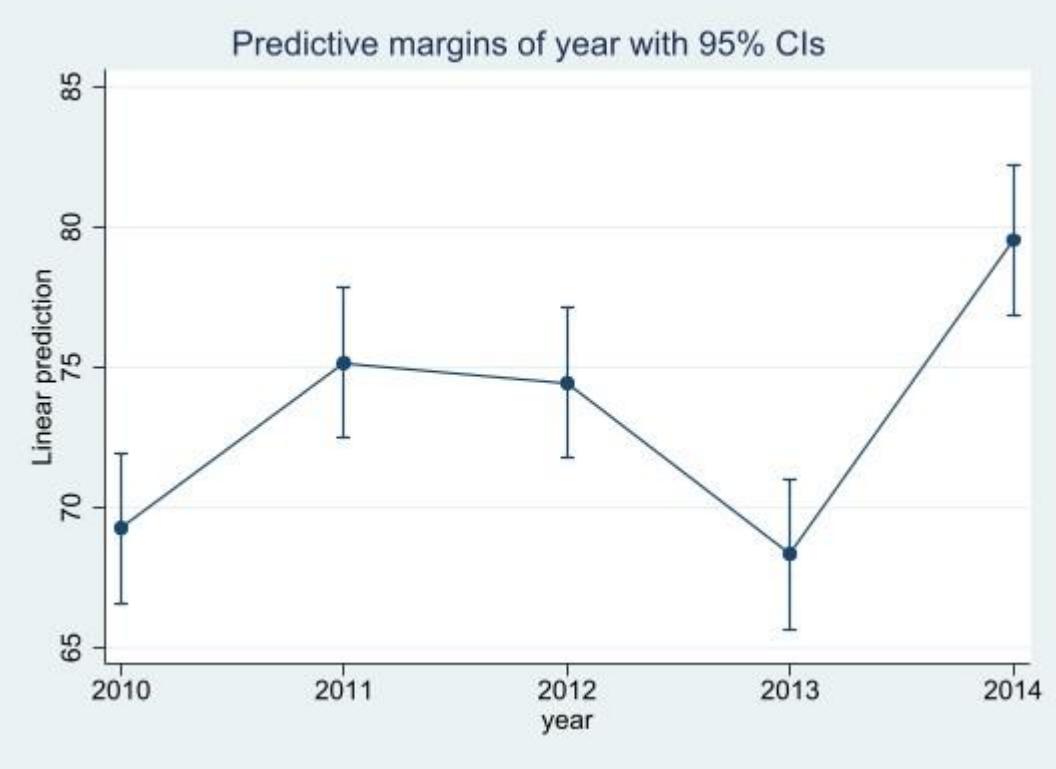


Figure 9 Suspended sentences per 100,000 of the population 2009/2010 to 2013/2014.

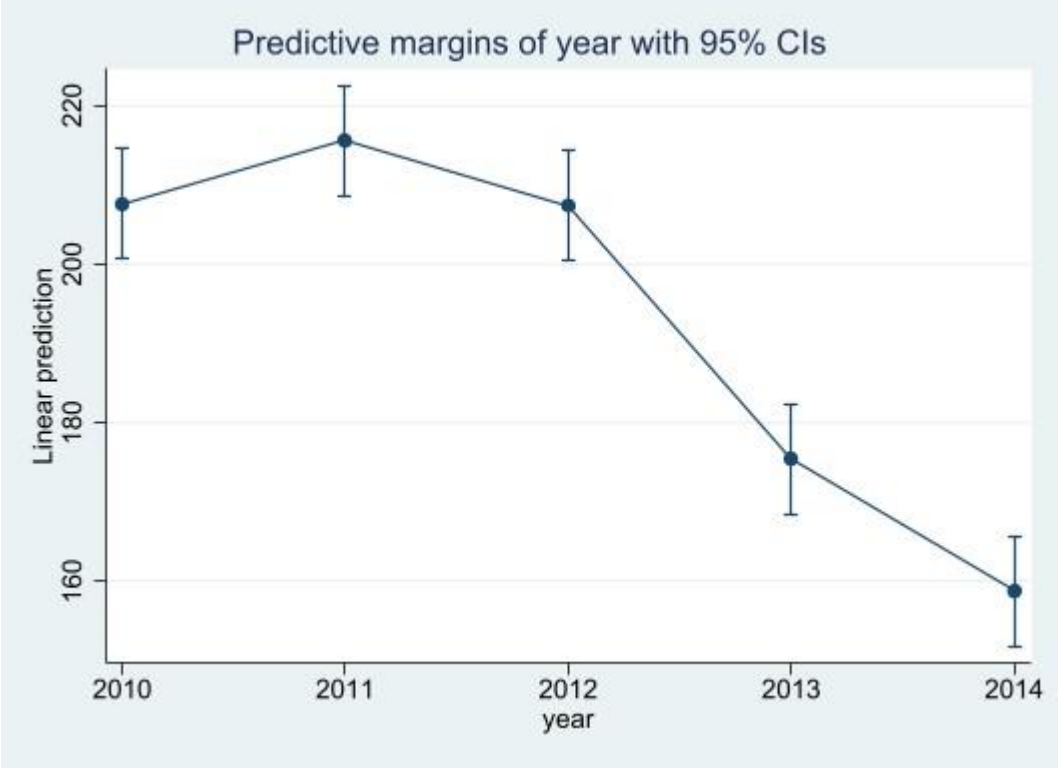


Figure 10 People given community sentences per 100,000 of the population 2009/2010 to 2013/2014.

Table 3, Table 4 *and*

Table *5* report the coefficients for the mixed linear multi-level models for sentenced to prison, suspended sentence, and community sentence respectively. In total there were 525 observations for each analysis, grouped into 185 CCGs nested into 37 PFAs. For both prison and suspended sentences higher mental health spending is significantly associated with an increase in sentencing rate: an additional 0.093 (95% CI 0.033 to 0.153) people per 100,000 of the population sentenced to prison per additional pound of spending and 0.053 (95% CI 0.018 to 0.088) people per 100,000 of the population given a suspended sentence per additional pound of spending. Higher substance misuse spending is associated with a decrease in the rate of suspended sentences in the same year (-0.109 95% CI -0.196 to -0.021).

The results for the 1-year lag, sentencing data compared to spending in the previous year for 526 observations, grouped into 183 CCGs nested into 36 PFAs (see

Table *6*, Table *7* and Table *8*) find increased spend decreases sentencing to prison (-0.091 95% CI -0.152 to -0.031), suspended sentences (-0.028 95% CI -0.044 to -0.012) and community sentence (-0.087 95% CI -0.156 to -0.017) for the year after the spending has occurred. For the 2-year lag sensitivity analysis, the impact of psychosis spending remains significant for the number of people sentenced to prison only (-0.047 95% CI -0.077 to -0.014), with no other analyses being significant.

Table 3 Change in the number of people sentenced to prison per 100,000 per additional £1 spent per head of the population.

	Model 1	Model 2	Model 3	Model 4
Main independent variable	$R^{\Delta Psychosis}$	$R^{\Delta SM}$	$R^{\Delta Other\ MH}$	$R^{\Delta CHD}$
Per additional £ spent	0.093**	-0.074	-0.002	-0.007
Covariates				
IMD Average score	0.017	-0.046	-0.069	-0.069
No. of MH patients	-0.001			
No. on CPA	-0.001			
No. police officers	0.0002	0.001	0.001	0.0001
Year (compared to change in 2010/2011)				
2011/2012	-4.899***	-4.543***	-3.731***	-3.721***
2012/2013	-19.277***	-20.111***	-19.745***	-19.751***
Constant	10.091	9.466	9.614	9.581
Wald Chi2	308.34***	274.93***	246.23***	246.26***

*p<0.05, **p<0.01, ***p<0.001

Table 4 Change in the number of people given a suspended sentence per 100,000 per additional £1 spent per head of the population.

	Model 1	Model 2	Model 3	Model 4
Main independent variable	$R^{\Delta Psychosis}$	$R^{\Delta SM}$	$R^{\Delta Other\ MH}$	$R^{\Delta CHD}$
Per additional £ spent	0.053**	-0.109*	-0.005	0.056
Covariates				

IMD Average score	-0.012	-0.057	-0.052	-0.067
No. of MH patients	-0.0003			
No. on CPA	-0.001			
No. police officers	0.0002**	0.0002***	0.0002**	0.0002**
Year (compared to change in 2010/2011)				
2011/2012	-7.151***	-6.650***	-6.081***	-6.437***
2012/2013	-11.119***	-11.584***	-11.017***	-11.133***
Constant	6.161	6.049	5.561	6.221
Wald Chi2	310.62***	270.03***	236.32***	242.63***

*p<0.05, **p<0.01, ***p<0.001

Table 5 Change in the number of people given a community sentence per 100,000 per additional £1 spent per head of the population.

	Model 1	Model 2	Model 3	Model 4
Main independent variable	$R^{\Delta Psychosis}$	$R^{\Delta SM}$	$R^{\Delta Other\ MH}$	$R^{\Delta CHD}$
Per additional £ spent	0.002	0.121	0.028	0.112
Covariates				
IMD Average score	-0.256*	-0.287**	-0.285**	-0.282**
No. of MH patients	-0.001			
No. on CPA	-0.001			
No. police officers	-0.0002	-0.0002	-0.0002	0.0003
Year (compared to change in 2010/2011)				
2011/2012	-15.547***	-15.346***	-15.471***	-15.581***
2012/2013	-38.240***	-37.898***	-37.943***	-37.978***
Constant	16.153	14.392	14.532	15.102
Wald Chi2	464.99***	468.04***	461.24***	467.59***

*p<0.05, **p<0.01, ***p<0.001

Table 6 1-year lag for sentencing data: change in the number of people sentenced to prison per 100,000 per additional £1 spent per head of the population.

	Model 1	Model 2	Model 3	Model 4
Main independent variable	$R^{\Delta Psychosis}$	$R^{\Delta SM}$	$R^{\Delta Other\ MH}$	$R^{\Delta CHD}$
Per additional £ spent	-0.091**	-0.025	0.001	0.006
Covariates				
IMD Average score	0.081	0.054	0.054	0.054
No. of MH patients	-0.001			
No. on CPA	-0.004*			
No. police officers	0.0002*	0.0002*	0.0002*	0.0002*
Sentencing Year (compared to change in 2011/2012)				
2012/2013	-11.881***	-14.374***	-14.336***	-14.345***
2013/2014	-3.705**	-4.029**	-3.956**	-3.946***
Constant	3.082	1.986	1.894	1.923
Wald Chi2	145.30***	125.63***	125.43***	125.45***

*p<0.05, **p<0.01, ***p<0.001

Table 7 1 year lag for sentencing data: change in the number of people given a suspended sentence per 100,000 per additional £1 spent per head of the population

	Model 1	Model 2	Model 3	Model 4
Main independent variable	$R^{\Delta Psychosis}$	$R^{\Delta SM}$	$R^{\Delta Other\ MH}$	$R^{\Delta CHD}$
Per additional £ spent	-0.028**	0.033	0.009	0.052
Covariates				
IMD Average score	-0.010	-0.024	-0.024	-0.024
No. of MH patients	-0.003			
No. on CPA	-0.0001*			
No. police officers	-0.00003	-0.00003	-0.00003	-0.00003*

Sentencing Year (compared to change in 2011/2012)				
2012/2013	-3.544***	-4.276***	-4.296***	-4.366***
2013/2014	12.553***	12.518***	12.478***	12.545***
Constant	0.226	1.986	-0.376	-0.129
Wald Chi2	717.28***	689.01***	688.00***	692.84***

Table 8 1-year lag: change in the number of people given a community sentence per 100,000 per additional £1 spent per head of the population

	Model 1	Model 2	Model 3	Model 4
Main independent variable	$R^{\Delta Psychosis}$	$R^{\Delta SM}$	$R^{\Delta Other\ MH}$	$R^{\Delta CHD}$
Per additional £ spent	-0.086**	-0.080	0.014	-0.047
Covariates				
IMD Average score	-0.228**	-0.237**	-0.235**	-0.237**
No. of MH patients	-0.001			
No. on CPA	0.001			
No. police officers	0.00004	-0.00003	0.00003	0.00004
Sentencing Year (compared to change in 2011/2012)				
2012/2013	-21.770***	-23.486***	-23.331***	-23.332***
2013/2014	-7.772***	-8.418***	-8.126***	-8.307***
Constant	-2.237	-2.397	-2.738	-2.860
Wald Chi2	309.28***	284.62***	282.88***	282.92***

*p<0.05, **p<0.01, ***p<0.001

4.5 Discussion

This analysis utilises the year-on-year changes in spending on treatment for psychosis, particularly the significant reduction in funding in 2010/2011 compared to the previous year, and that psychosis funding significantly differs by PFA and CCG, to test the relationship between psychosis funding and people sentenced to prison. The results suggest that an increase in psychosis spending per head of the population is related to an increase in the number of people sentenced to prison in the same year the spending occurred, but a

decrease in sentencing the following year. A limitation of the analysis is that it says nothing about the direction of causation, only correlation, and as a result there are limitations in interpreting the results. A potential explanation is the spending for psychosis is responsive to need in a given year, but that the benefit of responding to that need is only realised in the next year. This would also make sense given that sentencing lags behind arrest by 6-months on average.

That the effect has occurred across custodial (prison) and community sentences suggests that it is a function of crime and not as a result of prison acting as a replacement to inpatient care, as the Penrose effect suggests. This analysis though is unable to say anything about the relationship between inpatient mental health bed numbers and prison or crime. Bed numbers are reported by NHS Mental Health Trust (the organisation responsible for delivering specialist mental health care) and not by CCG (now Integrated Care Service (ICS)), LSOA or PFA. As a result an analysis of bed numbers would require mapping Trusts to their catchment areas, noting that some Trusts take out of area. It is likely though that bed numbers are highly correlated with funding and do play a role in the effect. To support this a recent study by Wild et al found a correlation between year on year mental health bed numbers and the number of people in prison (Wild, Alder, Weich, McKinnon, & Keown, 2021). This study used routine, national data on mental health bed numbers and number of people in prison at a national level, and found a time lag of the effect from 4 years up to 16 years, peaking at 10. Although focusing on beds, the weakness of these data is that they are at a national level only, which is not surprising given the issues with linking bed numbers and prison numbers at more granular levels. Landerso et al (2021) found in a Dutch cohort that propensity to admit had an impact on criminal and labour outcomes, with a higher rate of admission being linked to less criminal activity in the long run whereas care in the community had a neutral impact (Landerso & Fallesen, 2021). What this analysis and other evidence does suggest though is that the link between mental health treatment encapsulated by the Penrose effect, increased mental health care results in a decrease in prison numbers, has continued beyond the deinstitutionalisation of mental health services (Hartvig & Kjelsberg, 2009; Wild et al., 2021). Previous studies have also found that people under mental health treatment are more likely to be stable and have fewer days in a correctional facility (Robst et al., 2011). This, plus the effect seen in community sentences,

where community sentences reduce as psychosis funding increases, suggests that psychosis and prison are not substitutes, but instead that high quality care reduces the utility of crime by improving financial and housing stability through legal mechanisms as well as reducing the prevalence of violent crime through improving individuals stability. It is likely that increased funding is also related to improved partnerships across the criminal justice sector that allow for the proactive management of people with serious mental illness that might be at risk of crime. This is something that the review of mental health in prisons conducted by Lord Bradley set out to achieve (Bradley, 2009).

It is important to note though that that this analysis says very little about the relationship between Programme Budgeting area spend and crime, only sentencing. Although crime and sentencing are likely to be correlated, the number of people sentenced only reflects the number of people apprehended for a crime and found guilty. It does not reflect the large number of crimes where no perpetrator is found, or where insufficient evidence is available to result in a conviction. The number of people being sentenced may also change over time as sentencing policies change, for example if there is a policy push for community sentences over prison sentences, or the sentences for specific crimes change, i.e. if drug possession for a specific drug is strengthened by going from a community sentence to a prison sentence.

Overall though there is likely to be a complex relationship between the common determinants of prison, mental illness and health inequalities in general as is discussed in section 2.3.4.

4.5.1 Strengths, limitations and future work

The strength of this work is that it uses publicly available data to look at the potential relationship between funding by programme budgeting areas and court sentencing data.

The results of this analysis though should be interpreted with caution, and potentially only taken in the context of showing hints that there may be an effect but that further work is needed. There are a number of correlated cofounders that were potentially not included in this analysis. The number of people in treatment was included, but only at a single time point due to limited data being available.

A key factor included in the analysis, but in only a cursory way, was police numbers as the size of the police force interacts with sentencing in a number of ways (Hartvig & Kjelsberg, 2009). A reduction in police numbers can allow more crimes to happen. Unintuitively and conversely though a reduction in police numbers can also result in a reduction in the number of people being sentenced as the resources required to apprehend criminals and bring them to court with sufficient evidence for them to be sentenced are not available. This in turn can increase crime further as high volume criminals are left in the community to commit further crimes, whereas those crimes would not have happened if they were in prison (Freeman, 1999). Reduced police numbers and funding may specifically result in an increase in crimes for people with psychosis as the liaison relationships with mental health professionals may break down in the face of insufficient police resources. This analysis found a weak but positive relationship between police numbers and the number of people sentenced, potentially due to it being incorporated into the analysis to control for confounding rather than act as an explanatory variable.

This analysis only uses Programme Budgeting data from the 2009/2010 to 2012/2013 Spend and Outcomes Tool. Further Programme Budgeting data are available for PCTs that go back to 2006/2007 and a tool to map from PCTs to CCGs is available. Data have also very recently become available on mental health spending by CCG beyond 2012/2013. As a result there is the possibility to extend the time horizon of the analysis in the future.

Although the mixed effects linear multi-level model allows us to utilise the within and between subject variation in funding and sentencing to draw conclusions about the relationship between the two, it does not remove the potential risk of the dependent and independent variables being correlated with the fixed and random effects error terms. Two level models, particularly ones using a robust instrument, would be stronger models to use. This is something that could be explored further in future analyses, potentially utilising the same methodology used elsewhere to look at the impact of spending on mortality in the NHS (Martin, Claxton, Lomas, & Longo, 2022).

4.5.2 Implications for policy and conclusions

This analysis presents initial evidence that spending on psychosis related health services is related to the number of criminal sentences, both to prison and in the community, with

higher spending related to a greater number of people being sentenced in the first year and reductions in the year that follows. It's not clear though whether the increase in spending reflects value for money. Based on the reduced co-efficient for prison sentencing in the 1-year lag analysis of 0.091 fewer people per 100,000 being sentenced to prison for every additional £1 spent per head of the population, this would require an increased spending of over £1 million pounds to prevent 1 person going to prison. This is significantly greater than the average cost to accommodate one person in prison in 2021/2022, which was £47,434 (Ministry of Justice, 2023). Granted this does not reflect the wider costs of crime to the criminal justice system or to any potential victims or the reduction in health related quality of life and further life opportunities as a result of going to prison. As a result a more comprehensive piece of work would be required to assess the cost-effectiveness of increased spending on psychosis related health care. How to evaluate cost-effectiveness within the wider prison setting is something that will be explored in the following chapters.

5 SYSTEMATIC REVIEW OF ECONOMIC EVALUATIONS IN PRISONS

5.1 Aim

As set out in Chapter 3, there are a number of inefficiencies that exist in the delivery of health care in prisons due to the conflicting objectives of prison and health care, the objective of prison being the incarceration of individuals for the safety of society and the tripartite aims of health care of patient choice, quality of care and efficiency of delivery (Berwick et al., 2008). One of the key ways to evaluate allocative efficiency in health care are economic evaluations: the comparison of two or more interventions in terms of their costs and consequences (Drummond et al., 2015). High quality economic evaluations in prisons would be one way to establish the most efficient interventions to deliver in prison and where inefficiencies may exist. The aim of this chapter then is to conduct a systematic review to determine the quantity and quality of economic evaluations in prisons, determine best practice at the time of the review and the gaps in the literature. A second aim is to inform the methods of the economic evaluation to be conducted in Chapter 8 and the additional evidence required, which is explored in Chapter 6 and 7.

5.2 Introduction

As previously highlighted in 1.4, economic evaluations are common in health care, but less common in criminal justice settings: the economic evaluations database (EED) maintained by the Centre for Review and Disseminations (CRD) had over 17,000 listings of economic evaluations in March 2015 when funding for the database came to an end. A search of the database using the terms *Prison; Offender; Jail; Crim* and Correctional* found 20 economic evaluations related to prisons (Centre for Reviews and Dissemination, 2023).

A number of systematic reviews has been conducted that assess the costs and consequences associated with interventions that either reduce criminal behaviour or illicit substance misuse, where a potential environment for the delivery of the intervention is prison. They have found a paucity of studies: A review conducted in 2007 found 259 economic evaluations of opiate dependence treatment (Doran, 2008) and one conducted in 2006 found 61 economic evaluations of interventions to reduce criminal behaviour (Marsh, 2010) . A systematic review published in 2015 evaluating the effectiveness and cost-effectiveness of peer delivered interventions in prisons found only one economic evaluation out of a total of 57 included studies (Bagnall et al., 2015). The small number of economic

evaluations in this area is generally linked to the challenges associated with conducting high quality research in the area (Tyrer et al., 2009). The reviews also note poor methodology associated with the economic evaluations: costs and outcomes are rarely collected in a systematic way, and the paucity of randomised control trials (RCTs) conducted in prison means that the measure of effectiveness of the intervention is based on questionable data (Barbara Barrett & Tyrer, 2012; Chambers et al., 2009; Farrington et al., 2001).

Whether economic evaluations specific to prisons are required is a reasonable question, and in some instances there is no reason why the cost-effectiveness should be any different in prisons than in the community: physiological mechanisms are unlikely to change purely because someone is in prison and hence the purely biological treatment of a disease should be no different in prison than in the community. This would include things like the treatment and prevention of cardiovascular disease, cancer and diabetes. Indeed, in regards to equivalence, as mentioned in Chapter 3, there are legal and ethical requirements that health care in prisons is provided free of charge, and at the same quality as that available in the community.

For some areas though it might be that the intervention is more cost-effective when delivered in prison than in the community. This may be particularly true for the screening and treatment of health problems that are more prevalent in prison than in the community, such as communicable diseases. Some health care interventions, such as those for mental illness and substance misuse, may be directly related to criminal behaviour and hence it may be cost-effective to provide them, not from the perspective of health care, but from the perspective of society as a whole. Equally criminal justice focused activities such as diversion programmes may have an impact on health and health care spending as well as criminal justice costs. The Washington State for Public Policy carried out a review of comparative costs and benefits of programs to reduce crime, with health care interventions such as substance misuse treatment and cognitive behavioural therapy featuring heavily as interventions that can potentially have a net cost benefit on society as a result of reductions in criminal activity (Aos, Phipps, Barnoski, & Lieb, 2001). As a result it is not clear that the standard health care focused economic evaluations should equally apply in prisons. Instead it is likely that there will be a specific array of economic evaluations related to prisons, reducing criminal activity and health issues more prevalent in prisons.

There have been no reviews to date that have asked the question what is the quantity and quality of health economic evaluations conducted in prisons? The aim of this chapter then is to conduct a comprehensive review of the literature to provide a description of the quantity and quality of economic evaluations conducted in prisons, with quality being determined by the Drummond checklist (Drummond et al., 2015).

5.3 Methods

A comprehensive search strategy based on similar reviews and medical subject headings (MeSH) terms was piloted and employed to identify the maximum number of studies. The search included the following databases: PubMed including MEDLINE (Ovid), the NHS Economic Evaluations Database, Econlit, Embase, Scopus, Cochrane Database of Systematic Reviews and the Offender Health Research Network. Additionally a search of the internet using Google and Google Scholar was undertaken to identify any recently published studies and grey literature. Reference lists of identified papers and relevant systematic reviews were also hand searched. For conference abstracts and trial protocols additional searches were conducted and in some instances the authors contacted to identify if these were ever published as a full paper.

The search terms used to identify papers can be divided into three separate categories and search terms for each were used in each of the databases (i) prison, jail, criminal, offender, corrections and correctional institution or incarceration; (ii) costs, economics, health economics, economic evaluation, monetary benefit, or value for money; and (iii) health, mental health, addiction and drugs.

The inclusion criteria for papers was: (i) The paper included an economic evaluation or costing analysis of an intervention, defined as an assessment of the economic impact of an intervention, policy or programme. Pure costings of programmes that had no intervention or comparator and might be considered “business as usual” were excluded, for example the cost of psychiatric prescriptions in prisons. (ii) The intervention had to have taken place in prison for at least one group or the control group was an incarcerated population. Interventions in forensic or secure mental health institutions with no comparator group in a correctional institution were excluded. (iii) The aim of the intervention was to address a health need in an adult (over 18 years old) incarcerated population including personality

disorders, learning disabilities and substance misuse. (iv) The analysis was a decision analytic model or an analysis using data from an observational study or clinical trial.

The exclusion criteria were costings with no intervention group and interventions in juvenile or forensic or secure mental health institutions. Systematic reviews were also excluded, although the references were screened for additional studies to include.

The search was conducted on the 7th November 2016 and included papers published as early as 1969 with no publication year exclusion criteria applied. Only articles available in English were included, although papers published in other languages have been noted. Only papers published in peer review journals were included, although grey literature was accessed to review references and check for important contextual information including policy considerations and drivers of evaluations. The search results from each database were imported into Endnote (Thomson Reuters, 2016) for screening of titles and abstracts. Papers selected for full-text review were entered into an Access database (Microsoft Corporation, 2007).

A pilot of the review found that included studies had a wide range of costs and consequences, and as a result quantitative synthesis of the results was unlikely to be able to be undertaken. Instead the methodology for narrative synthesis was used (Popay et al., 2006).

A data extraction form for full-text papers included in the review was developed and piloted in Microsoft Access. Articles were classified by the type of economic evaluation: cost-utility analysis (CUA) where the cost per quality adjusted life year (QALY) gained, disability adjusted life year (DALY) saved or year of life saved was calculated and reported; cost-effectiveness analysis (CEA) where a cost per outcome was reported where the outcome was not QALYs or DALYs ; cost-benefit analysis (CBA) where the primary analysis was reported in terms of net-monetary benefit or a benefit-cost ratio; cost-consequences (CCA) where costs and consequences are reported separately; and cost minimisation (CMA) where only costs were included without any reference to outcomes, benefits or consequences. Other information extracted included country, currency, type of analysis (decision model or patient level analysis), effectiveness measure obtained from an RCT or observational study,

the perspective, what resource use and costs were collected and what outcomes were included.

Quality was assessed using the Drummond 10-point check list (Drummond et al., 2015) to assess the quality of the economic evaluation. The Drummond 10-point checklist is one of the most widely-used checklists for assessing the quality of health economic evaluations and is the basis of the British Medical Journal guidelines for reporting economic evaluations in peer review journals (Marsh 2010). Each item is given a score of one if the criteria are met. For items where both costs and consequences are assessed a score of one is only given if the criteria are clearly met for both. If it is unclear if the criteria are met, for example if it is not clear if costs and consequences are valued credibly, no points are given for that item. Criteria that are not applicable, for example question 7, adjustment for differential timing, is not applicable to models with a time horizon of less than a year, a score of one is still awarded. High quality analyses are characterised as those with a score of 8-10, average quality from 4-7 and poor quality for any paper with a score below 4 (Doran 2007).

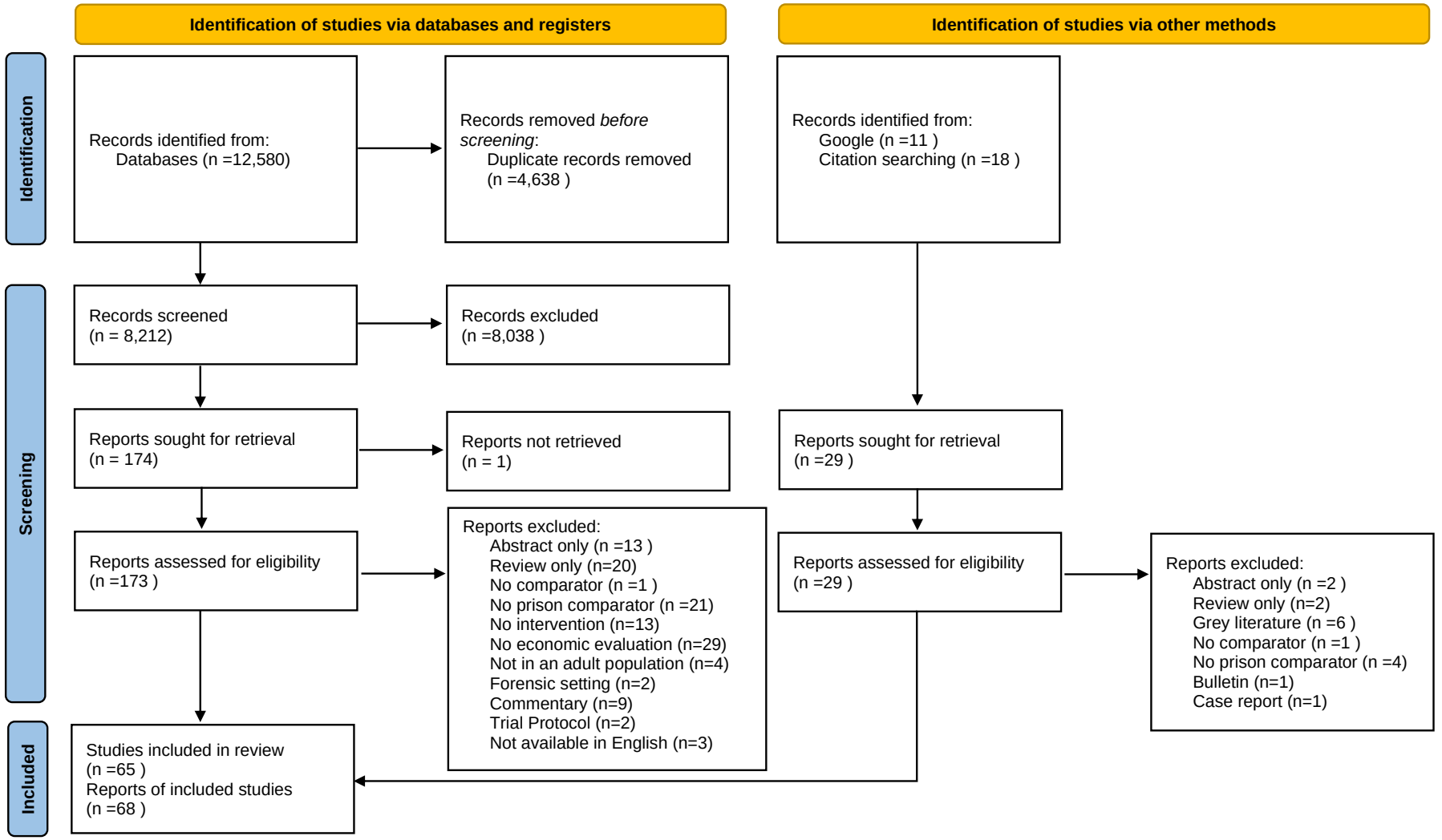
The inclusion of articles and quality of papers was assessed by the thesis author only given the purpose was to inform the conduct of a future economic evaluation.

5.4 Results

5.4.1 Search Results

The literature search identified a total of 12,850 papers which resulted in a total of 8,212 papers once duplicates had been removed. A review of titles and abstracts resulted in 8,145 being excluded. Full text was obtained following a review of the abstract of 173 papers (no copy could be obtained for Abbott, Magin, Lujic, & Hu, 2016 and an additional 117 were excluded. An additional 29 studies were identified from a search of Google and hand searching references, of which 17 were excluded.

This resulted in a total of 68 papers to include in the review, 65 of which were unique studies (see Figure *11*).



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

Figure 11 PRISMA flow diagram

The results fell broadly into the following clinical areas, each with a preferred methodology for measuring and reporting costs and consequences: communicable diseases; mental health; substance misuse treatment; telemedicine; miscellaneous. A summary of the number of papers by clinical area and type of economic evaluation is reported in Table *9*. The most common clinical area for economic evaluations was communicable disease, with a total of 32 (47%) papers, with the most common type of economic evaluation being CEA (n=23 34%).

The number of papers per year and their average Drummond score are shown in Figure *12*. 23% (n=16) of papers were evaluated as high quality, 60% (n=41) average quality and 16% (n=11) poor quality. The most common criteria that papers failed on was identifying all of the costs and consequences of interest (72% did not meet the criteria). For some analyses this is because they identified as being a societal perspective, but failed to identify all costs beyond a narrow health or prison perspective. Many said they were health care and/or prison but had a tendency to focus on costs to one sector or the other, rarely covering both comprehensively. The most common criteria they were successful on was defining an answerable research question (76% met the criteria) (see Table *10*).

The majority of analyses were in men's prisons, with only one specifically in a women's prison (screening incarcerated pregnant women) and one including a sample of women for TB screening.

Table 9 Clinical area and type of economic evaluation for included papers

Clinical Area	CBA	CEA	CUA	CCA	CMA	Total
Communicable Diseases	2 (6%)	15 (47%)	12 (38%)	0	3 (9%)	32 (47%)
Mental Health	2 (18%)	2 (18%)	0	1 (9%)	6 (55%)	11 (16%)
Substance misuse	5 (36%)	6 (43%)	1 (7%)	0	2 (14%)	14 (21%)
Tele-medicine	2 (25%)	0	1 (13%)	0	5 (63%)	8 (12%)
Miscellaneous	1 (33%)	0	0	0	2 (67%)	3 (4%)
Total	12 (18%)	23 (34%)	14 (21%)	1 (1%)	18 (26%)	68

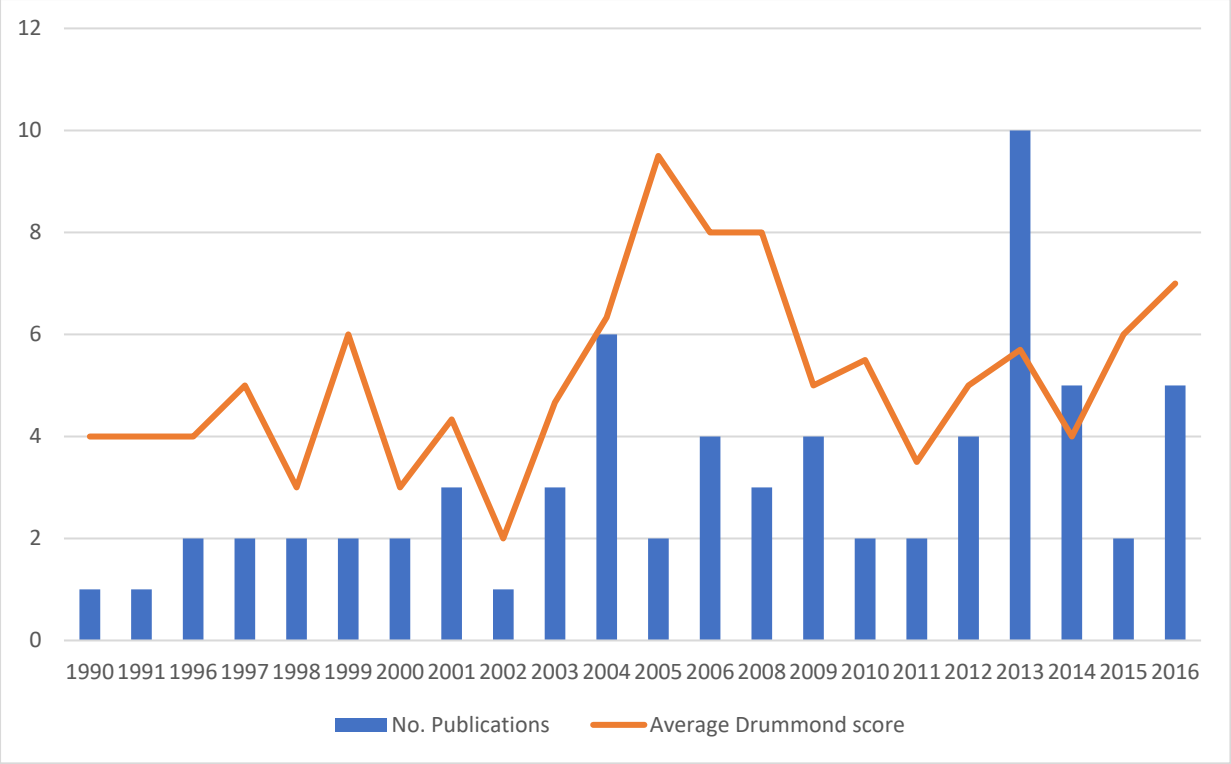


Figure 12 Number of publications per year included in review and average score on the Drummond checklist

Table 10 Performance of papers on each of the 10 Drummond criteria

Drummond criteria	No. of studies meeting criteria	Percent
Research question	52	76%
Description of the intervention	39	57%
Study design	28	41%
Identification of costs and consequences	19	28%
Measurement of costs and consequences	42	62%
Valuation of costs and consequences	38	56%
Discounting	39	57%
Incremental analysis	40	59%
Presentation of results with SA	31	46%
Discussion in policy and research context	46	68%

5.4.2 Communicable diseases

Table 11 Studies included for communicable diseases

Author and year	Country (Currency)	Study type and no. participants, duration	EE type	Intervention and control	Cost perspective	Costs included	Outcomes included	Summary statistic	Cost-effective	Drum. total
(Bandyopadhyay, Murray, & Metersky, 2002)	US (USD)	Observational n=168 4 year follow--up	CBA	Treatment with TB IPT in a clinic setting on release	Health care	Cost of programme, projected costs for cases prevented	% of patients that complete IPT course, cost savings	NMB 9227	Yes	2
(Castelnuovo et al., 2006)	UK (GBP)	Model with lifetime time horizon	CUA	Systematic HCV case-finding in prison - two scenarios vs Spontaneous presentation for HCV at services	Not specified	testing, genotyping, harm reductions advice, treatment, cost of long term disease	test uptake, liver disease progression, mortality	20,083 per QALY	Yes	8
(Dandona, Kumar, Kumar, & Dandona, 2010)	India (USD)	Observational and model with unclear time horizon	CEA	HIV prevention services	Unclear	Labour, overheads	HIV infections prevented, DALYs	13599 per DALY saved	No	4
(Gift et al., 2006)	US (USD)	Model with unclear time horizon	CEA	Male chlamydia screening and partner notification vs age based screening and	Correctional and health care	overheads, labour, correctional cost of testing, treatment, health care cost of testing and	cases detected	6095 per case treated	No	8

				testing based on symptoms of bacterial STDs		treatment, partner notification				
(Gopalappa et al., 2013)	US (USD)	Model with 1-year time horizon	CEA	Symptom based screening for STIs compared to 1) screen all men during PE (days 8-14) 2) Screen all men 35 and under during PE 3) Screen all men on intake 4) screen all men aged 35 and under on intake.	Correctional health services and public health	STI tests, treatment costs, case finding	Number of infections in women in the community	1) 1240 2) 860 3)1030 4) 710 per infection averted in women	Yes	8
(T. He et al., 2016)	US (USD)	Model with 30-year time horizon	CUA	Standard of care compared to HCV screening	Societal	HCV testing, antiviral treatment, management of chronic HCV	Cases diagnosed, new HCV infections, QALYs.	19600 per QALY gained	Yes	9
(Jacobs, Saab, Meyerhoff, & Koff, 2003)	US (USD)	Model with 35-year time horizon	CEA	1) Screen and defer vaccination; 2) screen and begin	Public sector	Serology, vaccination, administration costs	Protection against 0-2 viruses	1) 91 2) 99 3) 94	Yes	4

				vaccination; 3) vaccinate without screening for Hepatitis A&B screening and vaccination				per vaccine protection conferred		
(Jacobs, Rosenthal, & Meyerhoff, 2004)	US (USD)	Model with 50-year time horizon	CUA	Hepatitis A/B vaccination compared to Hepatitis B vaccination	Health care	Hepatitis A/B vaccination, Hepatitis B vaccination, cost of HCV.	Hepatitis A cases, years of life saved, hospitalisation	Hepatitis A/B vaccination dominant	Yes	3
(Johnson et al., 2013)	US (USD)	RCT 263 intervention; 259 control. 2-year follow-up	CUA	Single versus multi-session sexually transmitted infection risk reduction intervention.	Provider and societal	Staff time, consumables, overheads, administrative costs. Societal perspective also includes participants time.	High risk sexual behaviours, QALYs, HIV cases averted	Cost-effective if 1 HIV case prevented per 715 participants provider perspective; 1 HIV case every 753 participants societal.	No	2
(Jones & Schaffner, 2001)	US (USD)	Model with unclear time horizon	CEA	Miniature chest radiograph screening for TB compared to skin test or questionnaire	Health care	Cost of treating TB; preventative therapy for contact cases; radiograph screening; TB skin testing; Screening for TB	TB incidence	9600 per TB case prevented	Yes	4

						with questionnaire; evaluating screen positives				
(Kowada, 2013)	Developed countries (USD)	Model with lifetime time horizon	CUA	Chest x-ray; QFT; prophylaxis; TST; TST and x-ray	Unclear	Screening; treatment; labour; loss of productivity.	mortality, health utility, QALYs	349,574 per QALY gained of QFT compared to TST/QFT	No	5
(Kraut-Becher, Gift, Haddix, Irwin, & Greifinger, 2004)	US (USD)	Model with lifetime time horizon	CEA	Universal screening for chlamydia and gonorrhoea; universal screening for chlamydia only; presumptive treatment of chlamydia and gonorrhoea	Health care	Implementation of the program; cost of the disease and sequalae; screening costs; treatment cost for presumptive treatment; cost of HIV	Women: Pelvic inflammatory disease; neonatal sequelae; Men: Uncured cases of Chlamydia and Gonorrhoea	3690 per case prevented	No	8
(Leibowitz et al., 2013)	US (USD)	Model with 32-year time horizon	CMA	Condoms available to self identified gay and transgender men in prison compared to no condoms	Unclear	Staff, transport, materials, overheads, cost of treating HIV	New HIV infections per month	74,777 cost savings	Yes	5

(Liu, Watcha, Holodniy, & Goldhaber-Fiebert, 2014)	US (USD)	Model with lifetime time horizon	CUA	Sofosbuvir 3-drug therapy for HCV compared to no treatment during incarceration	Societal	Treatment and other medical costs	Liver fibrosis, Reinfection, mortality, quality of life	28800 per QALY gained	Yes	5
(Lucas et al., 2014)	US (USD)	Observational study with 1 - year time horizon	CMA	Condom dispensers in one California state prison compared to no dispensers in the same prison.	Unclear	Dispensing machine; cost per condom; cost of time spent refilling machines.	Incidence of penal code violations; condoms dispensed	1.49 per inmate	Yes	6
(N. K. Martin et al., 2013)	UK (GBP)	Decision model	CUA	Dried blood spot test for HCV screening compared to standard care	Health care	Training, testing, treatment	Referral, treatment, QALYs	59,418 per QALY	No	9
(Natasha K. Martin et al., 2016)	UK (GBP)	Decision model with 100 year time horizon	CUA	Increased HCV testing and treatment rates in prison; 8 - 12 week interferon free direct acting	Health care	HCV disease stages; HCV testing; HCV treatment	Disease progression; QALYs	Increased testing £19,851 per QALY; Increased treatment £15,090 per QALY; Increased treatment	Yes	8

				antivirals; treatment scale up for injecting drug users compared to current practice.				for injecting drug users £6461 per QALY		
(Nelwan et al., 2016)	Indonesia (USD)	Observational study intervention n= 888 control n= 871 unclear time horizon	CEA	Targeted screening of HIV compared to routine screening	Health care	Cost of HIV test	Cases of HIV detected	Routine screening cost an additional $75 per case of HIV detected	Yes	2
(J. T. Nguyen et al., 2015)	US (USD)	Observational study n=3227 unclear time horizon	CMA	HCV treatment for all HCV positive cases; HCV treatment for fibrosis; HCV treatment for advanced fibrosis	Correctional health care budget	HCV treatment, personnel, laboratory tests, follow-up visits	Total costs	All HCV positive $34 million; any fibrosis $41 million; advanced fibrosis $15 million	No	5
(Nijhawan, Iroh, Brown, Winetsky, & Porsa, 2016)	US (USD)	Observational n= 529; decision model with 12-month time horizon	CEA	QFT test compared to TST for TB	Health program	TB Nurse/Technician time; Security time; Chest X-	Cases of TB detected	TST cost $787 more per case detected	Yes	7

						Ray; materials for test;		compared to QFT-GIT		
(Nishikiori & Van Weezenbeek, 2013)	Global (USD)	Decision model	CEA	5 strategies for TB screening	Diagnostic costs	Screening	Cost per case detected	Cost per case heavily dependent on prevalence	Yes	4
(Resch, Altice, & Paltiel, 2005)	US (USD)	Observational n = 4925; decision model with lifetime time horizon	CEA	5 options of HIV screening of pregnant women compared to no-screening	Health care	Cost of test; cost of peri and post natal treatment; lifetime costs of HIV infant treatment	HIV testing; maternal ART; infant ART; breast feeding	Mandatory new-born screening dominant	Yes	9
(Schmid et al., 2014)	Brazil (USD)	Decision model with lifetime time horizon	CEA	Smear plus Detect-TB; Smear alone; culture alone; Detect-TB alone; smear plus culture	Societal	Out-of-pocket, laboratory, drugs, consumables, equipment, staff, treatment, monitoring.	Cases of TB diagnosed	0.06 per case detected for smear plus Detect-TB	Yes	6
(Silberstein, Coles, Greenberg, Singer, & Voigt, 2000)	US (USD)	Observational n=26,829; decision model with unclear time-horizon	CBA	Syphilis screening	Unclear	Testing, treatment, cost per case of syphilis prevented	Cases of congenital syphilis prevented	CBR 9.14:1	Yes	5
(Spaulding et al., 2013)	US (USD)	Observational n=543; decision model	CUA	Linkage from prison to HIV community care	Societal	Cost of program; medical care; linkage; treatment	Total served; number linked to community care;	72,285 per QALY gained	Yes	7

		with 10-year time horizon		compared to standard care.			successful treatment; reduction of onward transmission; QALYs			
(Andrew J. Sutton, Edmunds, & Gill, 2006)	UK (GBP)	Decision model with 12-year time horizon	CEA	Verbally screening for injecting drug use compared to do nothing	Health care	Nurse time, doctor time, cost of test	HCV cases detected	2012 per case detected	Yes	7
(A. J. Sutton, Edmunds, Sweeting, & Gill, 2008)	UK (GBP)	Decision model with 10-year time horizon	CUA	HCV case finding compared to no case finding	Health care	HCV test, genotyping, treatment, monitoring,	HCV infection status, liver transplant, death	54,482 per QALY gained	No	8
(Tan et al., 2008)	US (USD)	Decision model with lifetime time horizon	CUA	Combination therapy for HCV compared to no treatment.	Prison health care	Liver biopsy, treatment, end-of-life care	Liver fibrosis, mortality	Combination therapy is dominant	Yes	8
(Tuli & Kerndt, 2009)	US (USD)	Decision model with 10-year time horizon	CEA	Screening MSM in prison for syphilis and HIV	Societal	Screening, treatment	Infections detected, infections treated, infections averted	$42 per infection prevented Chlamydia, cost saving for syphilis	Yes	5

(Varghese & Peterman, 2001)	US (USD)	Decision model with lifetime time horizon	CEA	HIV testing and counselling compared to no testing	Societal	Screening, counselling, treatment	HIV infections prevented	Prevents HIV cases and is cost-saving to society	Yes	4
(Winetsky et al., 2012)	Russia and Eastern Europe (USD)	Decision model with lifetime time horizon	CUA	8 alternative TB screening strategies compared to MMR screening with sputum PCR	Health care	screening test, treatment	Infection, QALYs	$543 per QALY gained for sputum SPR compared to reference.	Yes	6
(Zishiri et al., 2015)	South Africa (USD)	Observational study n=7426	CEA	Systemic TB screening	Health care	GeneXpert machine, consumables, staff costs, over heads, TB treatment	Number screened, TB cases detected	35 per person screened; 1513 per case detected	Yes	7

ART = antiretroviral therapy; CBA = Cost Benefit Analysis; CEA = Cost Effectiveness Analysis; CMA = Cost Minimisation Analysis; CUA = Cost Utility Analysis; DALY= Disability Adjusted Life Year; EE = Economic Evaluation; GBP = British Pounds; HBV = Hepatitis B Virus; HCV = Hepatitis C Virus; HIV = Human Immunodeficiency Virus; IPT = Isoniazid Preventive Therapy; MMR = Mass Miniature Radiography; MSM = men who have sex with men; NMB= Net Monetary Benefit; PCR = Polymerase Chain Reaction; PE = Physical health Exam; QALY = Quality Adjusted Life Year; QFT = Quanti-FERON-TB; STD = sexually transmitted disease; STI = Sexually transmitted infection; TB = Tuberculosis; TST = tuberculin skin tests; UK = United Kingdom; US = United States; USD = United States Dollars.

Of the 32 papers that related to communicable diseases, the majority were CEA (n=15, 47%) followed by a number of CUA (n=12 38%). Over half of the papers were of average quality (n=18; 56%), with ten papers of high quality (31%) and four papers of poor quality (13%). A key aspect that studies failed on was to identify the perspective of the study and the duration that the analysis covered. As a result most papers failed to identify all of the relevant costs and consequences. Given the number of costings included, it's not surprising that a large number of papers also scored 0 on the Drummond criteria for reporting an incremental analysis of costs and benefits. A summary of all of the papers is reported in Table *11*.

All of the economic evaluations were either decision analytic models or observational studies with the exception of one analysis being informed by an RCT (Johnson et al., 2013).

Modelling of disease transmission within the prison is of variable quality, with some models including complex mathematical relationships, such as Sutton et al (2008). Others accounted for characteristics of the prison population, such as prison movements in simplistic ways or using unsubstantiated assumptions (Jacobs et al., 2004). The observational studies failed to include methods to address any potential bias between intervention and usual care groups.

Given the high prevalence of communicable diseases in prison (see Chapter 2), screening measures may potentially be more cost-effective than if they were delivered in community settings where the prevalence is lower (Castelnuovo et al., 2006; Nishikiori & Van Weezenbeek, 2013) as was the case in the study by Nickikiori et al (2013) when examining the cost per case detected when screening for TB. Prison though can present logistical problems when screening for communicable diseases. Local prisons in England (prisons that take directly from court) might see upwards of 10 prisoners per night who are at high risk of infections due to partaking in high risk behaviour such as injecting drug use. Many of these prisoners will move on within weeks or even a few days of arrival (Patel & Young, 2014). Screening is hence only a beneficial intervention if test results can be obtained quickly and treatment of cases actively managed. For a number of tests where samples need to be sent to a lab turn-around time can be from a few days to a week, at which point the prisoner may have moved onto the next prison or been released and hence the opportunity for intervention lost (Kraut-Becher et al., 2004). Models though rarely took into account the

logistical issues associated with screening the prison population for communicable diseases or the impact on the effectiveness of the intervention. Gopalappa et al (2013) found that screening of STIs is more cost-effective if done closer to the time of intake, as in one Arizona jail 62-74% of prisoners are released within 8 days of intake. A point-of-care test for TB, producing results in 2 hours, was able to overcome this issue, and instead was constrained by operational capacity to be able to undertake universal screening (Zishiri et al., 2015).

Another key cost that was missed by a number of studies, TB studies in particular, was the cost of contact tracing. When active cases of TB are identified, following up the people that the patient has been in contact with while contagious can be a lengthy and expensive process. Only Jones et al (2001) and Gopalappa et al (2013) included an estimation of the costs of contact tracing. Kowada (2012) identified the issue but failed to include it explicitly as a cost in the model. Partner notification was found to be the most cost-effective component of a STI screening programme for men in a correctional institution (Gift et al., 2006).

Results regarding the cost-effectiveness of prison case finding and treatment for HCV were equivocal, as the cost-effectiveness of HCV treatment is heavily dependent on the age, genotype and disease stage of the population (Tan et al., 2008). As a result there were key differences between the US and UK due to a higher prevalence of HCV in US prisons. In the UK HCV screening was just as cost-effective as in community settings targeting injecting drug users (Castelnuovo et al., 2006). In the US though a universal opt-out screening for HCV was found to be cost-effective based on a dynamic state transition model and is even better value for money than community based screening (He 2016). Screening for HCV in prisons also faces a number of challenges because of the high cost of treating HCV (between $66,000 and $150,000 USD 2015 for a 12 week course of simeprevir and/or sofosbuvir (J. T. Nguyen et al., 2015) and £34,983 for a 12 week course of sofosbuvir or £44,827 for a 12-week course of sofosbuvir–velpatasvir–voxilaprevir in the English NHS (National Institute for Health and Care Excellence, 2017)) As a result, many prisons do not screen for it given the need to then treat it (He 2016). A key issue noted here was the difference between cost-effectiveness and affordability noted by Nguyen et al., (2015) as although screening and treatment for HCV in prison might be cost-effective, it might not always be affordable.

In addition to the cost of in prison screening and treatment, active connections with the community are also important, particularly for diseases that require long-term intensive treatment to reduce the risk on onward transmission, such as HIV and HCV. Spaulding et al (2013) evaluated the cost-effectiveness of a HIV linkage service between prison and community treatment, modelling onward transmission of HIV in the community following release from prison. They assumed that successful linkage would increase the chance of sustained treatment and hence reduce the risk of onward transmission. The programme was cost-effective at the US threshold of $100,000 per QALY gained. As is common though the effectiveness of the intervention was not derived from a prison based RCT, but a community based one. Martin et al (2013) found that HCV case finding is unlikely to be cost-effective in prison unless continuity of care is ensured.

Although the majority of the studies were in the US (n=20; 63%) or the UK (n=5; 16%), 5 studies were in the developing countries India, Indonesia, Brazil, Russia and South Africa, the first two focusing on HIV screening and the last three on TB screening. The study in India found that HIV screening services were not cost-effective when delivered in prison, versus being cost-effective in community settings, although why was not clear (Dandona et al., 2010). It was also the only study to calculate disability adjusted life years (DALYs). The study in Indonesia found HIV screening in prisons to be of low cost, costing $75 USD per case detected, although no comparison with community services was made (Nelwan et al., 2016). Both studies were of poor quality based on the Drummond score. The three TB services all found the new screening technology being evaluated in the study to be cost-effective, although an invested interest in the success of the new technology is potentially present. The studies were all of average quality.

Most of the studies reported the analysis of incremental costs and consequences as a cost per infection prevented. Calculating the cost per infection prevented can present problems for the interpretation of incremental cost effectiveness ratios (ICERs) as if programs are not cost-saving, it is unclear what the willingness to pay for an infection prevented would be making it hard to determine if the intervention represents value for money. There were 12 CUAs, 7 (58%) of which were of high quality. For all of these studies utility scores for disease states were derived from the general population rather than prison specific groups. There

was only one extra value of partial information (EVPI) analysis conducted, which found that certainty around utility values accounts for most of the EVPI (Castelnuovo et al., 2006).

5.4.3 Mental health

The systematic review identified 11 economic evaluations of mental health prison interventions, 6 of which (55%) were CMA. There were no CUAs (see Table *9*). Two papers (18%) were high quality, seven papers (64%) were average with two papers (18%) being of poor quality. The two papers that included an ICER reported the cost per 1 point improvement in the Colorado symptom index (CSI) and cost per offence prevented. One paper included a cost-consequences analysis and the last two were CBA. The weakness of the majority of the papers was that they did not collect information on all of the costs and consequences of interest. Most of the papers were also underpinned by a poor research question. For more details see Table 12.

Table 12 Studies included for mental health

Author and year	Country (Currency)	Study type and no. participants, duration	EE type	Intervention and control	Cost perspective	Costs included	Outcomes included	Summary statistic	Cost-effective	Drum. total
(B. Barrett et al., 2009)	UK (GBP)	RCT; intervention n=21; control n=19. 6-months follow-up	CCA	Early assessment for DSPD programme compared to waiting list control	Unclear	DSPD formal assessment; Inpatient stays; staff time; substance misuse treatment; other health care use; group work; work; complaints; solicitor; probation; police	Personality disorder; Psychopathy checklist; Modified Overt Aggression Scale; Social functioning; WHOQOL-Bref	N/A	No	7
(Barbara Barrett & Tyrer, 2012)	UK (GBP)	Decision model with 25-year time horizon	CEA	DSPD Programme compared to usual care	Service	DSPD programme; prison; high secure hospital; community management	Serious reoffence; minor offence; reincarceration	2.24 million per serious offence prevented	No	5
(Cowell, Broner, & Dupont, 2004)	US (USD)	Observational; intervention n=570; control = 555. 1-year follow-up	CEA	Jail diversion (four different programmes) compared to not diverted	Taxpayer categorised as criminal justice and health care.	Courts, public defenders, prosecutors office, police, jails, inpatient mental health, residential substance abuse	Arrests, Victimisation, SF-12, alcohol abuse, CSI	1236 per 1 point change on CSI	Unclear	7

						care, outpatient, A&E, mental health assessment and evaluation, case management. All health care are MH and SM only.				
(Cowell, Hinde, Broner, & Aldridge, 2013)	US (USD)	Observational; intervention n=121; control = 347. 2-year follow-up	CMA	Diversion from jail for people with serious mental illness compared to usual care (prison)	Taxpayer	Criminal justice costs, treatment costs	Costs	Diversion cost 2800 less	Yes	6
(Forrester et al., 2009)	UK (GBP)	Observational; 17 months	CMA	Waiting time standard for the transfer of acutely mentally ill prisoners compared to Medical ward; psychiatric ward or secure hospitals	Health care	Mental health wards, acute ward	Transfer times	Saving to the NHS of 6.759 million for transfer delays	N/A	1
(Hughes, Steadman, Case, Griffin, & Leff, 2012)	US (USD)	Observational n= 878; Decision model; 2-years time horizon	CMA	Prison diversion for people with serious mental illness	Mental health and criminal justice	Police, pre-trial, courts, jail days and probation, mental heath and mental	Functioning and transitions to care or reoffending	2 million in cost savings from diversion	Yes	3

				compared to prison		health related health care services, mental health services in prison, reimbursement (Medicaid)		per 878 people		
(James & Hamilton, 1991)	UK (GBP)	Observational intervention n=80; control n=50	CMA	Psychiatric Liaison Service compared to remand prison	Unclear	Courts, Hospital Costs	Length of time on remand	N/A	Yes	4
(Prentky & Burgess, 1990)	US (USD)	Observational n=129; time horizon unclear	CBA	Sex offender treatment compared to no treatment	Unclear	Treatment, rehabilitation, incarceration, reoffending	Reoffending rate	67,989 cost saving	Yes	4
(Robst et al., 2011)	US (USD)	Observational n= 3769; Decision model; 4-years time horizon	CMA	Treatment for mental disorders compared to treatment	Criminal justice sector	Prison and jail expenditures	Criminal justice expenditure	N/A	N/A	4
(M. Shanahan & Donato, 2001)	Australia (AUD)	Decision model; time horizon unclear	CBA	Paedophile cognitive behavioural treatment program compared to current practice	Societal	Treatment programme, courts, criminal justice, victim out-of-pocket costs, intangible costs of abuse,	Reduction in recidivism	Dependent on monetary valuation placed on child sex abuse	Yes	5
(Steadman et al., 2014)	US (USD)	Observational intervention n=447; control	CMA	Mental Health Court compared to	Criminal justice and health care	Arrest, mental health court appearance,	None			3

		n=600. 3-years time horizon		Jail based psychiatric services		mental health treatment,				

A&E = Accident and Emergency; CBA = Cost Benefit Analysis; CCA = Cost Consequences Analysis; CEA = Cost Effectiveness Analysis; CMA = Cost Minimisation Analysis; CSI = Colorado Symptom Index; DSPD = Dangerous and Severe Personality Disorder; EE = Economic Evaluation; GBP = British Pounds; MH= mental health; NHS = National Health Service; RCT = Randomised Control Trial; SF-12 = Short Form 12; SM = Substance Misuse; UK = United Kingdom; US = United States; USD = United States Dollars; WHOQOL = World Health Organisation Quality of Life Scale.

The majority of this work has been costings (60%), as governments have attempted to quantify the cost of mental illness in prison. A significant amount of work in the US and UK though has focused on mental health court diversion programmes, the aim of which are to identify people with SMI as early as possible when they enter the criminal justice system and divert them to more appropriate care. Not all of the literature in this area has been reflected here, as this only includes studies where prison is a comparator. In addition to giving individuals the care that they need, diversion programmes have been proposed as a way to reduce the ever growing prison population. Cowell et al (2004) looked at 4 diversion programs across the US. Although results could not be combined across the programs due to differences between the nature of the programmes as well as differences in the populations across the sites, three of the programmes found higher jail costs for non-diverted people and higher mental health treatment costs for diverted people. For two of the sites the lower jail costs for diverted people were sufficient for the programme to be cost saving in total. Only New York found that diverted people had reduced costs for both jail and mental health treatment, resulting in a significant cost saving overall. Only one site, Memphis, showed that diversion was significantly better than not being diverted and only on the Colorado Symptom Inventory. Diversion was not worse than not-diversion for any of the variables or sites though (Cowell et al., 2004). A RAND evaluation found that the use of mental health courts resulted in an increased use of mental health treatment but a decrease in total jail time. The decrease in jail time was such that it offset the additional cost of the mental health treatment, although this is not a peer reviewed publication (Ridgely et al., 2007) . These programmes though rely on suitable mental health hospital beds being available, which given the move to care in the community in most high income countries and reduced numbers of inpatient mental health beds this is not always possible. Forrester et al (2009) identified that the average wait for a transfer from prison to a mental health bed was 102 days for Brixton prison and 93 days for Belmarsh prisons, and resulted in £6.8 million in potential cost savings to the NHS over an 18 month period, given that the cost of care fell on the prison and not the NHS. This sat well beyond the Department of Health recommendation of a 14-day window for transfer to a mental health ward and contravenes the human rights of people in prison (Forrester et al., 2009).

Even minor improvements in access to mental health care have been found to be beneficial. Robst et al (2011) found that there is a reduction in prison costs the more contact that people in prison with serious mental illness have with mental health services. As a result there is clear spill over effects between prisons and mental health services, in that inadequate spending on mental health services decreases prison costs for people with serious mental illness, something that was explored in Chapter 4.

Prentky & Burgess (1990) were potentially the first to publish an economic evaluation in a prison setting, quantifying the net monetary benefit of sex offender treatment in prison. They found that the benefits of such a programme potentially outweigh the cost due to the huge cost of reoffending. Shanahan & Donato (2001) took this a step further, attempting to quantify the cost of reoffending further through willingness to pay, contingent valuation and revealed preference studies looking at the cost of sex abuse. Although one of the few to incorporate this information into an economic evaluation, they note the lack of evidence in this area.

The dangerous and severe personality disorder (DPSD) programme was the only RCT, but was seminal in that it developed a process for collecting resources use in prisons (Barbara Barrett & Byford, 2007). The DPSD was also important as it showed the challenges in conducting RCTs in this population (Tyrer et al., 2009) in addition to evidence of the high cost of treatment in this population group with limited evidence of benefit.

Other than one decision model outside of the DSPD programme (M. Shanahan & Donato, 2001), the rest of the studies were observational, and noted problems with collecting and analysing data using administrative data sets, especially for individuals that go actively missing or use one or many aliases (Ahalt, Binswanger, Steinman, Tulsky, & Williams, 2012). The observational nature of the studies also meant that biases were inherent in the analyses. Steadman et al (2014) attempted to control for bias by using a matching algorithm, but note the limitations of this when people engaged with mental health courts are actively selected for. Other studies used self-report, but noted the biases inherent in the data and that these can also lead to problems with interpreting the results. None of the studies calculated QALYs.

5.4.4 Substance Misuse

Table 13 Characteristics of studies included for substance misuse

Author and year	Country (Currency)	Study type and no. participants, duration	EE type	Intervention and control	Cost perspective	Costs included	Outcomes included	Summary statistic	Cost-effective	Drum. total
(Anglin, Nosyk, Jaffe, Urada, & Evans, 2013)	US(USD)	Observational time lagged cohort DID intervention n=41607; control n=47355. 5 year follow-up	CMA	Probation with SUD treatment compared to incarceration or probation	Health and criminal justice	Prison, probation, courts, publicly funded health care, substance misuse treatment	Costs only	cost saving of $2985 per individual	Yes	5
(Bird, McAuley, Perry, & Hunter, 2016)	UK (GBP)	Observational before and after intervention n=1212; control n=1970 10 year follow-up	CUA	Naloxone on release compared to no naloxone	Prescription costs	prescription costs	Opioid related death, QALYs	£560 per QALY gained	Yes	8
(Daley et al., 2004)	US (USD)	Observational Intervention n=286; control n=545 2 year follow-up	CBA	Four tiers of substance misuse treatment in prison compared to no treatment	Unclear	Cost of the 4 treatment tiers, avoided costs of reincarceration.	Reincarceration at 1 year post release.	Benefit cost ratio: Tier 1: 5.74 Tier 2: 3.18 Tier 3: 1.79	Yes	8

(French, Fang, & Fretz, 2010)	US (USD)	Observational propensity score matched control intervention n=176; control n=545 12-month follow-up	CBA	Substance abuse treatment pre-release compared to TAU	Societal	Criminal justice, wages, cost of arrest, courts, cost to victims	Reincarceration	-$4,307	Yes	7
(Gore & Bird, 1996)	Scotland (GBP)	Observational intervention n=500; control n=500	CMA	Random mandatory drug testing compared to drug treatment	Health care and prison	Refusals, prevalence of injecting drug use, drug tests, drug treatment	None	RMDT twice the cost of drug treatment	No	4
(Griffith, Hiller, Knight, & Simpson, 1999)	US (USD)	Observational matched cohort Intervention n=291; control n=103 3-year follow-up	CEA	In prison TC and TC plus aftercare compared to in prison cohort	Criminal justice system	TC treatment, cost per day incarceration, parole, aftercare, court, counselling, referral to education and employment services, facility depreciation	Reincarceration	$494 per 1% decrease in reincarceration	Yes	6
(McCollister, French, Prendergast, Hall, & Sacks, 2004)	US (USD)	RCT Intervention n=341; control n=235 5 year follow-up	CEA	In prison TC and aftercare compared to In-prison treatment; in prison TC; no treatment	Societal	In prison TC; in prison treatment; Hospital inpatient; other health care costs;	Incarceration days avoided	$65 per treatment incarcerated day avoided	Yes	6

						community treatment costs				
(McCollister, French, Prendergast, et al., 2003)	US (USD)	RCT intervention n=335; control n=196 1-year follow-up	CEA	In prison TC and TC plus aftercare compared to treatment as usual	Department of Corrections	Cost of drug treatment	Number of days reincarcerated	$80 per incarcerated day avoided	Yes	5
(McCollister, French, Inciardi, et al., 2003)	US (USD)	RCT intervention n=309; control n=138 18-month follow-up	CEA	CREST a work release TC compared to Standard work release, CREST TC without aftercare	Criminal Justice	Cost of the CREST programme	Number of days reincarcerated	$65 per incarcerated day avoided	Yes	5
(Marian Shanahan et al., 2004)	Australia (AUD)	RCT Intervention n=309; control n=138 23 month follow-up	CEA	Drug court compared to conventional court system including jail	Treatment provider	Assessment, court, treatment, urine tests, probation	Time to first offense, offending frequency	$0.17 per day to first drug related offence; $1,905 per reduction in offence per day	Yes	6
(Warren et al., 2006)	Australia (AUD)	RCT and model. 12-month time horizon	CEA	Prison methadone compared to no methadone	Provider/ funder of prison methadone	Methadone treatment	Heroin free days, deaths avoided, HCV cases avoided.	$38 per heroin free day; $458,074 per death avoided; $40,428 per HCV case avoided	Yes	9

(Gary A. Zarkin et al., 2012)	US (USD)	Model with lifetime time horizon	CBA	5 policy options for substance misuse treatment	Societal and criminal justice	Crime, victimisation, arrest, court, incarceration, health care, lifetime earnings, treatment costs	Substance misuse, crime, employment, HIV	Criminal justice and societal savings dependent on policy option	Yes	8
(Zarkin, Dunlap, Belenko, & Dynia, 2005)	US (USD)	Observational intervention n=150; control n=130 6 year follow-up	CBA	DTAP screening and sentencing Compared to prison	Criminal justice system	Screening costs (including detention), treatment costs, monitoring and administration	Rearrest, incarceration	$88,554 net benefit	Yes	10
(Zhang, Roberts, & McCollister, 2009)	US (USD)	Observational intervention n=6773; control n=4504 2-year follow-up	CBA	Therapeutic community compared to prison	Prison	Administrative costs, therapeutic community treatment	Inmate infractions, inmate grievances, major incidents	$263,175 cost savings	Yes	7

AUD = Australian Dollars; CBA = Cost Benefit Analysis; CEA = Cost Effectiveness Analysis; CMA = Cost Minimisation Analysis; CUA = Cost Utility Analysis; DID = Difference-in- Differences; DTAP = drug treatment alternative to prison; EE = Economic Evaluation; GBP = British Pounds; HCV = Hepatitis C Virus; HIV = Human Immunodeficiency Virus; QALY = Quality Adjusted Life Year; RCT = Randomised Control Trial; RMDT = Random Mandatory Drug Testing; SUD = Substance Use Disorder; SM = Substance Misuse; TAU = Treatment As Usual; TC= therapeutic community; UK = United Kingdom; US = United States; USD = United States Dollars.

The systematic review identified 14 papers relating to substance misuse treatment and prisons. Six papers (43%) were CEAs and five (36%) CBAs with two (14%) CMAs and one CUA (7%). Five papers (36 %) were high quality with the rest (9 papers) being average quality. Four of the papers used results directly from a trial, with one decision model informed by a trial. For the observational studies, propensity score matching or difference-in-differences was used to attempt to reduce bias. The majority of the studies (n=10 71%) were in the US, with two Australian studies, one UK study and one Scottish study. For further details on the type and quality of papers see Table 13.

As set out in Chapter 3, substance misuse treatment is a health care issue given that the recommended treatment strategy in high income countries is the prescription of opiate maintenance therapy, usually methadone or buprenorphine (Department of Health, 2007) and that substance misuse, particularly injecting drug use has a higher risk of a range of health problems. It is a prison issue given the very nature of being related to controlled substances and the high prevalence of injecting drug use in prisons (see section 2.3.5).

As a result there are four types of interventions related to reducing the supply and demand of drugs in prisons. The first is access to treatment, including Naloxone to override opioid overdose, is clearly a health related intervention. That said, treatment can sometimes be paid for or delivered by criminal justice agencies, particularly in the case of Therapeutic Communities (TCs), and may involve abstinence based interventions. For the other three, (i) drug courts; (ii) diversion from prison and (iii) drug testing, the line between health and criminal justice becomes increasingly murky.

The main outcome of interest in evaluations assessing the cost-effectiveness of substance misuse treatment interventions was cost per incarcerated day avoided, followed by cost per drug relapse avoided. This is similar to the outcomes noted in other reviews of substance misuse treatment in prison (McCollister & French, 2003). Only one study included health related outcomes in the economic evaluation, reporting the incremental cost per heroin free day, death avoided and HCV case avoided in a trial based economic evaluation of methadone maintenance in Australia prisons (Warren et al., 2006). A lifetime simulation model of prison substance misuse treatment comparing five policy options included HIV infections in the outcomes, but did not report an incremental cost-effectiveness ratio, only a

net monetary benefit to society, with only the costs of treating people with HIV included in the model, not the QALY impact (Gary A. Zarkin et al., 2012).

The lack of focus on medical outcomes is probably because two thirds of the papers evaluated non-medical models for treating substance misuse such as prison based TCs, where inmates with opiate addiction are housed in a specific community that focuses on removing and addressing situations associated with dependence. McCollister et al., (2003) found an incremental cost of $80 per day incarcerated prevented for a prison TC. Given the cost per day to house a prisoner was $59 the question left was what the extra $20 was buying the commissioner of the programme. As discussed above, this can be a problem with CEA when the outcome of interest has no pre-defined value, particularly when there is likely to be more than just a monetary value to the outcome but a wider societal value. It also means that the perspective and the costs and outcomes included need to be clear, as otherwise the conclusions one can draw from the analysis are unclear.

That almost half of the economic evaluations were CBAs is partly due to the emphasis within substance misuse on it being an issue for the criminal justice rather than the health system. As a result they tend to follow guidance issued on evaluating criminal justice rather than health interventions. Zhang et al (2009) evaluated if TCs resulted in reduced cost of operations as a result of reduced incidents. Although they found a potential operations cost-saving due to reduced incidents, this was not greater than the cost of the TC.

Although these in-prison substance misuse programmes may have benefits beyond prison, they still incur the cost of incarceration. Drug courts on the other hand, where remand prisoners go to a special court for sentencing, try to divert problematic drug users away from the criminal justice system to community substance misuse treatment (Gary A. Zarkin et al., 2005). These courts emerged first in 1989 in the US in response to the “War on Drugs”, but are now wide spread in the US and other countries around the world including Australia and the UK (Degenhardt et al., 2014; Gary A. Zarkin et al., 2005). These courts have the sentencing option available to them of probation with drug treatment instead of prison. They are included in the review in instances where the control arm is “incarceration”. Anglin et al (2013) found that drug courts resulted in $2317 in savings per offender over 5 years. The added benefit of these courts is that as the accused is not incarcerated, in the US where

the corrections authority is responsible for paying for treatment, they no longer have to shoulder the cost of treatment as they would have to if the person was treated for substance misuse in prison. The drawback of this is that it may increase the cost to the health service, or out-of-pocket costs, something that was not evaluated to the same degree as for mental health services as discussed in section 5.4.3.

Finally, the one that is probably the closest to criminal justice is compulsory urine testing for drugs, be it random or selected. This is traditionally then associated with a disciplinary component, where refusal can result in a hearing and potentially punishment, and a treatment component, where those identified are referred to drug treatment. There is limited and contradictory evidence as to the effectiveness of compulsory drug testing (H. Nguyen, Midgette, Loughran, & Zhang, 2021). A key issue though discussed by Gore & Bird (1996), when mandatory drug testing was first being implemented in the English and Welsh prison estate, was the comparison of costs between drug testing versus treatment, the latter having a stronger evidence base than the former. They found that the 28 day cost of running the random mandatory drug testing was twice that of drug treatment in Scottish prisons (Gore & Bird, 1996).

5.4.5 Telemedicine

Of the 8 papers that related to telemedicine, the majority were CMA (n=5, 63%) with two CBAs (25%) and 1 CUA (13%). One paper was of high quality (13%), two of poor quality (25%) and the remainder of average quality (n=5 63%). Only one paper (Aoki et al., 2004) established the effectiveness of the intervention. The majority of papers also failed to identify all of the important costs and consequences and given that the majority were CMA it's not surprising that a large number of papers also scored 0 on the Drummond criteria for reporting an incremental analysis of costs and benefits. A summary of all the papers is reported in Table 14.

Table 14 Characteristics of included studies for telemedicine

Author and year	Country (Currency)	Study type and no. participants, duration	EE type	Intervention and control	Cost perspective	Costs included	Outcomes included	Summary statistic	Cost-effective	Drum. total
(Aoki et al., 2004)	US(USD)	Decision Model; lifetime time horizon	CUA	Tele-ophthalmology for diabetic retinopathy compared to face-to-face	Prison	Tele-ophthalmology, face-to-face examination, photocoagulation, care for blind person	QALYs	Dominant	Yes	8
(Brunicardi, 1998)	US (USD)	Observational; n=469	CMA	Telemedicine compared to no telemedicine	Prison	Transport, chase vehicle, physician, telemedicine equipment	Number of consultations	Savings of $8.48 per consult	Yes	5
(Doty, Zincone Jr, & Balch, 1996)	US (USD)	Observational; costs over 4-years	CBA	Telemedicine in prison compared to off-site visits	Unclear	Avoided costs due to transportation, physician fees, escapes and litigation	Contract and personnel costs	Net cost of £1,467	Maybe	4
(McCue et al., 1998)	US (USD)	Observational; n=290; 12-month follow-up	CMA	HIV, cardiology and oral surgery services provided by telemedicine compared to no telemedicine	Prison	prison litigation, cost of prisoner transportation, telemedicine costs including physician, technical staff, nurse, line rental, maintenance.	None	$14 saved per telemedicine consult	Yes	1
(McCue et al., 2000)	US (USD)	Observational; n=188; 3-year follow-up	CMA	Tele-cardiology service compared to	Department of Corrections	Technical manager, line rental, maintenance, transport including	None	Total cost savings $16 over 3 years.	Yes	1

				visit to hospital cardiology clinic		salary for guards, maintenance and fuel, cost of clinical tests and cardiology clinic visits.				
(McCue et al., 1997)	US (USD)	Observational before and after study; intervention n=163; control n=73	CBA	Telemedicine consult for HIV infected inmates compared to pre-telemedicine	Prison	HIV clinic cots including staff, administrative costs, professional fees, lab costs.	None	$241 saved per clinic visit avoided	Yes	5
(Zincone L.H, Doty, & Balch, 1997)	US (USD)	Observational 5-years	CMA	Prison telemedicine compared to no telemedicine	Prison and taxpayer	Contract costs, prison health care staff, prison security staff, transportation, prison escapes, medical litigation	None	Breakeven at one contact a day	No	5
(Zollo, Kienzle, Loeffelholz, & Sebille, 1999)	US (USD)	Observational n=274; 12-month duration	CMA	Telemedicine - ICD-10 codes for most common diagnostic conditions compared to no tele-medicine	Department of Corrections	Telemedicine line rental, equipment including telemedicine and diagnostic, clinical staff, technical staff, overheads, prisoner transportation.	None	Break even at 275 prisoners per year as tele-consults.	No	6

CBA = Cost Benefit Analysis; CEA = Cost Effectiveness Analysis; CMA = Cost Minimisation Analysis; CUA = Cost Utility Analysis; EE = Economic Evaluation; HCV = Hepatitis C Virus; HIV = Human Immunodeficiency Virus; ICD-10 = International Classification of Diseases 10th revision; QALY = Quality Adjusted Life Year; US = United States; USD = United States Dollars.

Table 15 Characteristics of included studies not otherwise captured

Author and year	Country (Currency)	Study type and no. participants, duration	EE type	Intervention and control	Cost perspective	Costs included	Outcomes included	Summary statistic	Cost-effective	Drum. total
(Nagi, Wilson, Kadis, & Jenkins, 2012)	UK(GBP)	Observational; n=5; unclear time-horizon	CMA	Prison diabetes service compared to hospital based service	Health care	appointments, escorts	Quality outcomes framework.	£24,639 cost savings	Yes	4
(Ha & Robinson, 2011)	US (USD)	Observational; n=212; 3 year follow-up	CBA	Asthma management as part of a chronic care model compared to no service	Health care	Cost of program, savings from hospitalisations avoided.	Stakeholder satisfaction	£15 million in savings	Yes	3
(Panesar et al., 2014)	US (USD)	Observational; n=; 2 year follow-up	CMA	Transplant in end stage renal disease compared to dialysis	Health care	Continued dialysis, transplant	Successful transplant	$354,508 savings over 7 patients	Yes	1

CBA = Cost Benefit Analysis; CMA = Cost Minimisation Analysis; EE = Economic Evaluation; GBP = British Pounds; UK = United Kingdom; US = United States; USD = United States Dollars.

During the 1990s improved telecommunication technology, particularly in rural US, made telemedicine, two-way video between a medical specialist in remote site and a patient and clinician in prison, an attractive solution. Telemedicine in prisons provides the potential for improving access to specialist consultants, while reducing the need to transport prisoners securely to and from hospital appointments, which in the USA can present significant distances and hence costs (Zincone 2009). In Ohio, for example, the average one way travel time between the prison and the medical centre was 2 hours and 10 minutes (Brunicardi 1998). In North Carolina the prison was 100 miles from the teaching hospital (Doty et al., 1996). Consults with telemedicine can sometimes be easier to arrange and hence can reduce the time from referral until being seen (Brunicardi 1998)

There is an assumption though in telemedicine studies that the quality of care is equivalent, and hence there tends to be a focus only on costs (Zincone 2009). Only Aoki et al (2004) evaluated the quality of the service and included some health impact on people in prison. The three studies by McCue et al., (1997, 1998, 2000) are all similar studies using the same data forming part of a cost-savings analysis required by the Department of Corrections. Particularly important in these studies was the need for a more cost-efficient way to provide cardiology services due to aging prison population. They all assume that with and without telemedicine the clinical outcomes and the direct health care costs for treatment will be the same. This is potentially debatable as it is possible that remote specialist might order more tests when seeing the patient using telemedicine if the inability physically to examine the patient causes some uncertainty.

All of the analyses also assumed that the necessary infrastructure to run telemedicine was already available in the prison as development costs are not included. In Iowa the state commissioned the first US state-owned fibreoptic network, a technology that allowed for telemedicine to occur between the Iowa prison and teaching hospital (Zollo et al., 1999). This cost as a result was not included in the CMA. Although potentially relevant in this case it means that the results of the evaluations are not generalisable to prisons that do not have access to the same technology. As technology improves additional costs to update systems may also be required.

Overall there is a question regarding the relevance of these studies as technology changes and improves. The COVID-19 pandemic required a shift in how medicine was delivered so that telemedicine became more widespread using technologies that were not available when these economic evaluations took place. As a result it is likely that the results of these studies can become quickly outdated.

5.4.6 Other studies not otherwise captured

There were three studies that could not be classified into the other four groups: a prison based diabetes service, a chronic care model for asthma and a study looking at transplant in end stage renal disease. They were made up of two costings and a CBA: all were of poor quality. As a result there is very limited evidence for economic evaluations outside of the key 4 areas of communicable disease, mental health, substance misuse and telemedicine. Further details of the studies are reported in Table 15.

These three studies though present the potential burden and challenges of managing long term physical health conditions in prison. Both the diabetes service (Nagi et al., 2012) and asthma chronic care model (Ha & Robinson, 2011) are different to studies reported elsewhere in the review in that they ask patients their opinions regarding the quality of care they receive. The aim of these studies is to provide evidence for the cost savings of providing better health care in prison compared to no care. Most of these cost savings come from hospital attendances avoided as a result of better management of long term conditions.

The study by Panesar et al., (2014) took a clinical problem that exists in both the community and in prison and provided a focus to it that is more likely in a prison: HCV positive patients receiving kidneys that were also HCV positive. In the study 33% of patients received a HCV positive kidney, which significantly reduced the waiting time for a kidney transplant and resulted in no adverse outcomes for the patients.

5.4.7 Effectiveness of methods in identifying papers

Previous studies have found that the EED will identify the majority of health economic evaluations, with limited benefit to searching further. In this instance it only captured 26% of the total papers. Extending the database selection to Medline and Embase has previously

been reported to capture over 90% of all papers (Shemilt et al 2006). For this review EED, Medline, Embase, Econlit and prison specific databases (OHRN) only captured 72% of the total papers, with 12 of the papers coming from Google Scholar or hand searching references. This is mostly due to large number of articles in this area published in criminal justice journals not included in the databases and a number of poor quality papers also published in journals not covered. Using the search term "correction*" was also problematic as it produced a large number of articles that were a correction for a previous article. As a result systematic reviews in this area need careful design and piloting and may be more resource intensive than in standard medical interventions.

5.5 Discussion

The systematic review found a wide array of economic evaluations of health related interventions in prisons, with a focus on the areas of communicable disease control, substance misuse and mental health. Overall the studies can be considered to be evaluating one of two things: (i) the most cost-effective intervention within a prison environment for example hepatitis B vaccination versus hepatitis A/B vaccination (ii) if it is better value for money for the intervention to be delivered in prison or in the community. The second is made up of two categories of interventions (a) mental health or substance misuse interventions that may be more effective when delivered to people in the community rather than in prison (b) public health interventions where due to the high prevalence of disease in the prison population screening and treatment is more cost-effective than in the general population or other high risk groups for example screening for and treatment of HCV. As discussed in Chapter 2, people in prison are at a greater risk of communicable diseases due to high risk behaviours and the nature of the prison estate. Given the importance of addressing communicable diseases in prisons, and, as discussed in Chapter 3 the potential efficiencies in addressing them during time in prison, as expected the majority of papers were in the area of communicable diseases.

The quality of papers was mostly average, with very few high quality papers and a larger number of poor papers. This was mostly due to poorly framed research questions (24%), or the large number of CMAs. There is a potential that there is some publication bias given that 43 of the 68 studies included (63%) found the intervention to be cost-effective.

5.5.1 Costs

As noted above, one of the key problems with economic evaluations in prisons is that the stakeholder that accrues the costs for the new intervention is not always the same stakeholder that sees the associated cost-savings. Given the complex relationship between criminal justice agencies and health care there needs to be a clear distinction between which agency is actually incurring the cost and who is incurring the cost savings (Swanson et al 2013). This is particularly the case for substance misuse and mental health treatment in that the stakeholder that sees most of the cost-savings from treatment being effective, the criminal justice system, is not always the same stakeholder that sees the additional cost, the health care system. This problem has been noted for other non-prison based evaluations of substance misuse treatment, such as supervised injectable heroin. There is general agreement as to the importance of taking into account the savings to the criminal justice system of effective drug treatment, even if the mechanism for this has not been identified (Hunter & Hasan, 2013). In England, payment by results in substance misuse treatment has tried to address this problem by making payment to substance misuse treatment providers dependent on success across a range of outcomes, including reoffending and health outcomes. There are concerns though that the model may unfairly punish some providers or that gaming the system may occur (Maynard, Street, & Hunter, 2011). Another way to address the problem has included the system change pilots where criminal justice system, health and social care budgets were pooled to treat substance misuse. The programme also had variable results and was not renewed (Hodgkin et al., 2020; Maynard et al., 2011). On the other hand there is also a number of non-medical models of substance misuse treatment that have health impacts: for example in the case of TCs the criminal justice system sees most of the cost but none of the cost savings associated with things like reductions in BBVs or hospital attendances if these are paid for out of a health care budget.

The purely health care based interventions though, particularly for communicable diseases, failed to capture the cost to the prison establishment of the intervention. For the English NHS the perspective of economic evaluations is commonly health and personal social services (PSS) given this is the NICE reference case (National Institute for Health and Care Excellence, 2022) and current conversations suggest that this is unlikely to change. The NICE Public Health guidance does acknowledge that costs outside of health and PSS might need to be included, particularly if you are doing cross agency working (Edwards, Charles, &

Lloyd-Williams, 2013; National Institute for Health and Care Excellence, 2012). Overall though it is important that any economic evaluation of a prison based intervention does include the cost to the prison service. This is because there are likely to be wider operational costs for any intervention, including prison officers needing to move the prisoner from A to B (Warren et al., 2006) or processes to ensure continuity of care when transferring prisoners between prisons or on release (Zhang et al., 2009). In the case of telemedicine, new technology, such as high speed internet, might need to be installed and maintained at the prisons expense. The presence or absence of effective substance misuse treatment programmes in prisons can also have an impact on prison misconduct, including assaults on prison staff which can result in staff turnover and sick leave, although these can be challenging to cost (Zhang et al., 2009). On the other hand prison operational effectiveness can also impact on health costs, as prisoner-on-prisoner violence is one of the key sources of emergency health care costs in prisons (Zhang et al., 2009). A whole prison approach to addressing health and wellbeing has been seen as a necessary requirement for improving outcomes in prisons in HMPPS (Leaman et al., 2016) meaning that large gains are challenging to make unless the prison regime and health care are working together.

To attempt to address this most of the papers in the review chose a societal cost perspective or a combined health and criminal justice perspectives. The analysis then failed to identify all of the costs required by the perspective, for example few of the societal analyses included employment or impact on family and close others. If these wider costs were identified they then failed to report them separately in a way that might be useful for decision makers. There was only one CCA, a method that is recommended in public health evaluations to better report the impact on a wide range of costs and consequences (Edwards et al., 2013). One of the key recommendations coming out of this work is that economic evaluations in prisons should have a clearly thought out, logical research question and cost perspective. They need to collect, analyse and report the cost impact of a new intervention on all of the stakeholders involved as defined by the research question. They also need to address the question of affordability compared to cost-effectiveness as in HCV treatment, which is cost-effective, but if treatment was provided to everyone would cost twice the current health care budget in one correctional institution (Nguyen et al., 2015).

One of the challenges of economic evaluations in prisons is the limited information on the costs of health care in prison. There is ongoing research though to address this, for example how to develop a diagnostic model of funding in Australian prisons (Cai, Moore, & McNamara, 2013). Studies also found challenges in collecting resource use, even from patient files, with issues with poor recording and patient files going missing (Barrett et al., 2009). Instruments to standardise resource use collection though have been developed (Barrett & Byford, 2012). Some studies also found it challenging to identify unit costs and hence had to modify their methods from the gold standard set out by Drummond (Shanahan et al., 2004).

5.5.2 Consequences

The comparability between the different prison studies is challenging because of the wide array of outcomes used. The lack of standardised information collection has been noted as an issue that plagues criminal justice related research across a number of areas (McCollister, French, Sheidow, Henggeler, & Halliday-Boykins, 2009; Woodhouse et al., 2016). In a review of forensic mental health research by Chambers et al (2009) they found 450 different measurement instruments were used with limited evidence to support using any one of them as an outcome. Only 14 studies in this review used cost per QALY analysis. The utility values in all 14 studies though were derived from studies in the general population with an assumed utility value of 1 for incarcerated individuals who are disease free. Given the prevalence of mental and physical health problems in prison it is unlikely that the mean utility value for someone in prison is 1. This would be supported by results from a cross-sectional survey of 734 people in prison in Australia, 84% of which were men, asking them to complete the SF-36. This was then transformed into utility scores based on the SF-6D (Brazier, Roberts, & Deverill, 2002) and assigned to various medical conditions including asthma, angina, depression, HCV, HIV and injecting drug use. The mean utility of the population calculated using the SF-6D was 0.725, with key predictors of disutility being sex (being female had a disutility of -0.0253 95% CI -0.0462 to -0.0193), age (disutility of -0.0007 for each additional year of age; 95% CI -0.0013 to -0.0001) and depression (disutility of -0.0079 for each additional score on the Beck Depression Inventory; 95% CI -0.0096 to -0.0062) (Chong et al., 2009). In two studies in this systematic review data was collected directly from individuals and could have been used to calculate QALYs, but was not. Cowell

et al (2004) collected SF-12 data, they chose to report the cost per change in CSI instead. No significant differences in the SF-12 physical or mental components of the score were seen though in this observational, jail diversion study. Ascher-Svanum et al (2010) collected SF-36 data, with a significant difference between those who had criminal justice system encounters, including being a victim of crime, versus those who did not on the mental component of the score, but again did not calculate QALYs.

Although guidelines recommend CBA (HM Treasury, 2022) or in the case of economic evaluations of health care interventions CUA (National Institute for Health and Care Excellence, 2022) these were not the most common type of analyses, with the most common type of analysis being CEA followed by CMA, CMA being an analysis that is advised against as there are only rare instances where it can be used (Briggs & O'Brien, 2001). Due to the variety in costs and consequences measured and the way they were reported it is hard to compare results across analyses. The area of public health has recently noted that CUAs may prove challenging in areas where QALYs are hard to measure or quantify and has released specific guidelines for this area. The recommendations though suggest CBA or cost-consequences where CUA may not be appropriate and feasible (Edwards et al., 2013; National Institute for Health and Care Excellence, 2012)

One of the most important criteria for choosing an outcome for a CEA is to choose one that is relevant to the decision maker (Drummond et al., 2015). In most the analyses very little thought was given to who the decision maker was and hence what outcome would be most relevant and important.

There remains the question though if the perspective of the analysis is prisons or the criminal justice system, and a cost per QALY is calculated, is it right to use the same threshold as is used for health care interventions in the community to determine if the intervention is cost-effective? For example, the perspective of the analysis of Tan et al (2008) was prison costs, but they used the general US threshold of cost per QALY of $100,0000. It is not clear that prisons would value a QALY the same way that health care services do, given it is not necessarily a key outcome of interest or efficient to do so given that prison has a negative impact on health. For health care services provided in prison that come from the health care budget though the question is more complicated and is

dependent on whether one views the threshold from a decision maker perspective such as the NICE threshold, as a measure or opportunity cost or as a willingness to pay value. Each of these may result in a different answer to if the same threshold should be used in prisons and is explored further in chapter 9.

5.5.3 Effectiveness of intervention

As a result of the paucity of RCTs in prison, observational studies were one of the most common ways that the effectiveness of the intervention was established with the majority of interventions making no attempt to quantify the effectiveness of the intervention instead using sensitivity analysis. Amongst the substance misuse studies in particular the participants in the treatment arm acted as their own control, and costs of treatment were calculated based on the previous year's activity, with no attempt made to control for any changes that may have occurred over that time. The type and number of people who enter treatment, particularly for substance misuse treatment, can depend on the facility that they are sent to, availability of treatment and type and length of their sentence (Daley et al., 2004). In substance misuse treatment in particular motivation to enter treatment and engage is an important consideration that is rarely taken into account. The study by Ascher-Svanum et al (2010) was one of the few studies that made any attempt to control for bias in their analysis. Although their comparator group was not a pure prison group, they used propensity matching of treatment and control groups to establish costs and consequences. (Zhang et al., 2009) also use propensity score matching. The method of propensity score matching has been criticised though elsewhere in the literature given that it can cause imbalance and can still cause bias (King & Nielsen, 2019). In one of the few RCTs (McCollister & French, 2003) selection bias was still present as the aftercare group was totally voluntary. Barret et al. (2009) are the only ones to utilise a true RCT design using waiting lists controls. This meant though that the time-horizon for the analysis could only be 6-months as at that stage the control also received the intervention. Anglin et al (2013) use difference in differences analysis to control for bias in their evaluation of Proposition 36 – allowing substance misusing offenders to enter probation rather than prison. This is the only study to utilise econometric methods to attempt to address bias.

5.5.4 Strengths and weaknesses

This is the first review I am aware of to look at the quantity and quality of economic evaluations conducted in prisons. The methods of the review have been incredibly comprehensive, covering a wide array of databases and sources. It provides evidence not previously available on the plethora of methods used in economic evaluations in prisons, with clinical area being a key predictor of the type of analysis chosen.

I chose to use the Drummond check-list given that the aim of the review was to assess the quality of economic evaluations of interventions that could impact on the health of people in prison. Other checklists exist that allow for more detailed assessment of quality including the Philips checklist for decision models (Philips, Bojke, Sculpher, Claxton, & Golder, 2006), the Consensus on Health Economic Criteria for economic evaluations alongside trials (Evers, Goossens, de Vet, van Tulder, & Ament, 2005) and the Consolidated Health Economic Reporting Standards (CHEERS) for reporting (Husereau et al., 2022). The Drummond checklist has the weakness that it is a blunt tool: as it cannot say if a study is good or bad, particularly given that a score out of 10 could occur for a poorly conducted, biased study (Frederix, 2019). As a result I have also included information about the study design informing the economic evaluation to describe potential bias in the study or analysis.

Given I was the singular reviewer on this review it is possible that my results contain some bias.

The systematic review was conducted in 2016 and hence the landscape for the literature may have changed since then. As part of my thesis I have kept abreast of relevant papers, and found that the pattern of very few papers published in the area and challenges with conducting health economic evaluations in prisons has remained consistent (see section 9.4 for further information).

5.6 Conclusion

There is a limited number of prison related economic evaluations published, with the peak of publishing being in 2013 at 10 in one-year and has remained low since then. The women's estate in particular is an under researched area with only two studies including women in prison. The quality of the studies has predominately been average, partially due to limited evidence on the effectiveness of health related interventions implemented in prisons and

the challenges associated with conducting high quality research in this environment. Although researchers conducting economic evaluations related to health and prisons would benefit from clear guidance on methods including the perspective analyses should take and what costs and consequences should be included in the analysis, much of this overlaps with guidance on how to conduct economic evaluations in public health, which should be the first port of call for researchers in this area. The needs of the decision maker in particular should be well thought through before an economic evaluation is undertaken in this area.

6 PREDICTORS OF HEALTH CARE COSTS IN CRIMINAL JUSTICE

6.1 Aim

The rapid review in Chapter 2 and systematic review in Chapter 5 identified limited information on the cost of health care in prisons. Although there is a range of evidence for the cost of care for people with mental illness in prisons (see section 5.4.3), very little is known about the wider cost of health care for people in prison. When designing an economic evaluation alongside a trial it is important to have information on key cost drivers to ensure that these are recorded and costed reliably. As there is currently limited information available for this population the aim of this analysis is to use data from the Care for Offenders: Continuity of Access (COCOA) study to calculate the costs of health care, for people in contact with criminal justice, both in prison and in the community, to ascertain the key predictors of costs.

6.2 Background

Prison health care has been noted as an area where it is challenging consistently and transparently to calculate costs (Cai et al., 2013) and hence where limited data on unit costs are available (Brookes, 2013). More information though is available on the total cost of health care for people in prison, primarily from administrative sources. Sridhar et al (2018) conducted a systematic review of prison health care costs and found that costs ranged from $34 per prisoner per year in Sri Lanka to $6,714 per prisoner per year in the UK, with all costs reported in 2016 USD (Sridhar, Cornish, & Fazel, 2018). As part of this work they set out a guideline of what cost components should be included when costing health care services in prisons.

Some of the most comprehensive data on the costs of prison health care come from the PEW report into US prisons health care costs, which found that in 2011 US states spent £7.7 billion on health care, likely one fifth of total prison expenditures. In terms of a breakdown of what that funding was spent on, 37% was spent on general medical care, 20% on hospitalisations, 14% pharmaceuticals, 14% on mental health, 5% substance misuse, 4% dental care, 4 % health care administration and 1% other. More remote prisons had higher costs, with transportation potentially exceeding $2000 a day. Prevalence of disease and having an older population also increased costs. The number of older inmates, those above 55 years of age, in US prisons grew by 204% between 1999 and 2012, from 43,300 to

131,500 compared to a 9% growth in numbers for those under 55. Median health care spend is higher in states where a higher proportion of people in prison are over the age of 55 - $5196 per inmate for 5.6% over 55, $7142 if 9.1% over 55 (Pew Charitable Trust & John D and Catherine T MacArthur Foundation, 2014). This level of detail in regards to spending is not readily available for other countries.

Costs for prison health care can vary widely though and little has been done to look at the predictors of costs of health care spend. One study by Barrett et al (2009) looking at the predictors of service use for people with DSPD in prison reported that prisoners with poorer social functioning cost more, suggesting they were treated according to need and whereas prisoners with higher levels of psychopathology cost less. The researchers were unable to identify why higher levels of psychopathology were related to lower costs, but hypothesised it was as a result of poorer engagement with services. An observational study using medical invoice data in Switzerland looking at the predictors of health care costs in prisons found that chronic infectious, musculoskeletal and skin diseases are strong predictors of physical health costs, whereas schizophrenia, personality disorders and drug dependence is related to mental health service costs (Moschetti et al., 2018). Little is known about the predictors of costs in an English NHS prison cohort or how this compares to other people in contact with criminal justice or in the community.

For the future work regarding the economic evaluations alongside the clinical trial in prisons, the key predictors of costs are important to know to ensure they are captured as part of any analysis or decision modelling. In particular it will be important to know what the additional costs are associated with having a common mental health problem and what role being in prison or in contact with the criminal justice system plays when predicting health care costs.

6.3 Method

6.3.1 Recruitment

Participants were recruited to a longitudinal interview study of people in contact with the criminal justice from two sites in England, one in the South East and one in the South West,. The aim of the study was to examine access to and continuity of health care prior to, during and after their contact with criminal justice agencies. Participants were recruited at one of

three time points: (a) at the start of a prison sentence (including remand); (b) the end of a prison sentences; or (c) at the start of probation supervision. Inclusion criteria were aged 18 years and over; at the beginning or end of their prison sentence for groups (a) and (b) respectively; and previously living or planning to return to following release the south west or south east areas. Exclusion criteria were being unable to give informed consent; current mental or physical health that would preclude them from being involved in the study, particularly the potential for distress and a history of violence or other threatening behaviour that may pose a risk to the researcher. The sample included both men and women, although there were no women in the prison sample due to difficulties in recruitment from a women's prison.

At baseline participants were asked about the previous 6-months health care use. A random sample of 50% of participants were then followed up at 3-month intervals up-to 6-months after joining the study.

6.3.2 *Data collection*

Based on coding done by research assistants, participants were grouped according to if they had a depression, anxiety or any other common mental health problem, serious mental illness, personality disorder, opiate dependence, other drug dependency, a learning disability, physical disability or any other physical health problem. This was done for each time point they were followed up.

Information was collected at either the initial interview, or at 3-month time points up to 6-months after joining the study for the sub-study, asking about health-care contacts in the previous 6-months or since last interview. Where the person had been in the criminal justice system in the past 6-months or since last interview was also recorded. Of 313 participants originally assessed for eligibility, 286 were invited to join and 227 agreed to take part. In total 200 participants (male and female) from prison and the community attended the first interview.

Unit costs were applied to health care resource based on NHS reference costs 2013/2014 for acute care contacts and the Personal Social Services Research Unit (PSSRU) Unit Costs of Health and Social Care 2015. Criminal Justice costs were obtained from Ministry of Justice

and published sources. All costs other than for acute care are reported in Table 16 and are in 2013/2014 British Pounds. Acute care costs have not been included given the small patient numbers and hence potential for individuals to be identified.

Table 16 Unit costs in 2013/2014 British Pounds

Resource use	Unit Cost	Reference
GP - cost per minute	£3.20	(Curtis & Burns, 2015)
Community drug services (per contact)	£124	(Curtis & Burns, 2015)
Prison drug services	£104	(Brookes, 2013)
Escorts	£170	(Department of Health Prison Health, 2006)
Bed-watches	£4539	(Department of Health Prison Health, 2006)
Community mental health team contact	£36	(Curtis & Burns, 2015)
Other Allied Health Professional contact	£34	(Curtis & Burns, 2015)
Dentist – cost per minute	£2.5	(Curtis & Burns, 2015)
Prison health care nurse – cost per minute	£0.78	(Curtis & Burns, 2015)
Social care – cost per minute	£0.92	(Curtis & Burns, 2015)
Cost per month in prison	£2815	(Ministry of Justice, 2014)
Cost per arrest	£384	(Heslin et al., 2017)

Public cost per court appearance	£425	(Heslin et al., 2017)
Cost per month probation	£212	(Ministry of Justice, 2014)

6.3.3 *Data analysis*

Descriptive statistics were calculated at baseline for the full sample by recruitment location group (start of sentence, end of sentence and probation). Significant differences between the three recruitment location groups were calculated based on ANOVA for continuous variables and Chi-squared test for categorical.

Means and standard deviations were calculated for each of the three recruitment location groups for all health care resource use cost and resource use categories at initial interview asking about the past 6-months. Up-to 12-month mean costs are reported for the followed-up sample. For all other analyses a variable for duration was used to account for how long each participant had been followed up.

Univariate analysis was used to determine variables significantly related to costs, with all possible variables included in the demographic table (n=18) included in univariate models. Running a large number of analyses creates the risk of identifying relationships by chance, which would not be significant if tested in another dataset. A way to address this is external and internal validation. Unfortunately external validation is not possible given how unique this dataset is. The sample size is too small to hold out a portion of the sample for internal validation. Instead I have adhered to the recommendation by Harrell et al (1996) and kept the number of univariate tests to under n/10 or, given the sample of 200, under 20 and only run 18 univariate tests (Harrell, Lee, & Mark, 1996).

Backwards and forwards substitution, focusing on variables that were significant in the univariate model, was then used to develop multi-variate models using the Akaike Information Criteria (AIC) (Akaike, 1974) to determine the best model fit, with the model with the lowest AIC selected. A range of general linear models were also explored to determine the best model, again using the AIC, in line with best practice guidance (Barber &

Thompson, 2004). In most cases this is a gamma family and log link due to the positively skewed data, but negative binomial and Poisson models were also tested. The marginal mean cost was then calculated based on the adjusted model with the best fit. Variables were considered significant if the 95% confidence interval for the marginal cost did not cross zero.

An extensive break-down of health service use was reported in the COCOA publication (Byng et al., 2012) and hence has not been included in this analysis.

6.4 Results

The characteristics of the recruited cohort are reported in Table 17. Across the three groups at baseline, asking about the past 6-months, the end of prison sentence group had, on average, spent 2.8 of the previous months in prison compared to 1.8 months for the start of prison sentence group and 1.1 months for the probation sample, with a significant difference between the 3-groups ($p<0.001$). In total 84 participants were successfully followed up at 3 or 6-months (84% of the random sample of 100). Details of the followed-up participants are reported in Table 18. At 6-months and covering up to the previous 12-months, the start and end of sentence sample had spent 5.7 and 4.8 months in prison respectively, compared to 1.6 months in the probation sample, with a significant difference between the 3-groups ($p<0.001$)

Table 17 COCOA cohort characteristics at baseline

	Start of prison sentence n=50	End of prison sentence n=50	Probation n=100	Significance
Male n (%)	50 (100%)	50 (100%)	79 (79%)	p<0.001
Age mean (sd)	32.3 (10.7)	29.7 (9.9)	32.4 (10.6)	p=0.308
Ethnicity n (%)				p=0.499
White British	49 (98%)	46 (92%)	86 (86%)	
White Other	0	0	4 (4%)	

Black	0	2 (4%)	3 (3%)	
Asian	1 (2%)	0	3 (3%)	
Mixed	0	2 (4%)	3 (3%)	
Other	0	0	1 (1%)	
Children under 18 yes n (%)	29 (58%)	23 (46%)	51 (51%)	p=0.482
Housing (on release)				p=0.239
Owned house	4 (8%)	1 (2%)	3 (3%)	
Rental – housing association	14 (28%)	16 (32%)	35 (35%)	
Rental - private	18 (36%)	9 (18%)	17 (17%)	
Supported accommodation	1 (2%)	2 (4%)	1 (1%)	
Hostel	3 (6%)	3 (6%)	9 (9%)	
Homeless	1 (2%)	2 (4%)	0	
Friend or Family	7 (14%)	5 (10%)	23 (23%)	
Sofa surfing	0	4 (8%)	7 (7%)	
Other	1 (2%)	5 (10%)	2 (2%)	
Problems with accommodation	23 (46%)	17 (34%)	37 (37%)	p=0.425

In employment (in community or before prison)	17 (34%)	10 (20%)	15 (15%)	p=0.013
Highest qualification	n=44	n=46	n=90	p=0.041
No formal qualifications	4 (9%)	14 (30%)	13 (14%)	
GCSE/A levels	24 (55%)	20 (43%)	36 (40%)	
Higher education	3 (7%)	1 (2%)	14 (16%)	
Other qualifications	13 (30%)	11 (24%)	27 (30%)	
Sentence length - days mean (SD)	471.8 (464.0)	158.5 (315.3)	467.3 (381.9)	
Health problems n (%)	n=50	n=50	n=100	
Depression	26 (52%)	24 (48%)	48 (48%)	p=0.914
Anxiety	20 (40%)	17 (34%)	23 (23%)	p=0.396
Other common mental health problems	16 (32%)	13 (26%)	18 (18%)	p=0.175
Serious mental illness	7 (14%)	11 (22%)	7 (14%)	p=0.054
Personality disorder	2 (4%)	2 (4%)	5 (5%)	p=0.907

Opiate dependence	15 (30%)	22 (44%)	19 (19%)	p=0.008
Any drug dependence	33 (66%)	37 (74%)	55 (55%)	p=0.098
Learning disability	15 (30%)	15 (30%)	12 (12%)	p=0.005
Physical disability	13 (26%)	15 (30%)	12 (12%)	p=0.114
Any physical health problem	48 (96%)	47 (94%)	87 (87%)	p=0.05
3 or more physical health problems	11 (22%)	12 (24%)	17 (17%)	p=0.351

Table 18 COCOA characteristics of followed-up cohort at baseline

	Start of prison sentence n=26	End of prison sentence n=19	Community n=39
Male n (%)	26 (100%)	19 (100%)	29 (74%)
Age at baseline mean (sd)	34 (11.3)	28.2 (6.3)	31.2 (11.5)
Ethnicity n (%)			
White British	25 (96%)	19 (100%)	35 (90%)
White Other	0	0	1 (3%)
Black	0	0	3 (8%)
Asian	1 (4%)	0	0
Mixed	0	0	0

Other	0	0	0
Children under 18 yes n (%)	17 (65%)	6 (32%)	19 (49%)
Housing (on release)			
Owned house	3 (12%)	0	1 (3%)
Rental – housing association	8 (31%)	7 (37%)	16 (41%)
Rental - private	9 (35%)	3 (16%)	6 (15%)
Supported accommodation	0	1 (5%)	1 (3%)
Hostel	3 (12%)	2 (11%)	2 (5%)
Homeless	0	0	0
Friend or Family	3 (12%)	2 (11%)	9 (23%)
Sofa surfing	0	2 (11%)	3 (8%)
Other	0	1 (5%)	0
In employment (in community or before prison)	9 (35%)	3 (15%)	8 (21%)
Highest qualification	n=22	n=16	n=35
No formal qualifications	1 (5%)	3 (18%)	3 (9%)
GCSE/A levels	15 (68%)	10 (63%)	11 (31%)
Higher education	1 (5%)	1 (6%)	9 (26%)
Other qualifications	7 (31%)	2 (13%)	12 (34%)
Sentence length - days mean (SD)	442.9 (414.2)	209 (457.6)	456.3 (322.7)
Health problems n (%)			

Depression	15 (58%)	9 (47%)	17 (43%)
Anxiety	12 (46%)	9 (47%)	8 (21%)
Other common mental health problems	10 (38%)	4 (21%)	6 (23%)
Serious mental illness	5 (19%)	2 (11%)	3 (8%)
Personality disorder	1 (4%)	1 (5%)	1 (3%)
Opiate dependence	9 (34%)	10 (53%)	8 (21%)
Any drug dependence	20 (77%)	13 (68%)	20 (51%)
Learning disability	7 (27%)	4 (21%)	8 (21%)
Physical disability	4 (15%)	9 (47%)	6 (15%)
Any physical health problem	25 (96%)	18 (95%)	36 (92%)
3 or more physical health problems	7 (24%)	5 (26%)	7 (18%)

Table 19 Health-care costs at baseline covering the previous 6-months: mean (SD)

	Start of prison sentence n=50	End of prison sentence n=49	Probation n=89
GP community	77 (136)	35 (46)	70 (148)
GP cost police	58 (225)	9 (46)	41 (108)
GP cost prison	10 (32)	6 (21)	3 (16)
Primary care prison	106 (634)	20 (27)	9 (45)

Drug services community	536 (1353)	698 (1319)	687 (1904)
Drug services prison	275 (528)	272 (493)	43 (218)
Acute care	84 (208)	41 (125)	161 (488)
Mental health community	7 (38)	22 (152)	36 (89)
Mental health prison	27 (119)	11 (38)	10 (61)
Other costs community	3 (16)	6 (30)	18 (105)
Other costs prison	19 (109)	4 (27)	6 (49)
Social care	0	1 (4)	2 (18)
Escort and bed watches	108 (641)	7 (48)	6 (40)
Total community health care cost	623 (1357)	763 (1340)	813 (1891)
Total prison health care cost	437 (834)	312 (502)	72 (231)
Total health and social care cost	1310 (1907)	1131 (1684)	1092 (1962)
Total health care excluding drug treatment	450 (977)	161 (256)	362 (629)

Table 20 Health-care costs at follow-up for the longitudinal cohort, covering up to 12-months. Mean (SD)

	Start of prison sentence n=26	End of prison sentence n=19	Probation n=39
Total community health care cost	1307 (1790)	973 (1768)	808 (1249)

Total prison health care cost	437 (554)	653 (1040)	52 (144)
Total health and social care cost	1978 (2366)	1900 (1977)	1179 (1468)
Total health care excluding drug treatment	792 (1270)	279 (357)	547 (855)

When adjusting for duration of follow-up and using a log link with family gamma, the best model as defined by the AIC, there was no significant difference in total health care cost across the three groups (start of sentence mean cost per participant (mcpp) £1216 95% CI £608 to £1824; end of sentence mcpp £1211, 95% CI £602 to £1820; probation mcpp £1127 95% CI £697 to £1557). There was a significant difference between the three groups for criminal justice costs when accounting for duration of study follow-up, with the probation group costing significantly less (start of prison mcpp £11,667 95% CI £10,077 to £13,257; end of prison sentence mcpp £10,932 95% CI £9352 to £12,512; probation mcpp £5452 95% CI £4332 to £6572).

For the univariate analyses, significant variables for all health care costs included employment at any time, problems with accommodation, learning disability and opiate dependence. The best performing model based on the AIC was a negative binomial model. Only problems with accommodation and opiate dependence remained significant in the multivariable model, with people who said they had problems with accommodation having a marginal cost -£461 lower (95% CI-£125 to -£796) than people who did not identify problems with accommodation and people with opiate dependence having an additional marginal cost of £2051 (95% CI £1347 to £2754) compared to no opiate dependence and when accounting for duration of study follow-up.

If the costs for drug treatment services are excluded from health care costs, adjusting for duration of follow-up and using a negative binomial model, people at the end of their prison sentence cost significantly less than people at the start of their prison sentence (marginal additional cost at the start of the prison sentence of £309 95% CI £160 to £458) and people in probation (marginal additional cost in probation £164 95% CI £75 to £254). In the univariate models, the variables that are related to non-drug treatment health care costs

are feeling settled in accommodation, employment at any time, anxiety, depression and other common mental health problems. In the multivariable model the best performing model included all variables other than anxiety. All marginal costs were significant and are reported in Table 21.

Table 21 Marginal health care cost excluding drug treatment costs: negative binomial model and adjusting for duration of study follow-up

Variable	Marginal cost	95% Confidence interval
Start of sentence compared to end	264	105 to 423
Probation compared to end of sentence	112	13 to 211
Feeling settled in accommodation	149	42 to 256
In employment at any time	-188	-83 to -292
Depression	235	107 to 364
Other common mental health problems	-224	-115 to -333

For criminal justice costs, in the univariate analyses, depression, any common mental health problem, any serious mental illness, opiate dependence, any drug dependence and any physical health problem were all significantly related to criminal justice costs. When fitted into a multivariable model, including recruitment group and duration of follow-up, in the model with the best fit based on the AIC (gamma distribution and log link), depression is the only variable that remains significant, with a marginal cost of £2028 (95% CI £185 to £3870) for participants that had depression at any time during the study.

6.5 Discussion

There was a significant impact on health care costs, excluding drug treatment costs, dependent on if a person was in prison or in the community, with people at the end of their sentence having a lower health care cost than people at the start of their sentence or in probation. The cost of health care appeared to be unrelated to having a physical health problem. Depression and being in settled accommodation though were associated with

higher health care costs, whereas employment and common mental health problems other than depression and anxiety, with lower costs. When drug treatment service costs are included within the health care costs, opiate dependence is the key predictor of costs as well as problems with accommodation, with people with problems with accommodation having lower costs.

These findings appear to be counter intuitive given the evidence described in Chapter 2 regarding the health needs of people in prison: one would expect that health care costs would be higher for people in prison than people in probation given the higher level of need, although physical health need was only marginally higher in prison than in probation in this study. That problems with accommodation or not feeling settled in accommodation was associated with lower health care costs also appears unintuitive given the high health care needs of people who are homeless or have insecure housing.

These findings though fit with the wider literature regarding access to care for people in prison and with insecure housing, highlighting the important difference between need and access when accounting for demand for health care. The COCOA study, from which these data were obtained, found that health care contacts were significantly lower for people in prison compared to those in probation. In particular they found limited engagement with services in regards to mental health problems, with only 50% of mental health problems being addressed by health care services (Byng et al., 2012). Given the low rate of engagement with services for people with mental health problems, but the higher cost for people with depression, this would suggest that the problems with depression were potentially manifesting themselves elsewhere. This would fit with the qualitative interviews with participants, where mental health problems were rarely recognised by the participant themselves and health care was not perceived to be part of the solution where mental health problems were identified, with housing, employment and relationships being identified as more important factors that contribute to poor mental health (Byng et al., 2012).

Other studies using routine data in England have also found that people in prison use secondary care services 24% less than their peers in the community (Davies, Rolewicz, Schlepper, & Fagunwa, 2020). Our own study looking at cancer care in prison using NCRS and HES data also found that people in prison are less likely to receive curative care than matched peers in the community and hence have a lower cost of cancer care (Davies et al., 2023).

Other studies have also found that people with insecure housing can struggle to access planned care in England, as GP practices will sometimes not register people who do not have any formal documentation to prove their address, despite national guidance that a fixed address is not required for registration (Worthing, Seta, Ouwehand, Berlin, & Clinch, 2023). 11% of the COCOA participants were not registered with a GP, with no difference between the three groups, although GP registration was associated with improved access to health care (Byng et al., 2012). That homeless populations are not registered with a GP can sometimes explain some of their high use of emergency care services, in addition to their greater level of need (Gutwinski et al., 2021).

The factor most closely related to criminal justice costs was having depression at any point during the study. This is one finding where the direction of causation is unclear, as it may be that the criminal justice system contacts are causing the depression, rather than the other way around. Overall, this fits with the statement above that depression is not actively acknowledged or addressed in this population group, often considered instead to be a by product of life factors rather than something to seek diagnosis and treatment for.

6.5.1 Strengths and weaknesses

This is one of very few studies to examine the predictors of costs for people in contact with the criminal justice, particularly those in prison.

The data reported here is based primarily on self-report by people in contact with the criminal justice system, many of whom live chaotic and complex lives. A validation study was conducted as part of the COCOA study though for 49 participants, although records could only be accessed for 25 (51%) of participants. They found that overall self-report was reliable, particularly for drug treatment services (Byng et al., 2012). Other studies in homeless and serious mental illness have similarly found that their self-report of health care use and justice contacts is reliable (Somers et al., 2016).

Although aspects of this study are longitudinal, very little can be said about causation in this study. Instead it highlights factors that are related to costs and should be the focus of future research. Small sample sizes and bias in reporting and follow-up may mean that some key factors were missed. Physical health conditions in particular have been grouped together due to very small numbers for each condition and hence may not capture the true predictive cost

for each condition. Further work on larger cohorts is required to determine the cost of specific health conditions in prison. The reason for the negative relationship between health care costs and other common mental health problems is also unclear, although may again be due to lack of engagement with services.

6.6 Conclusion

People in prison potentially have a lower cost of health care while in prison, not as a result of a lower level of need, but due to challenges in accessing care. Depression and other common mental problems have a complex relationship with health care costs, and in the case of depression criminal justice related costs, that warrant further research. Overall, any study looking at the cost of health care in prison needs to make sure it takes into account opiate dependence and mental health in both the costs and the outcomes. Improved access to care for people with depression should be a key priority for criminal justice services going forward. Any intervention for depression though needs to acknowledge the wider needs of this population group as addressing depression in isolation from addressing concerns regarding housing, finances or relationships is unlikely to be successful. Economic evaluations for interventions that include a criminal justice population will need to go beyond a purely health and social care perspective due to the complex interaction between the criminal justice system and health care costs. Resource use measures will need to be designed to ensure they reflect the unique pattern of service use for this population.

7 SUITABILITY OF PREFERENCE BASED MEASURES FOR ECONOMIC EVALUATIONS IN PRISONS

7.1 Aim of the chapter

The systematic review conducted in Chapter 5 found that approximately one fifth of economic evaluations included QALYs in the calculation of an ICER, with no studies including primary data collection from people in prison to inform the calculation of QALYs. In the area of mental health there were no cost per QALY analyses. The aim of this chapter is to determine a suitable outcome measure to calculate QALYs as part of an economic evaluation of a prison intervention. The chapter sets out what cost-utility analysis is, then describes potential instruments for calculating QALYs for mental health in prison. In particular, this chapter compares the performance of the Clinical Outcomes in Routine Evaluation 6 dimension (CORE-6D), a preference-based utility measure of emotional and physical health, with a generic preference based measure of health related quality of life (HRQoL), the EQ-5D, specifically the 5 level variant (EQ-5D-5L). This chapter also looks at the suitability of measuring capability using a generic measure of capability and associated tariff, the Investigating Choice Experiments Capability Measure for Adults (ICECAP-A). The population group of interest are people in prison with common mental health problems recruited as part of the Engager pilot.

7.2 Introduction

7.2.1 What is cost-utility analysis?

The aim of cost-utility analysis is to aid in decision analysis in health care. In particular, it provides a standardised mechanism for comparing resource use and health outcomes across health care technologies and disease areas. The term was coined to differentiate it from cost-effectiveness analysis: a health economic evaluation where the denominator of the ICER is a cost per unit change in a disease or programme specific outcome, for instance cost per depression free day or cost per infection prevented. Instead, the outcome in the denominator of the cost-utility analysis ICER is a compound measure of mortality and morbidity quantified using preferences or risk in a standardised way (Drummond et al., 2015; Hunter et al., 2015; National Institute for Health and Care Excellence, 2022). The quantity and quality of life is then combined to calculate QALYs, DALYs or a variant thereof. As the units of analysis are standardised they theoretically make it easier to compare the

health and social care resource implications of different programmes and disease areas. Also to note is that cost-utility analysis is still called cost-effectiveness analysis in the US and in the UK a cost-utility analysis may be referred to as a cost-effectiveness analysis or cost-utility analysis depending on the author's preference (Drummond et al., 2015).

In health technology assessments in developed countries QALYs are the most commonly used outcome in the denominator of the cost-utility analysis. QALYs are calculated by weighting each year of life lived using a utility score. Utility scores are anchored so that 1 is perfect health and 0 is equivalent to the state of death. In some models negative scores are possible, representing states that are theoretically worse than death. Multiplying time in a health state by the health state utility value, one year of life lived in perfect health is equal to 1 QALY. If a person were to live for 2 years in a health state that is weighted as 0.5 of full health this is also equivalent to 1 QALY. The utility value and hence QALYs are valued independently of a person's age, so 1 QALY is the same for someone who is 18 years of age as for someone who is 80 years of age (Torrance & Feeny, 1989).

The term "utility" in cost-utility analysis and its theory is based on von Neumann-Morgenstern (vN-M) utility theory. The normative model for utility theory, the model for how a rational individual ought to behave, is that utility scores represent the strength of an individual's preference when faced with uncertainty for a given outcome, in this case a health state. There is a number of conditions that utility scores should meet, and although the model is normative, it should somewhat reflect the way individuals make decisions when faced with uncertainty (some empirical research however suggests these conditions may be more often violated than met (Torrance & Feeny, 1989)). vN-M utility theory also assumes that utility scores are cardinal in that individuals are able to quantify the extent to which they prefer one health state to another. This is as opposed to scores being purely ordinal; individuals are only able to order health states in terms of preference. Theoretically, utility scores that form the basis of QALYs are meant to have these qualities, making them as close as possible to the utility scores in vN-M utility theory (Drummond et al., 2015). The area though is not without its controversies and the terminology used can be confusing. "Utility" in vN-M utility theory and in the calculation of QALYs should not be confused with the way that the word utility is used in other areas of economics such as welfare theory and Pareto optimisation (Drummond et al., 2015).

7.2.2 Calculating utilities using the EQ-5D

Calculating patient level utility scores as part of a trial is usually made up of two steps: (1) asking patients to complete a generic measure of HRQoL at different time points over the duration of the trial, including baseline to measure a patient's health status; and (2) applying a preference based algorithm to calculate utility scores for each patient's health status at each time point.

The key body responsible for providing advice and guidance on best clinical practice including value for money in England, NICE, recommends that utility scores are obtained from a random sample of the general population and valued using a technique called time trade-off (TTO) to arrive at a measure of preference under uncertainty for a given health state (National Institute for Health and Care Excellence, 2022). The generic questionnaire favoured by NICE is the EuroQol group's EQ-5D and the 3 level version. This questionnaire consists of five questions asking if patients have no, some or extreme problems with mobility, self-care, usual activities, pain and anxiety/depression. In total the questionnaire defines 243 distinct health states, each of which have an associated, country specific, utility score representing the preferences of a sample of the general population of that country. In the UK the utility scores for the EQ-5D 3 level ranges from 1 for perfect health to -0.594 - states worse than death are possible with this value set, which are given negative scores (P. Dolan, 1997). Following concerns of ceiling and floor effects, and to increase the sensitivity of the EQ-5D a 5 level version has been developed (Herdman et al., 2011), with the 5-levels being no, slight, moderate, extreme and severe. A preference based health state valuation from a random sample of the general population has been derived for the EQ-5D-5L (Devlin, Shah, Feng, Mulhern, & van Hout, 2018), although NICE still express a preference for mapping back to the 3-level version when valuing the EQ-5D-5L (National Institute for Health and Care Excellence, 2022). The EQ-5D-5L is the version used in the pilot trial.

7.2.3 Calculating utilities using a mental health measure

In some instances there is evidence that the EQ-5D is not suitable for a particular patient group or disease (Longworth et al., 2014). In this instance NICE recommends either the use of another generic preference based measure, a condition specific preference base measure or conducting your own preference elicitation study (National Institute for Health and Care

Excellence, 2022). Although there is some evidence that the EQ-5D might not be suitable in serious mental illness (Brazier, 2010) for common mental health problems such as depression and anxiety, the evidence suggests that the EQ-5D-5L functions just as well, if not better than mental health specific preference based measures (Franklin, Hunter, Enrique, Palacios, & Richards, 2022). Based on the results of the systematic review in chapter 5, there is no evidence as to what measure might be most suitable for an economic evaluation of an intervention for a common mental health problem in prison.

In this study we look at the performance of the Clinical Outcomes in Routine Evaluation - Outcome Measure (CORE-OM), a generic measure of mental health and its preference based tariff. The CORE-OM is a 34 item measure that was designed to be relevant to all patients in psychotherapy. It was developed as part of the push for mental health services to provide data on outcomes to show clinical effectiveness. It comprises of four domains: subjective well-being (4 questions), symptoms (12 questions), functioning (12 questions) and risk (6 questions). The symptom domain includes questions about anxiety, depression, physical problems and trauma and the functioning domain asks questions about general functioning, close relationships and social relationships. Each question has 5 levels of responses from “not at all” to “most or all of the time” (Michael Barkham et al., 1998). The CORE-OM has been shown to have good psychometric properties and to function well in primary and secondary care psychotherapy patients (M. Barkham, Gilbert, Connell, Marshall, & Twigg, 2005; Evans et al., 2002).

Following Rasch analysis of CORE-OM from a sample of 400 people with common mental health problems the CORE-6D was developed. Rasch analysis is a method for identifying which items on a questionnaire may measure similar psychometric properties and hence can be used to reduce the number of items on a questionnaire (Boone, 2016). When developing a preference based measure this is incredibly important as additional domains and levels exponentially increase the number of potential health states that might need to be valued. For example, changing a 5 item 3 level questionnaire to a 6 item 3 level questionnaire would triple the number of potential health states from 243 to 729. The final 6 domains of the CORE-6D are 5 emotional domains of feeling alone and isolated, panic and terror, humiliation and shame, able to do things, and suicidal ideation and 1 item of physical domain including physical problems, aches and pains. Each domain is made up of three

levels (never, occasionally and often) for a total of 729 unique emotional and health states. In line with NICE guidance, TTO valuations were completed by 225 UK respondents for 8 CORE-6D health states per respondent. 18 health states in total were chosen for respondents to value: approximately 75 respondents valued 17 of the health states and all respondents valued health state 222220. Based on an analysis of these results a utility index was developed for the CORE-6D for use in economic evaluations to calculate QALYs (Mavranezouli, Brazier, Rowen, & Barkham, 2013).

Subsequent to the development of the CORE-6D, the Recovering Quality of Life (ReQoL) questionnaire (Keetharuth et al., 2018) and associated questionnaire with a preference based tariff, the ReQoL utility index (ReQoL-UI) (Keetharuth, Rowen, Bjorner, & Brazier, 2021), has been developed, which measures recovery in mental health service users. Although this would have been a suitable measure to use in the Engager pilot, the outcome measure had not been developed at the time when the pilot took place.

7.2.4 Calculating capabilities

Within economic evaluations of complex health and social care interventions there is concern that generic measures of HRQoL such as the EQ-5D do not sufficiently capture "spill-over" effects – that a health or social care intervention may have well-being implications beyond health that are not captured (Mitchell, Roberts, Barton, & Coast, 2015). The Investigating Choice Experiments Capability Measure for Adults (ICECAP-A) measure was developed to try to capture broader well-being. It is has been developed based on Sen's capability approach and qualitative interviews with people about what is important in their lives other than health. Unlike generic HRQoL measures that focus on symptoms of ill health the ICECAP-A asks questions about people's ability to achieve for five attributes: stability (feeling settled and secure); attachment (being able to have love, friendship and support); autonomy (being able to be independent) achievement (being able to achieve and progress); and enjoyment. Each attribute has four levels of capability from full capability to no capability (Al-Janabi, Flynn, & Coast, 2012).

The valuation of the ICECAP-A within a QALY framework proves problematic given its conceptual differences to HRQoL. A particular methodological problem is anchoring the measure in relation to death, which is required to give the measure its utility scores on the

mortality/morbidity scale. Although the zero or lowest value on the capability scale, the equivalent to death on the QALY scale, is likely to be no capability its relationship with death is not clear: although a person who is dead is likely to have no capability a person who has no capability is not necessarily dead (although one can argue the same for QALYs given states worse than death). Instead capabilities are better defined as a measure of "unmet" need so should exist outside of the QALY framework (Coast, Smith, & Lorgelly, 2008). Given its problematic relationship with death the decision was taken not to calculate a preference based utility score using TTO given that how to conceive of trading capabilities for more of less life is not intuitive or sensible. Instead ICECAP-A has been valued using best worst scaling (BWS) to arrive at a preference based tariff (Flynn et al., 2015).

7.2.5 Engager II trial

In addition to the limited number of mental health economic evaluations conducted in prison mentioned in Chapter 5, there is a paucity of treatment available to address mental health problems in prison, particularly for people with common mental health problems (Byng et al., 2012; Lennox et al., 2018). The aim of Engager II is the development and trial of an intervention to identify people in prison with common mental problems and provide them with a wrap-around service. This includes providing evidence based therapy, medication and resettlement services; the treatment of mental health problems such as depression and anxiety is unlikely to be successful without addressing the social determinates of the disorder such as housing, finances, training and employment support (Byng, Kirkpatrick, et al., 2022; Lennox et al., 2018). An additional aim is to ensure that people continue to get treatment for their common mental health problem following release from community health care services such as primary care and improved access to psychological therapies (IAPT). There is evidence that following release from prison ex-prisoners do not access health care services that they need (Byng et al., 2012).

Engager II is formed of a number of workstreams, with the focus being an RCT of the Engager intervention compared to current practice. An important research question is the economic consequences of providing an intervention to treat common mental disorders in prison and if it is cost-effective compared to current services. This question will be discussed in detail in a full economic evaluation of the trial in Chapter 8. A pilot trial to assess

recruitment, performance of outcomes and trial procedures was conducted prior to the full RCT (Lennox et al., 2018). The results presented in this chapter are from the data collected as part of the pilot trial only. One of the aims of the pilot was to assess the suitability of outcome measures for collection and analysis in the main trial.

Data in the pilot were collected on the three outcome measures with preference based tariffs; EQ-5D-5L, CORE-OM and ICECAP-A. The aim of this analysis is to evaluate the suitability of each outcome measure for use in a full trial. Of particular interest is how responsive the outcome is to a relevant clinical measure.

7.3 Method

7.3.1 Data collection

The aim of data collection as part of the pilot was to assess the feasibility and acceptability of collecting data on a range of outcome measures from men in prison with a common mental health problem. To be eligible for inclusion in the trial prisoners needed to have one of seven common mental health problems: depression, anxiety, obsessive compulsive disorder (OCD), post-traumatic stress disorder (PTSD), panic attacks and eating disorders. They also needed to be sentenced prisoners with less than two years remaining on their sentence. Once recruited to the pilot trial participants were given questionnaires at baseline, 3 months follow-up. Further details are available in the protocol (Quinn et al., 2018).

A secondary aim of the pilot was to assess the feasibility of recruiting to the trial and delivering the intervention, the results of which are reported in the main clinical paper (Lennox et al., 2018). This aim will not be assessed as part of this paper.

7.3.2 Validation of questionnaires

Fitzpatrick et al in their 1998 HTA report specify the methods for validating outcome measures to be used in clinical trials (Fitzpatrick R, Davey C, Buxton M, & Jones D, 1998). These methods have been used as guiding principles for assessing the performance of the CORE-6D compared to the EQ-5D-5L and the ICECAP-A.

Reliability and the general psychometric properties of the different measures have already been assessed as part of other studies (Al-Janabi et al., 2012; M. Barkham et al., 2005; Evans

et al., 2002; Janssen et al., 2013). What has not been assessed is how the questionnaires function in a prison population with common mental health disorders. The key questions to answer then are is the measure appropriate given the trial question and are people able to complete the measure? Given that the aim of the trial is to identify and treat common mental health problems a further issue is how each measure and its associated utility score relate to a clinical measure of mental health.

7.3.3 Appropriateness

Appropriateness asks whether the outcome measure is the correct one to use in the context of the research questions being asked in the trial. It speaks directly to the issue of what the hypothesis of the trial is and if the outcome measure adequately captures that. In addition one needs to consider the suitability of each measure as part of an economic evaluation of the cost-effectiveness of a common mental health wrap-around service compare to current practice appropriateness in Engager II. Aspects of the appropriateness question have been addressed by a Delphi exercise, the methods and results of which are published in a separate paper (Byng, Kirkpatrick, et al., 2022). The results of the Delphi exercise will be discussed briefly though to give an indication of the appropriateness of the three different questionnaires.

7.3.4 Completeness

The proportion of missing data for each of the questionnaires will be reported to provide a measure of completeness.

7.3.5 Responsiveness

Although ceiling and floor effects for the EQ-5D-5L have been assessed elsewhere (Janssen et al., 2013) they have not been assessed for this specific population. Utility scores were calculated using the preference based TTO algorithm (Devlin et al., 2018) as the analysis pre-dates the NICE position statement regarding the valuation of the EQ-5D-5L. Subsequent work has also found that the TTO algorithm is likely to perform better than the mapping algorithm in common mental health problems (Franklin, Enrique, Palacios, & Richards, 2021; Franklin et al., 2022). Although the psychometric properties of the CORE-OM and ICECAP-A questionnaires have been well established (Al-Janabi et al., 2012; M. Barkham et al., 2005;

Evans et al., 2002) less has been reported on the utility and capability tariffs respectively. These were calculated from the algorithm from Mavranezouli et al (2013) for the CORE-6D and Flynn et al (2015) tariff for the ICECAP-A. Descriptive statistics (mean and standard deviation), boxplots and frequency histograms of utility and capability tariffs will be reported to assess the responsiveness of the three questionnaires.

7.3.6 Validity

Although the intervention developed as part of Engager II is designed to address a range of social problems, one of the key aims is to address common mental health symptoms. In this regard one of the aims of the trial is to make a measurable clinical improvement to mental health symptoms for people in the intervention group compared to people who receive current practice only. A good outcome measure in the economic evaluation should also be able to capture that clinical change.

Depression is the most common mental health disorders in this population. The validated clinical measure used to evaluate depression severity in the Engager trial is the Patient Health Questionnaire (PHQ) depression module (PHQ-9) which assess each of the diagnostic statistical manual four (DSM-IV) criteria for depression on a scale of 0 (not at all) to 3 (nearly every day) (Kroenke, Spitzer, & Williams, 2001). To assess how well the three questionnaires capture differences in the clinical outcome a stepped hierarchical approach was used.

1) Simple linear regression models were developed to capture the change in utility or capability tariff for each one point increase in the PHQ-9.

2) Two-way scatter plots with LOWESS (locally weighted scatterplot smoothing) and median splines superimposed were used to inform suitable model structures. Based on this the next model chosen was a split linear models fitted at the clinical cut-off (a score of ≥10). The clinical cut-off was chosen as it appeared to best fit the data, although other cut-offs were tested and did not perform better.

Model (2) or more complex, non-linear models using non-linear splines would only be adopted as the preferred model if they were better as assessed using Akaike's Information Criteria (AIC) (Akaike, 1974). The best models are then compared on AIC across the three

questionnaires using the same test of statistical significance to identify better models, as well as the F-statistic and R-squared.

7.4 Results

7.4.1 Sample characteristics

121 participants were asked to complete the questionnaires at baseline. All participants were men and in prison at baseline, sentenced and with less than 2 years remaining on their sentence. Descriptive statistics for participants are reported in Table 22. The most prevalent common mental health problem was depression (90%) with almost half (48%) of the participants having 3 or more common mental health problems.

Table 22 Characteristics of trial participants in the Engager II pilot

	Participants (N=121)
Mean age (SD)	34 (9.6)
Age distribution	
18-24 (%)	27 (22.31%)
25-34 (%)	39 (32.23%)
35-44 (%)	41 (33.89%)
>45 (%)	14 (11.57%)
Depression (%)	108 (90.00%)
Anxiety (%)	95 (78.33%)
PTSD (%)	41 (34.17%)
OCD (%)	27 (22.11%)
Panic Attacks (%)	12 (35.00%)
Eating disorder (%)	17 (13.68%)
Treatment for psychosis (%)	4 (3.31%)
Drug or alcohol problem	83 (68.33%)
> 1 common mental health problem (%)	105 (86.78%)
3 or more mental health problems (%)	58 (47.93%)

7.4.2 Appropriateness

Assessing the appropriateness of a measure is not straightforward given it can be assessed along a number of domains.

One domain would be how it functions within the economic evaluation framework. As previously stated NICE recommends the use of the EQ-5D for calculating QALYs to allow for comparability between cost-utility analyses (National Institute for Health and Care Excellence, 2022). There are recognised instances though where the EQ-5D does not need to be used:

1) The questionnaire does not adequately measure symptoms or clinical changes in disease state, for example a clinically meaningful response to treatment is not captured. In this case the recommended action is to use another measure that functions appropriately and has been valued using TTO (National Institute for Health and Care Excellence, 2022).

2) In public health trials there is clear guidance and acknowledgment of the need to capture outcomes outside of health (Edwards et al., 2013; National Institute for Health and Care Excellence, 2012).

In the instance of the Engager II trial one could argue that outcomes outside of HRQoL such as social functioning are important and hence a measure such as ICECAP-A may be more appropriate. In support of this, prior to the pilot trial, a Delphi exercise was conducted to assess important outcomes from the Engager trial. The exercise asked 24 individuals from a range of stakeholder groups to rate the importance of 16 outcomes. Groups included clinicians, criminology or social science researchers and a health economist. The respondents also included 10 people in prison. The result of the analysis was that mental health symptoms was judged the most important outcome in the exercise. Second were symptoms relating to self-harm and suicide, and third social functioning defined as access to and use of resources, activities and services such as employment, adequate housing, health care, education and training. Quality of life was number seven on the list of priorities. All groups responded similarly except for people in prison: they ranked relationships with

family and friends as joint first with symptoms of mental health (Byng, Kirkpatrick, et al., 2022).

In this regard CORE-OM and the associated CORE-6D are the most acceptable measures as both are mental health focused and include self-harm and suicide symptoms. This is also reflected by the fact that CORE-OM has been selected as the primary outcome for the trial (Kirkpatrick et al., 2018). ICECAP-A would also be considered acceptable given that it measures social functioning. People in prison in particular would consider it an important outcome given its emphasis on relationships with others. The EQ-5D might be considered less desirable given that it is further down the list as a quality of life measure. If the domain anxiety/depression captures anxiety and depression though this might increase the argument for the EQ-5D as a questionnaire that captures mental health outcomes.

7.4.3 Missing data

There were three potential causes of missing data in the pilot trial:

1) Missing questionnaires as patients did not complete them.

2) Missing items on questionnaires.

3) The decision to collect CORE-OM at baseline was made part way through the pilot. As a result approximately half of the participants (n=61) are missing CORE-OM at baseline as it was never administered to them.

At baseline 3 participants (2.5%) were missing EQ-5D questionnaires. Of the participants that completed questionnaires there was no missing data from incomplete items.

The same 3 participants also missed questionnaires for ICECAP-A. There were also two missing responses, one potentially as a result of a coding error: 1 questionnaire was missing a response for question 2 (love and friendship) and an illogical value was entered for question 3 for one questionnaire. As a result there was 116/121 questionnaires that could be used to calculate the capabilities tariff.

Of the 60 participants that completed the CORE-OM only two questionnaires were incomplete for the items needed to calculate the CORE-6D: 1 questionnaire was missing a

response to question 15 (panic and terror) and 1 questionnaire was missing a response to question 16 (plans to end my life).

Follow-up at 3 months was quite low as this was not the objective of the pilot. 30 people completed the EQ-5D-5L and the ICECAP-A, with 1 response to question 3 (feeling independent) missing from the ICECAP-A. 18 people completed the CORE-OM at 3 months.

7.4.4 Utility scores and capability tariff

Descriptive statistics at baseline and 3 months for completed questionnaires are reported in Table 23. Figure 13, Figure 14 and Figure 15 show histograms of responses to the CORE-6D, EQ-5D-5L and ICECAP-A respectively at baseline, Figure 16 box plots and Figure 17 EQ-5D and Figure 18 ICECAP-A domains at baseline. Item responses to the CORE-6D have not been included given that they are rescaled items and hence hard to interpret.

The most notable finding is that for question 5 of the EQ-5D-5L, anxiety and depression, 39% of people report having no problems with anxiety and/or depression. 90% of the participants that report no problems with anxiety and depression screened positive for anxiety and/or depression and 67% for both.

Table 23 Descriptive statistics at baseline

	Baseline	3 month follow-up
Mean CORE-6D (n, SD)	0.742 (n=58, 0.16)	0.763 (n=18, 0.18)
Mean EQ-5D-5L (n, SD)	0.806 (n=118, 0.22)	0.83 (n=30, 0.21)
Mean ICECAP-A (n, SD)	0.623 (n=116, 0.19)	0.764 (n=29, 0.19)

7.4.5 Model testing

The three questionnaires regressed against the PHQ-9 using (1) simple linear regression and (2) a linear spline fitted at the clinical cut off of 10 are reported in Table 24. In each instance the AIC was not lower for the more complicated spline model. As a result it was assessed that adding the additional variable does not improve the fit of the model and that more complicated model structures would not be investigated. Given the amount of missing data for CORE-OM it was not possible to compare the performance of the best models across the three measures unless only patients with CORE-OM, ICECAP-A and EQ-5D-5L complete questionnaires only were included. The results of including completed questionnaires only

and a simple linear model are reported in Table 25. The CORE-6D had the best model fit based on AIC criteria.

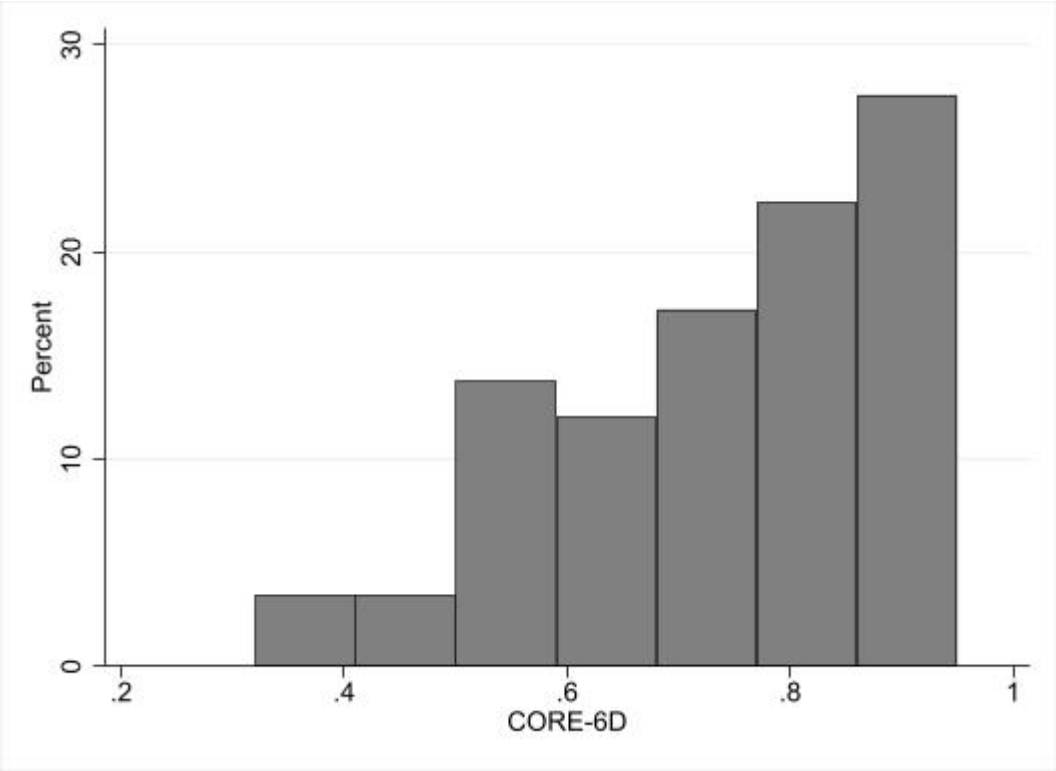


Figure 13 Percentage histogram of baseline utility scores for the CORE-6D

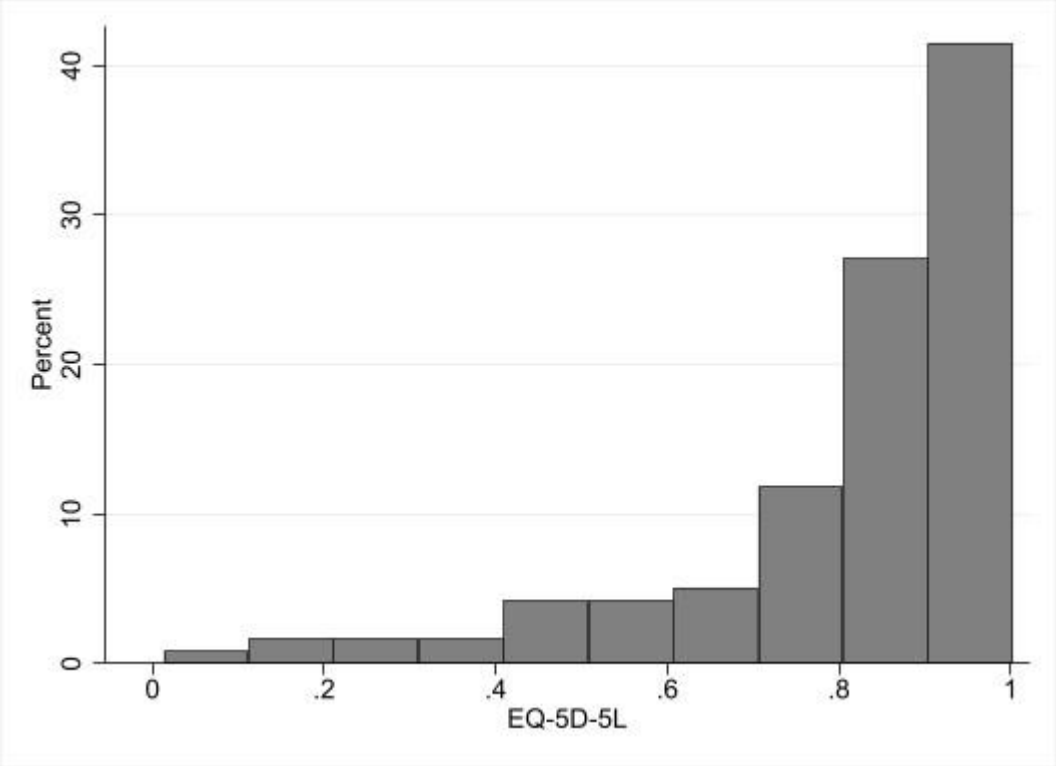


Figure 14 Percentage histogram of baseline utility scores for the EQ-5D-5L from Devlin et al 2018

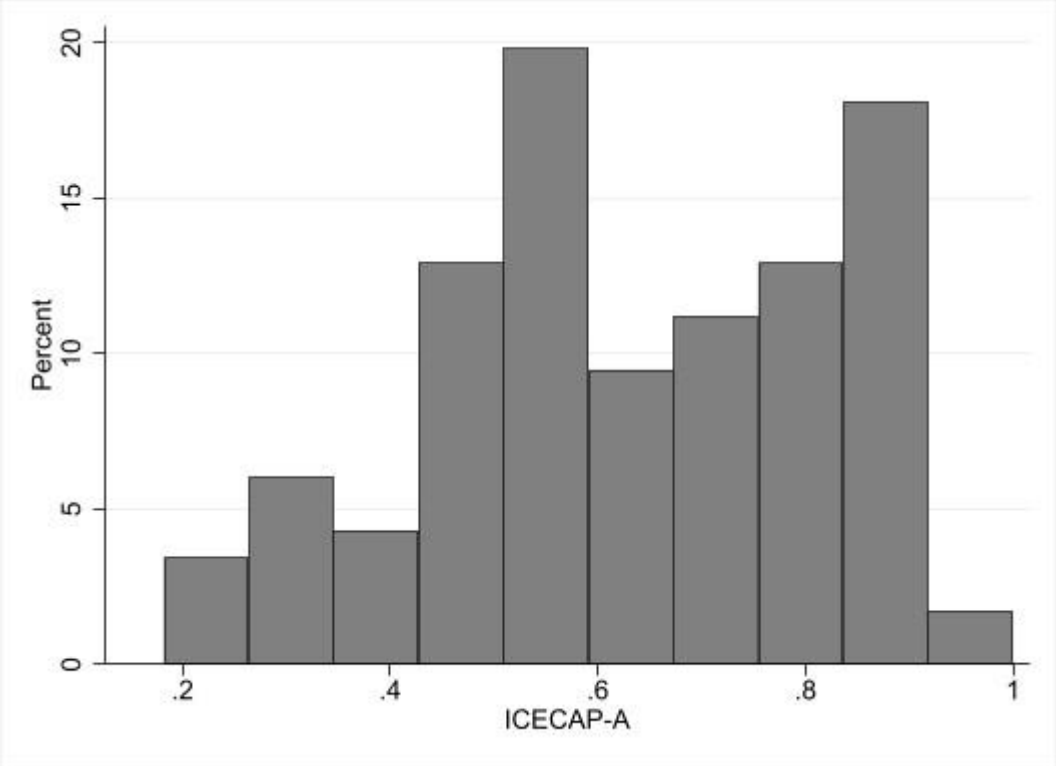


Figure 15 Percentage histogram of baseline capability tariffs for the ICECAP-A

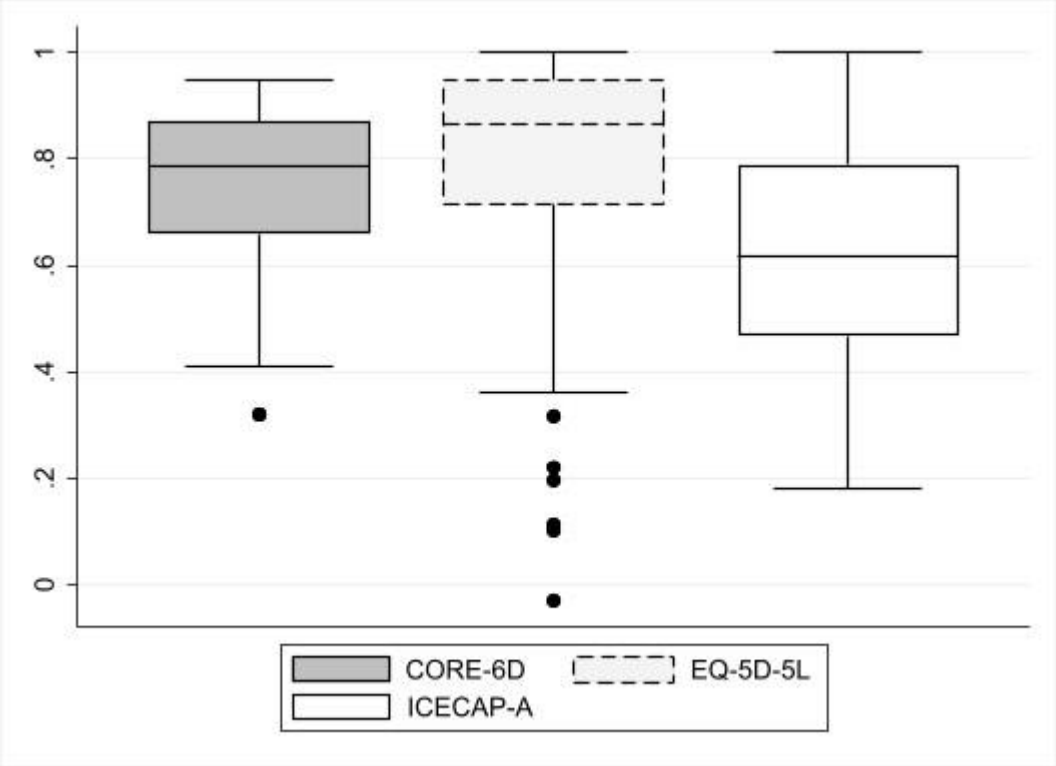


Figure 16 Boxplot of baseline utility scores and capability tariffs

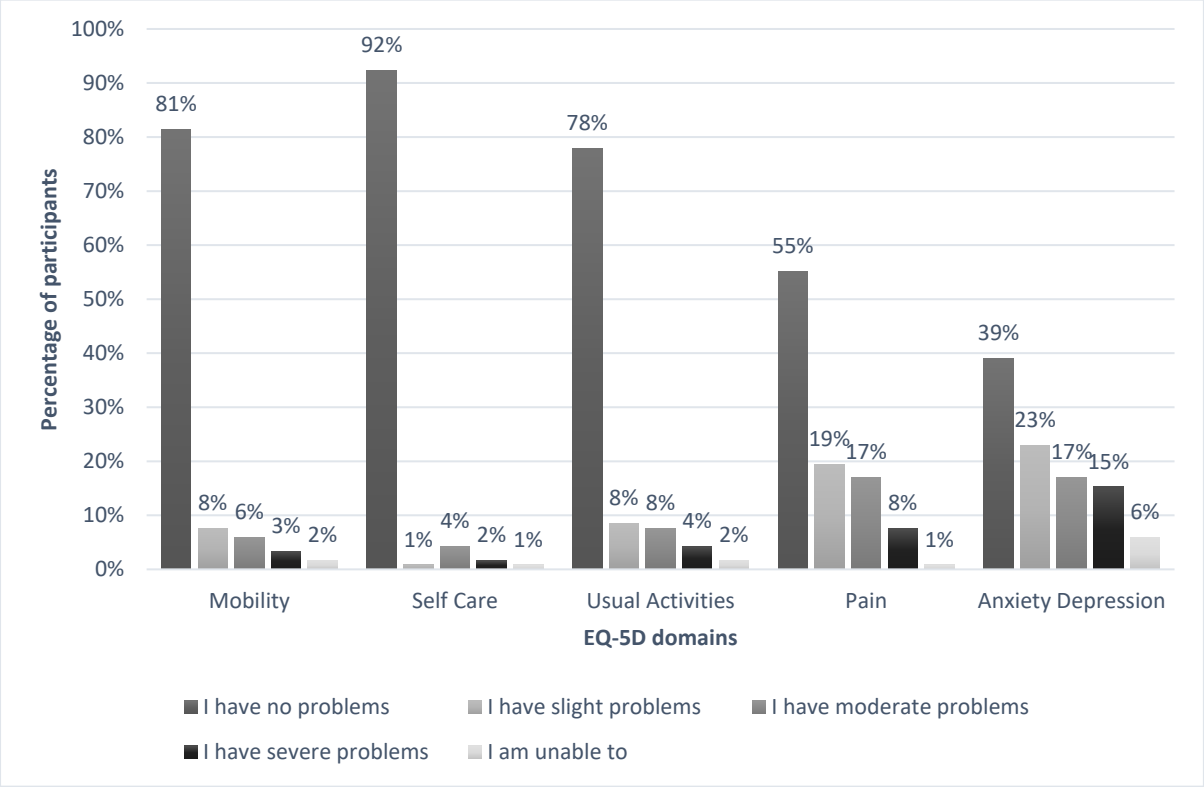


Figure 17 Domain responses EQ-5D-5L at baseline

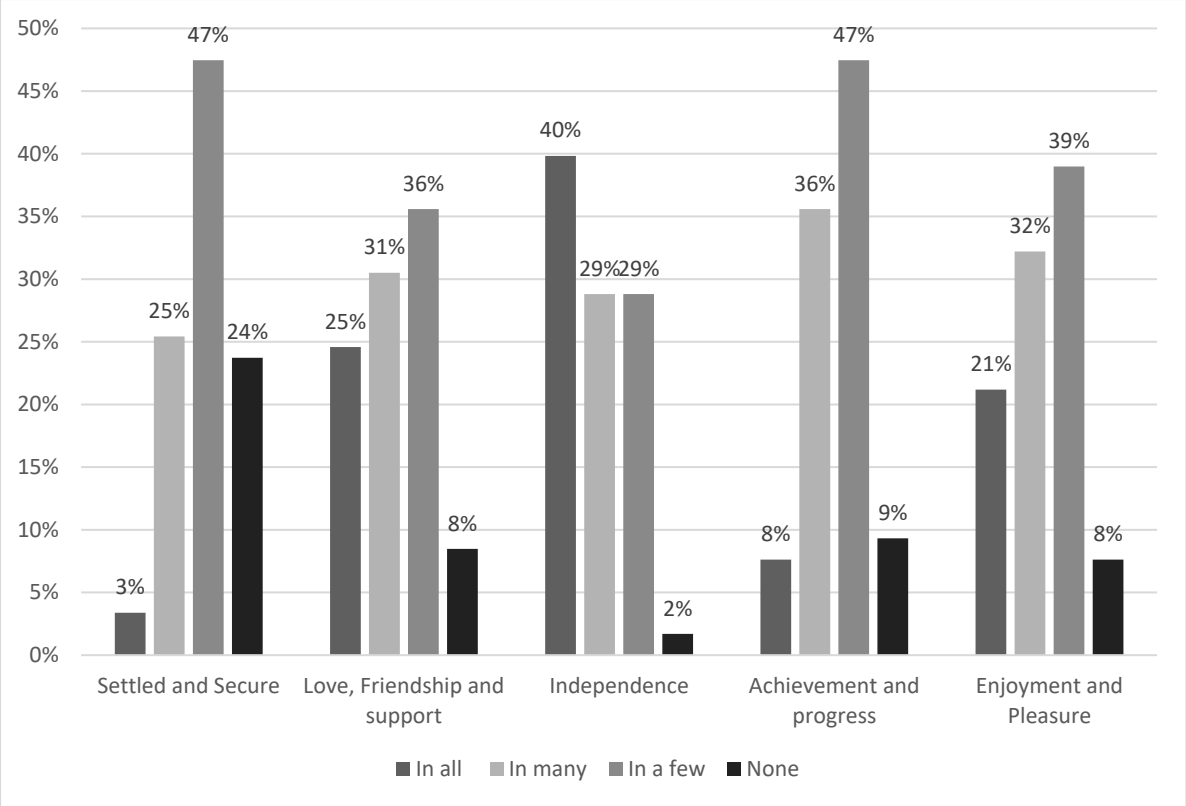


Figure 18 Domain responses to ICECAP-A at baseline

Table 24 Testing three questionnaires and 2 models of fit

	Model 1: simple linear model **CORE-6D**	Model 2: Spline at clinical cut point **CORE-6D**	Model 1: simple linear model **EQ-5D-5L**	Model 2: Spline at clinical cut point **EQ-5D-5L**	Model 1: simple linear model **ICECAP-A**	Model 2: Spline at clinical cut point **ICECAP-A**
n	58	58	113	113	111	111
Constant (95% CI)	0.866 (0.785 to 0.947)		0.951 (0.877 to 1.025)		0.749 (0.681 to 0.818)	
β - PHQ-9 (95% CI)	-0.011 (-0.018 to -0.005)		-0.013 (-0.019 to -0.007)		-0.012 (-0.018 to -007)	
Intercept PHQ-9<10 (95% CI)		0.763 (0.615 to 0.838)		0.838 (0.705 to 0.928)		0.651 (0.574 to 0.728)
Intercept PHQ-9>=10 (95% CI)		0.726 (0.667 to 0.859)		0.817 (0.705 to 0.928)		0.663 (0.651 to 0.765)
β - PHQ-9<10 (95% CI)		-0.016 (-0.037 to 0.005)		-0.013 (-0.033 to 0.007)		-0.004 (-0.023 to 0.014)
β - PHQ-9>=10 (95% CI)		-0.013 (-0.028 to 0.002)		-0.016 (-0.029 to – 0.003)		-0.017 (-0.028 to -0.005)
AIC	-55.19	-51.47	-41.99	-38.21	-61.88	-59.18

Table 25 Testing 3 models only for participants with complete questionnaires (n=58)

	Model 1: simple linear model **CORE-6D**	Model 1: simple linear model **EQ-5D-5L**	Model 1: simple linear model **ICECAP-A**
Constant (95% CI)	0.866 (0.785 to 0.947)	0.953 (0.834 to 1.073)	0.779 (0.668 to 0.890)
β - PHQ-9 (95% CI)	-0.011 (-0.018 to -0.005)	-0.014 (0.024 to -0.004)	-0.016 (-0.024 to -0.007)
AIC	-55.19	-12.28	-24.14
F-statistic	12.13	8.61	12.35
R-squared	0.178	0.138	0.174

7.5 Discussion

Based on the linear models CORE-6D has the best fit with the clinical measure PHQ-9 using AIC as the test criteria if only patients with complete questionnaires are included. The ICECAP-A appears to have the second best fit, with very similar F-statistic and R-squared to the CORE-6D. Both questionnaires also appear to have less of a ceiling effect than the EQ-5D-5L. EQ-5D-5L had the highest completion rates and fewest missing data.

There appears to be a significant problem with the EQ-5D-5L and the validity of the anxiety and depression domain. Of the 46 patients (39%) that reported no problems for anxiety/depression 90% of the participants screened positive for either anxiety and/or depression and 67% had both anxiety and depression. In a community sample recruited from IAPT with a similar anxiety and depression profile, all patients reported at least slight problems with anxiety/depression (Franklin et al., 2021), although arguably people in prison are not aware of the anxiety and depression diagnosis in the same way that someone in IAPT is. There may be for a variety of reasons why participants with depression and/or anxiety respond that they have no problems on the anxiety/depression EQ-5D domain: the culture in prisons may be one where people are conditioned to not want to show weakness and hence do not want to report these problems. Another potential explanation is that anxiety and/or depression may have become normalised for people in prison; either they themselves have experienced the symptoms for so long they fail to recognise it as a problem or potentially also those around them display the symptoms so often that depression and anxiety may just be the way things are rather than something to be recognised as a clinical

problem and treated. Without speaking to the participants themselves it is hard to conclude the cause of this under-reporting. What it does point to though is both the inadequacy of the EQ-5D-5L in detecting anxiety and depression in this group and the need for active screening and treatment in this population given they will not self-identify as having depression and/or anxiety. The other questionnaires may capture depression better because they do not ask a diagnostic question but ask instead about symptoms or social correlates.

One of weaknesses in the analysis is that there are only a small number of CORE-OM questionnaires at baseline due to the late decision to start collecting this outcome measure. At follow-up there are very few responses for all questionnaires as this was not the purpose of this pilot trial. Ideally the analysis would compare responses on a clinical measure at baseline and follow-up and assess if clinical changes are captured in each of the three questionnaires to be used in an economic evaluation. Due to the small percentage of responses at follow-up coupled with missing data for CORE-OM at baseline patient numbers were too small to conduct the analysis. Future analyses though aim to explore this relationship.

The ICECAP-A appears to be an appropriate measure, with a range of stakeholders commenting that it is "what we want to measure". It also appeared to measure change on the PHQ-9 better than the EQ-5D-5L, although not as well as the CORE-6D. Although the ICECAP-A does not fit within the current QALY theoretical framework, there are methods published for combining patient level response over time for use in economic evaluations such as years of full capability equivalent years (Flynn et al., 2015) and setting a sufficient capability threshold (Mitchell et al., 2015). Some work with members of the public has come to a cost-effectiveness threshold of £33,500 for years of sufficient capability and £36,150 for years of full capability (Kinghorn & Afentou, 2021). The perspective for this though was wider than for the NICE threshold for QALYs set at £20,000 to £30,000 per QALY gained, and which continues to be a health and personal social services only perspective (National Institute for Health and Care Excellence, 2022). Further discussion regarding the implications for cross-sectoral economic evaluations is discussed in the next chapter, Chapter 8.

Questions also remain regarding what domains such as “I can achieve and progress” and “I have love friendship and support” in the ICECAP-A mean for people in prison. For example, feeling one can achieve may not always correlate with actual achievement. This is an important distinction in the context of rehabilitation and obtaining employment and other meaningful activities on release. Other work done as part of Engager II has also suggested that although people in prison report good relationships with peers those relationships might not always be positive, for example they may encompass close relationships with other people that supply or use illicit substances that are seen by the respondent as a good relationship.

7.6 Conclusions:

Overall this study would suggest that the CORE-6D and its utility score is a good outcome measure to use in trials of interventions to screen and treat common mental disorders in prison. ICECAP-A also appears to be promising, although its conceptual underpinnings require further discussion in relation to its use for resource allocation in a prison setting. The EQ-5D-5L might only be left in for reasons of comparability to other evaluations but would not be recommended as the primary analysis.

8 ECONOMIC EVALUATION OF ENGAGER INTERVENTION

8.1 Aim of chapter

The previous chapters in this thesis have looked at the current evidence base for economic evaluations of health related interventions in prison. The aim of this chapter is to report the results of a full economic evaluation of the Engager II intervention delivered in a prison setting. The methods for this chapter were informed by the results from chapters 5, 6 and 7 in the thesis. Initially the trial would also include a full decision model to evaluate the long term cost-effectiveness of the intervention. This was decided against based on the work done in conjunction with Dr Rob Anderson at Exeter University and the results of chapter 5 given that there was insufficient evidence available to model outcomes.

A version of this chapter has been published in the European Journal of Health Economics (Hunter et al., 2022) and in an NIHR Programme Grants for Applied Research report (Byng, Lennox, et al., 2022).

8.2 Introduction

As stated in chapter 1, commissioning physical and mental health care in English prisons has been the responsibility of the NHS since 2006 (Hayton & Boyington, 2006). Mental health care in prison is provided by in-reach teams, with a number of models of delivery, the aim being to achieve an equivalence between mental health care in prisons and in the community. As a result there is some evidence that the mental health care in prisons is improving (Steel et al., 2007). This care though covers specialist mental health care focusing on serious mental illness. In England the diagnosis and treatment for common mental health problems is the responsibility of General Practitioners (GPs) and the IAPT service. However, the latter is not routinely delivered in prison settings. There is evidence that those in contact with the criminal justice system, whether in prison or the community, do not have their common mental health needs met: Byng et al., (2012) found that 59% of people in contact with criminal justice had a common mental health problem, although only 61% felt they received the medication and 32% the therapy they needed. People also experience problems with continuity of care when they move from prison into the community (Byng et al., 2012).

As stated previously in the thesis, the preferred methodology for evaluating the allocative efficiency of a new technology is to calculate the incremental cost per QALY gained of the new

health technology compared to current best practice (Drummond et al., 2015; National Institute for Health and Care Excellence, 2022). The NICE reference case states that QALYs should be calculated using the EQ-5D (Hunter et al., 2015; National Institute for Health and Care Excellence, 2022). As reported in chapter 5, economic evaluations of mental health interventions in prison are rare, with none identified in the review. Most economic evaluations instead focused on programmes that divert people with serious mental illness away from prison or substance misuse treatment. The most common economic evaluation type was CEA, with no CUAs conducted in mental health (see Table *9* and Table 12). Since the review was completed the Critical time Intervention for Severely mentally ill prisoners (CrISP) study has been published which reported an array of cost information. Although the study collected resource use, there was no self-reported measure of health or quality of life included, hence a CUA was not conducted (Shaw et al., 2017). As a result there is very limited evidence regarding the best practice for a prison based economic evaluation in mental health.

The aim of this chapter is to report the results of an economic evaluation of the Engager intervention plus usual care compared to usual care using participant level trial data over 12 months following release from prison. Trial participants completed a range of patient reported preference based measures of mental and physical health related quality of life and capability. They also completed a comprehensive battery of resource use questionnaires. The primary aim of the evaluation is to calculate the mean incremental cost per quality adjusted life year (QALY) gained following release from prison and from an NHS perspective. The chapter also investigates the cost impact of Engager plus usual care compared to usual care on a range of different public sector budgetary perspectives as well as including productivity gains. As set out in section 5.5 I use a cost-consequences analysis given the importance of reporting a wide range of outcomes relevant to both the NHS and HMPPS as key decision makers. The decision was made to make the CORE-6D the primary analysis, going against the NICE reference case, given the evidence presented in chapter 7.

8.3 Methods

8.3.1 Recruitment

Two investigation centres (south-west and north-west of England) recruited patients to the parallel, two-group, randomised control trial. Participants were randomised with an 1:1

allocation to either the Engager Intervention plus usual care (the intervention group) or usual care alone (the control group). Participants were included in the study if they were serving a prison sentence of 2 years or less in a male prison in England, with between 4 and 20 weeks remaining of their sentence and were identified as having or likely to have common mental health problems, including anxiety, depression, phobias, OCD and PTSD. Men were excluded if they met any of the following criteria: they were unable to provide consent; were on remand; had a serious and enduring mental health disorder including being on the caseload of the prison in-reach team; had a primary personality disorder; presented a serious risk of harm to the trial and intervention delivery team; or posed a risk of harm to themselves and the healthcare team felt participation in the study would be detrimental.

The primary objective of the trial was to evaluate the effectiveness of the Engager intervention in improving psychological and social outcomes for men with common mental health problems in prison. The primary outcome for the trial was the CORE-OM measured at 6 months after release from prison. The study was approved by the UK National Health Service, Wales Research Ethics Committee 3 (ref: 15/WA/0314) and the National Research Committee of Her Majesty's Prison and Probation Service (ref 2015-283). A trial protocol was published to provide additional detail on the trial (Kirkpatrick et al., 2018). A number of trial processes and outcomes were informed by the feasibility trial described in chapter 7 prior to the full trial (Lennox et al., 2018; Quinn et al., 2018).

8.3.2 Engager Intervention

Participants randomised to the intervention arm received the Engager intervention delivered by an Engager practitioner. As discussed in section 7.2.5, Engager was a manualised, person centred intervention with the aim of meeting participants mental health needs. These included addressing wider support issues such as education, accommodation, social relationships and financial management that may be related to mental health. Prior to release the Engager practitioner worked with participants on goals and needs using a goal attainment plan. On release from prison ongoing work between the participant practitioner included signposting to key community services to address the participants needs. All of this was underpinned by practitioners offering a mentalization based approach to support. The

development of the intervention was based on a realist evaluation of prison interventions for common mental health problems (Pearson et al., 2015).

Participants allocated to usual care continued with existing service provision for men prior to and following release from prison which included primary care, secondary care (specialist) mental health services, substance misuse services and other criminal justice and third-sector organisations that would provide support regarding education, accommodation, social relationships and financial management as standard.

8.3.3 Cost of Engager Intervention

The cost of the Engager intervention includes the time of an Engager practitioner from a range of different disciplines including psychology, mental health nursing, substance misuse and housing at the level of assistant practitioner or entry level counsellor (NHS pay grade Band 4, £32 per hour (Curtis & Burns, 2019)) to deliver the intervention, plus an allocation of the initial cost of training and supervision from a senior practitioner from a similar wide range of disciplines at Clinical Psychologist or Specialist level (NHS pay grade Band 7, £56 per hour (Curtis & Burns, 2019)). Training and supervision costs were calculated as the time allocated to attend training sessions multiplied by the cost of practitioner and supervisor time; the cost of delivering the training and mentalisation based approach (MBA) sessions; regular practitioner supervision; and meta-supervision conducted by a senior clinician (senior clinical consultant, £111 per hour (Curtis & Burns, 2019)). As a conservative estimate (overestimate of the true cost if this was implemented as part of routine care at a larger scale) the cost per participant of training and supervision is calculated as the total cost of training and supervision for the whole Engager trial divided by the number of participants randomised to the intervention arm of the trial. Practitioners were directed to keep detailed records of the amount of time they spent delivering different aspects of the Engager intervention. This information was then transcribed into a database so that the cost of the intervention could be calculated for each participant in the intervention arm.

A top-down costing of the intervention has been included as a sensitivity analysis, costing staff involved in the intervention based on total full time equivalent staff including oncosts and overheads (Curtis & Burns, 2019). The total cost per participant is calculated as the total

top-down cost of staff plus the additional cost of training divided by the number of participants in the intervention arm of the trial.

Data on additional services that participants were signposted to and attended as part of the intervention were collected using the resource use questionnaires, as described in the next section.

8.3.4 Resource use and costs

Resource use in both groups was collected using a version of the Client Service Receipt Inventory (CSRI) (Beecham & Knapp, 2001) adapted based on what I had found from looking at descriptive statistics from the Engager feasibility trial (Quinn et al., 2018). The CSRI was broken into key areas with examples of services in each area provided. It also asked if the service use was planned or unplanned/emergency. Mental and physical health care (planned and emergency) including primary care, secondary care, and medication was self-reported at baseline, 6 months and 12 months post-release asking about the previous 3 months at baseline and since last follow-up at 6 and 12 months. Accommodation, education, training, employment, financial advice, relationship and criminal related service use was self-reported at baseline, pre-release, 6 and 12 months post release, asking about the previous 3 months at baseline and since last follow-up at pre-release, 6 and 12 months. Participants were asked to report number of contacts as well as average duration of contacts. Unit costs and sources used to calculate costs are reported in Table 26. Medication was costed using the British National Formulary (Joint Formulary Committee, 2019).

Table 26 Resource use unit costs in 2017/2018 British Pounds

Resource use	**Unit Cost**	**Reference**
Health care resource use		
Hospital transfer (community)	258	(NHS Improvement, 2020)
Hospital transfer (prison)	4548	(Department of Health Prison Health, 2006)

Alcohol Brief Intervention (delivered by nurse)	8	(Curtis & Burns, 2019)
Community mental health nurse (per hour)	34	(Curtis & Burns, 2019)
Counselling (per contact)	74	(NHS Improvement, 2020)
Criminal Justice Liaison Service (per contact)	234	(NHS Improvement, 2020)
Dentist	164	(NHS Improvement, 2020)
Cognitive Behavioural Therapy (per contact)	74	(NHS Improvement, 2020)
GP (prison and community; per contact)	28	(Curtis & Burns, 2019)
Home help/care worker (per hour)	28	(Curtis & Burns, 2019)
Substance misuse services: prison (per contact)	80	(Brookes, 2013)
Substance misuse services: community (per contact)	130	(NHS Improvement, 2020)
Mental Health Clinic (per contact)	160	(NHS Improvement, 2020)
NHS Walk-in centres	35	Estimated using (Curtis & Burns, 2019)
Occupational Therapist (per contact)	81	(NHS Improvement, 2020)
Optician (per contact)	54	(Violato et al., 2016)
Peer groups for substance misuse (with Band 5 Counsellor leading – per contact)	34	(Curtis & Burns, 2019)
Physiotherapist (per contact)	57	(NHS Improvement, 2020)
Practice Nurse (per hour)	37	(Curtis & Burns, 2019)
Prison Nurse (per hour)	37	(Curtis & Burns, 2019)

Psychiatrist (per hour)	111	(Curtis & Burns, 2019)
Psychologist (per contact)	74	(NHS Improvement, 2020)
Sexual Health Worker (per contact)	120	(NHS Improvement, 2020)
Social Worker (per hour)	45	(Curtis & Burns, 2019)
Learning Difficulties Nurse (per contact)	79	(NHS Improvement, 2020)
Blood Borne Viruses Nurse	89	(NHS Improvement, 2020)
Behaviour Change (per contact)	74	(NHS Improvement, 2020)
Pharmacy – dispensing cost (per contact)	9	(Pharmaceutical Services Negotiating Committee, 2018)
Podiatrist/Chiropodist (per contact)	51	(NHS Improvement, 2020)
Healthy Living (per client)	120	(Curtis & Burns, 2019)
Smoking Cessation (per contact)	15	(National Institute for Health and Care Excellence, 2008)
IAPT (per contact)	96	(Curtis & Burns, 2019)
Criminal Justice		
Probation Worker/ Community Rehabilitation Company (CRC) worker (per hour)	21	(Indeed, 2020)
Enhanced Thinking Skills	154	(Brookes, 2013)
Healthy Relationships Programme (HRP) High (per contact)	148	(Brookes, 2013)
HRP Moderate (per contact)	121	(Brookes, 2013)

Controlling Anger (per contact)	114	(Brookes, 2013)
Counselling, Assessment, Referral, Advice and Throughcare (CARAT) Prison (per contact)	80	(Brookes, 2013)
Education Course (per attendance)	120	(Ipsos Mori Social Research Institute, 2018)
Prison (per person per year)	40,843	(Ministry of Justice, 2019a)
Police (per contact)	457	(Heslin et al., 2017)
Police (per night in custody)	411	(Heslin et al., 2017)
Police (per additional day in custody)	1032	(Heslin et al., 2017)
Local Authority		
Citizens Advice (per contact)	21[a]	(Citizens Advice, 2019)
Employment worker/officer (per contact)	68	(Curtis & Burns, 2015)
Housing worker/officer (per contact)	25	(Schneider et al., 2009)
Supported accommodation (per person per day)	118	(Curtis & Burns, 2019)
24hr Supported accommodation (per person per day)	267	(Curtis & Burns, 2019)
Social housing (per person per week)	108	(Curtis & Burns, 2019)
Probation hostel (same as supported accommodation)	118	(Curtis & Burns, 2019)
Other		
Lawyer (per hour)	200	(Harcourt Barristers Direct, 2020)

Legal Advocate (per contact)	34	(Devine, Spencer, Eldridge, Norman, & Feder, 2012)
Listeners/Visitors/Samaritans (per contact)	49[b]	(Samaritans, 2020)
Support from Religious organisations (per hour)	29[c]	(Thornhill Parish Church, 2020)
Life Coach (per contact)	50	(Bidvine, 2020)

a £26.8 million in funding and 1,273,000 contacts; b £6.2 million in funding and £78 million in volunteer equivalent time; 3.6 million calls; c £230 per day to keep a church open

Conventionally employment costs are costed as wages or salary lost due to illness or interrupted employment. People in contact with criminal justice, however, have relatively low employment rates: prior to incarceration 33% of the Engager trial population were in paid employment. Rather than preventing the reduction of productivity through illness the Engager intervention aims to facilitate access to paid employment. As a result, employment costs were costed as productivity gains using the human capital approach and assuming an hourly gross wage of £18.50 (Office of National Statistics, 2018), the mean wage for men. Insufficient information was provided to use a job specific wage for each trial participant, but the value of £18.50 value is close to the mean hourly wage for the construction industry (£17.29) (Office of National Statistics, 2018) the most common area that the trial participants worked in where information was available. The total productivity gain per participant was then subtracted from total per participant costs.

All costs are reported in 2017/2018 British Pounds, the most recent year costing data were available for. Any costs for earlier years were adjusted for the current year using the hospital and community health services (HCHS) index for health and social care costs (Curtis & Burns, 2019) and using the Services Producer Prices Index (Office of National Statistics, 2020) for other costs

8.3.5 Outcome Measures

As set out in chapter 7, limited work has been done on determining suitable outcome measures for economic evaluations of interventions delivered in prisons. The CORE-OM was

identified as probably the most suitable outcome, and was also chosen as the primary outcome of the main effectiveness analysis of the trial. The CORE-OM was collected at baseline, 1, 3, 6 and 12 months post release from prison, applying the algorithm from Mavranezouli et al., (2013) to calculate utility for the cost per QALY analysis. The EQ-5D-5L and ICECAP-A were collected at baseline, 3, 6 and 12 months post release from prison. Utility from the EQ-5D-5L was calculated from (a) the van Hout mapping algorithm (van Hout et al., 2012) to the EQ-5D-3L recommended by that National Institute of Health and Care Excellence (NICE) (National Institute for Health and Care Excellence, 2022); (b) the EQ-5D-5L value set (Devlin et al., 2018). ICECAP-A capability was calculated based on the tariff developed by Flynn et al (2015).

8.3.6 Statistical Analysis

Analyses were pre-specified in a health economics analysis plan (HEAP see Appendix 1).

Complete case (participants that were followed-up at that time point and completed that section of the questionnaire) descriptive statistics were calculated for the percentage of participants and mean number of contacts for each type of resource use. As questionnaires were completed with the aid of a research assistant it was assumed that if a value was missing for a resource use item it was because the participant did not use that item and hence it was imputed as 0. Questionnaires for participants that were followed-up that were specified as missing though were included as missing. Complete case means and standard deviations for costs were also calculated. The mean difference in costs, 95% confidence interval and p-value for each resource use type was calculated using regression analysis adjusting for baseline costs, with centre as a covariate and bias corrected bootstrapping with 3,000 iterations for complete cases (available at all time-points).

QALYs were calculated as the area under the curve (Hunter et al., 2015) using the CORE-6D and EQ-5D-5L. People that died before they reached a specific follow-up point are included as 0 for each follow-up point after they died, assuming linear interpolation from their last complete questionnaire until death. Years of Full Capability (YFC) (equivalent) were calculated using the ICECAP-A and methods for decision making set out by Flynn et al., (2015). For the CORE-6D, EQ-5D-5L and ICECAP-A we report the mean values at each time point and mean unadjusted QALYs/YFC from baseline to 12 months. Mean difference in

QALYs and YFC, 95% confidence interval and p-value were calculated using regression analysis adjusting for baseline utility/tariff (Hunter et al., 2015), with centre as a covariate and bias corrected bootstrapping with 3,000 iterations for complete cases (available at all time points).

In line with the statistical analysis plan, it was assumed that data missing at follow-up was missing at random. Following examination of a range of outcome measures no predictors of missingness were identified. Costs, utility scores and the ICECAP-A tariff were imputed for the recommended number of 30 datasets using chained equations (multiple imputation using chained equations (MICE)) and predictive mean matching (van Buuren, Boshuizen, & Knook, 1999).

For the incremental cost-effectiveness ratio (ICER) seemingly unrelated regression (Stata command SUREG) was used to account for the correlation between costs and outcomes to calculate the incremental mean cost per QALYs/YFC gained of Engager plus usual care compared to usual care. An adjustment for baseline and centre as a covariate were also included in the analysis. The primary analysis was calculated using the multiple imputation datasets and bootstrapped results (Leurent et al., 2018). The bootstrapped, imputed results were used to calculate the CEAC (Briggs, Wonderling, & Mooney, 1997; Fenwick, Claxton, & Sculpher, 2001) the probability that Engager is cost-effective compared to usual care for a range of thresholds for a QALY/YFC gained. A cost-effectiveness plane has also been reported.

As the trial based analysis covers a 12 month duration no discount rate was applied. Analyses were conducted using Stata version 16 (StataCorp LLC, 2022).

8.3.7 Secondary within-trial analyses

ICERs, CEACs and CEPs will be reported for the following analyses:

i) Health and social care cost perspective using the EQ-5D-5L for the calculation of QALYS.

ii) Health and social care cost perspective using the ICECAP-A for the calculation of YFC.

iii) All costs minus productivity gains and the CORE-6D for the calculation of QALYS

iv) All costs minus productivity gains and the EQ-5D-5L for the calculation of QALYS

v) All costs minus productivity gains and the ICECAP-A for the calculation of YFC.

8.3.8 Sensitivity analyses

1) The Engager intervention is costed based on information on contact times reported by Engager practitioners. In sensitivity analysis 1 the Engager intervention is costed as the top-down costing that includes the total cost of employing practitioners based on their FTE. This reflects the actual cost to the NHS of delivering Engager, including the learning curve of delivering the Engager intervention, as well as tasks that may not have been reported by the practitioner, particularly administrative tasks.
2) If Engager were to be rolled out more widely, the meta-supervision delivered by a senior clinician is unlikely to be included as part of the training and supervision included in the cost of the intervention. As a result, I conducted a sensitivity analysis where the cost of meta-supervision was not included in the training and supervision cost.
3) In the Engager manual it was stated that supervision was to occur on a weekly basis; in reality it may occur less frequently than this, for example on a fortnightly basis. A sensitivity analysis has been included with fortnightly supervision instead of weekly in the training and supervision costs.
4) Removing pre-release costs from the total costing as potentially these occurred before participants had received the Engager intervention.
5) There may be an interaction between being randomised to the Engager intervention and the pre-release duration in prison and other outcomes. A sensitivity analysis will include adjusting for the duration in prison pre-release, included as a covariate in the regression analysis.

8.3.9 Cost-consequences analysis

Cost-consequences analysis facilitates the comparison between costs and a range of outcomes. This is particularly important for interventions such as Engager where different costs and consequences are likely to fall on a number of different public sector budget holders including health care, criminal justice and local government, who in England are

responsible for substance misuse, social care and some accommodation services. Modelling work carried out by Dr Rob Anderson, but informed by the systematic review conducted in chapter 5, identified the importance of differentiating between planned versus unplanned care as a determinant of future costs and outcomes (Byng, Lennox, et al., 2022).

The initial aim prior to obtaining trial data was to estimate the incremental cost of health and social care including the cost of the Engager intervention in the treatment arm compared with the incremental number of trial participants who had outcomes such as stable accommodation, were in employment or had reduced contact with criminal justice agencies. The cost and QALY benefits associated with these positive gains would then be extrapolated further into the future. Within the pre-specified HEAP this analysis was given very broad methodological details as many aspects were reliant on the final results.

The analysis carried out as part of the main trial evaluation showed no evidence for participants randomised to the Engager intervention being more likely to be in stable accommodation (Byng, Kirkpatrick, et al., 2022). There was also no evidence for reduced contact with criminal justice agencies, with the results suggesting instead the opposite. As a result the following analyses were chosen instead:

- Greater odds of being in paid employment: calculated as an odds ratio adjusting for baseline employment and centre.
- Greater odds of accessing education: calculated as an odds ratio adjusting for baseline education and centre.
- Greater odds of accessing services to help with finance and accommodation: calculated as an odds ratio adjusting for baseline finance and accommodation service use respectively.
- Greater odds of being in contact with substance misuse services: calculated as an odds ratio adjusting for baseline substance misuse need and centre.
- Reduced number of unplanned contacts: calculated using general linear models and family (Poisson or negative binomial) based on the most suitable model as informed by the AIC (Akaike, 1974).

The weakness of this approach is that there is limited evidence on which to base any potential extrapolation of the benefits associated with each of these outcomes. As has been

set out in chapter 3 and 5 access to substance misuse services has been shown to be associated with reduced criminal activity and improved access to stable housing in the long term (Gossop, Trakada, Stewart, & Witton, 2005).

8.4 Results

8.4.1 Participants

Between January 2016 and October 2017 280 eligible participants were identified and gave consent to be involved in the trial: 140 participants were randomised to Engager plus usual care and 140 to usual care (see Figure 19 for Consort), with 1 person excluded post-randomisation in usual care (total 139 in usual care). Baseline characteristics of trial participants can be found in Table 27. Further baseline details are reported in the main effectiveness paper (Byng, Kirkpatrick, et al., 2022). There was an imbalance between the two groups at baseline in the proportion in stable accommodation pre-release and in paid employment pre-release, with usual care participants more likely to be in stable accommodation and/or paid employment.

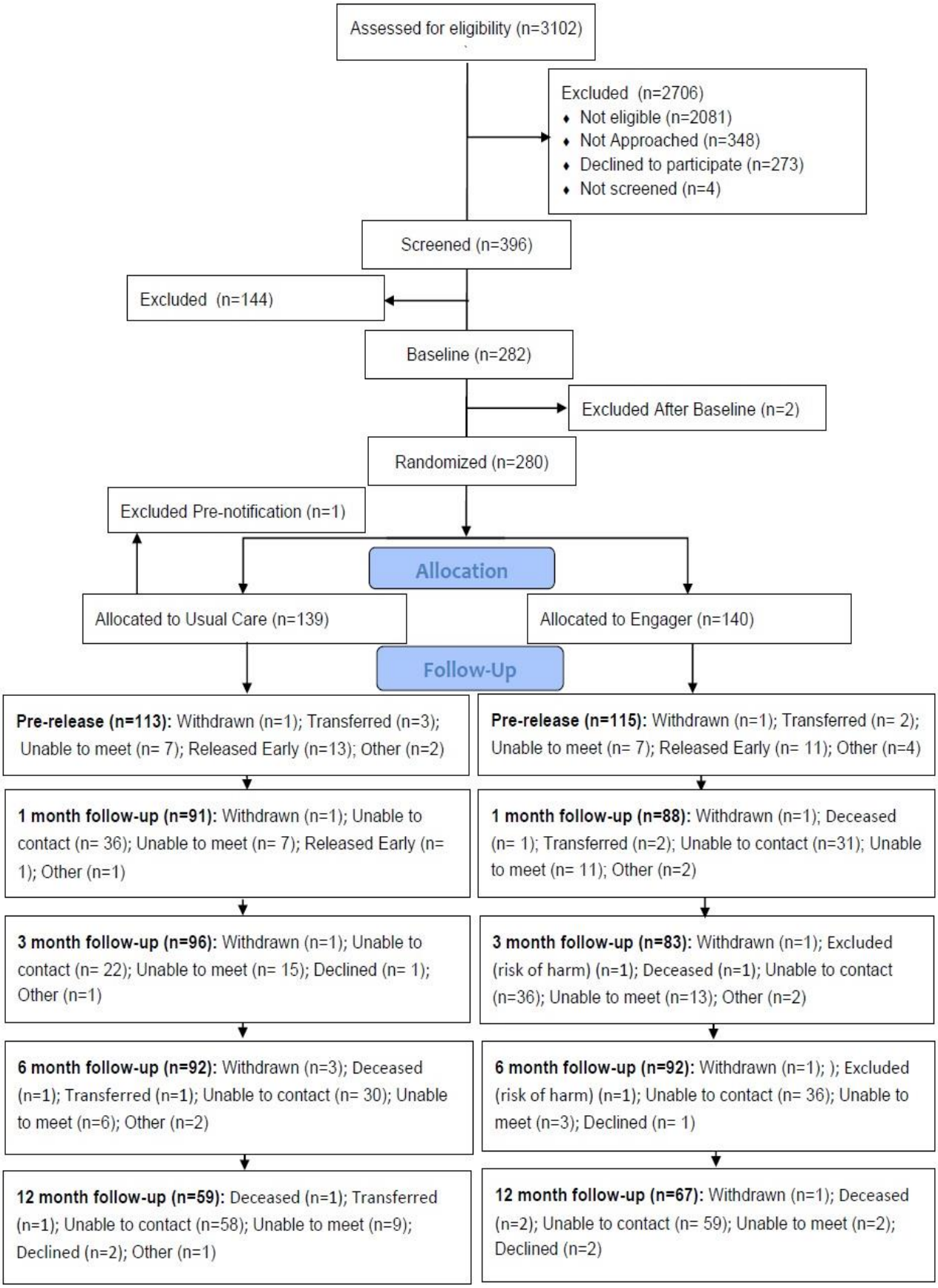


Figure 19 Engager Consort Diagram

Table 27 Baseline characteristics Engager Trial

	Engager	Usual care
Characteristic	N=140	N=139
Age (years); mean (SD)	34 (11.4),	35 (9.9)
Ethnic group; n (%):		
White	128 (93)	133 (96)
Other	10 (8)	6 (4)
Pre-Prison Accommodation; n (%)		
Stable	56 (40)	73 (52)
Unstable	76 (54)	58 (41)
Enforced	8 (6)	8 (6)
Other	0 (0)	1 (1)
Educational background; n (%):		
No qualifications	38 (27)	34 (24)
Basic school level qualifications	41 (29)	41 (29)
A' level or equivalent	10 (7)	12 (9)
Degree/Professional qualification	51 (36)	53 (38)
Pre-prison employment status; n (%)		
Full-time/Part-time paid employment	28 (20)	40 (29)
Full-time/Part-time self employed	7 (6)	13 (9)
Other (e.g. voluntary, retired, carer)	1 (1)	2 (1)

Not working	104 (74)	85 (61)
Pre-prison income source; n (%)		
No source of income	22 (16)	11 (8)
Employment	30 (21)	40 (29)
Benefits	77 (55)	78 (56)
Other	11 (7)	11 (8)
Pre-prison income (£); n (%)	N=138	N=138
Less than 13,500	114 (82)	107 (76)
13,501 or more	24 (17)	31 (23)
Alcohol problem (self-report); n (%)	50/139 (36)	50 (36)
Drug problem (self-report); n (%)	69/139 (50)	60 (43)
CORE-6D; mean (SD)	0.750 (0.168)	0.713 (0.181)
EQ-5D-5L Crosswalk; mean (SD)	0.679 (0.234)	0.657 (0.225)
EQ-5D-5L Tariff; mean (SD)	0.767 (0.186)	0.754 (0.182)
ICECAP-A; mean (SD)	0.613 (0.221)	0.613 (0.226)

8.4.2 Cost of the Engager intervention

The total cost of training and supervision for the duration of the Engager trial was £59,303 (see Table 28). Of the 140 participants randomised to Engager, 129 are included in the intervention delivery cost analysis after removing withdrawals (n=5), deaths during intervention delivery (n=2) and participants where no case notes were available (n=4). If the total cost of the training and supervision is divided by the 140 participants randomised to the intervention the training and supervision costs were £424 per participant. The number of participants randomised to the intervention has been used to calculate the cost per

participant of training and supervision as this is more likely to reflect the total number of patients receiving the intervention if rolled out, if still a conservative estimate (over estimate of costs) as in reality this number would be higher.

The cost per participant of the Engager intervention is detailed in Table 29. Of the 129 participants where data is available, on average they received 5.7 (SD 3.9) sessions in prison, with 5 participants (4%) having no contacts with practitioners. The average time per session delivered in prison was 43 minutes (SD 17) with an average cost of the prison component of the intervention of £149 (SD 124) per trial participant, including those who did not have any contact with a practitioner in prison. Including only participants that had at least one session with a practitioner in prison, the average cost per participant is £155 (SD 122). Of the 129 participants that data is available for, 61 (47%) were met 'at the gate' (soon after release) by an Engager practitioner, and another 10 (8%) had another form of 'at the gate' contact (phone call or probation), with an average contact time of 215 minutes (SD 128) and an average cost of £61 (SD 76) per participant, including those who did not have any contact with an intervention practitioner 'at the gate'. A total of 108 (84%) participants received at least one Engager session in the community with the average session time for the interventions delivered in the community being 36 minutes (SD 42) per session (face to face and telephone contacts). The average cost per participant of the community component of the intervention was £256 (SD 384), including those who did not have any contact with a practitioner. The total average cost per participant of delivering all intervention sessions (prison, 'at the gate' and community) was £467 (SD 475). When the cost of training and supervision (£424) is added this is an average cost per participant in the Engager arm of £891.

A second way to cost the intervention would be to use total staff wages and overheads. The delivery of the intervention required two whole full time equivalent (FTE) NHS Band 4 staff and one 0.5 FTE NHS Band 7 staff member at each site over the 2 years. Including oncosts and overheads as taken from PSSRU (Curtis & Burns, 2019), the total cost for the two Band 4 Engager practitioners per site per year is £95,230 and the total cost of the Band 7 0.5 FTE supervisor per year is £45,370 for a total cost of £138,800 per site per year. Over two sites and two years this is a total staff and overheads cost of £555,200. However, staff turn-over meant that the sites were not at their full staff profile for the whole two years: For 3

months there was only one Band 4 staff member in one site and for a second 3 months there were no Band 4 staff members at the other site, hence reducing Band 4 salaries by a 9-month period £35,711 the total revised cost is £519,488. The additional training costs on top of this (see Table 28: includes delivery of training and Meta-supervision) total £10,215, for a total cost of £529,704. Divided by 140 participants this is a total cost per participant of £3784.

Table 28 Total cost of training and supervision

Activity	Description	Total cost
Training attendance	3 training sessions delivered over 7 days attended by all 4 practitioners and 2 supervisors.	£8400
MBA session attendance	8 MBA sessions attended by 4 practitioners and 2 supervisors.	£5760
Training session for new staff	1 training session over 2 days for the 4 new practitioners and 1 new supervisor	£1840
Delivery of training	Cost of trainer to deliver all 9 sessions	£3375
Delivery of MBA session	Cost of trainer to deliver 8 MBA sessions	£2400
Weekly supervision	As directed by the Engager manual, weekly supervision over 2 years and accounting for 1 practitioner for 3 months in site 1 and no practitioners in site 2 for 3 months.	£33088
Meta-supervision	40 hours of face-to-face and phone call contacts over the trial by a senior clinical academic.	£4440
Total cost of training and supervision		£59303

8.4.3 Resource use and costs

Descriptive statistics for resource use are reported in Appendix 2. Table 29 reports the mean costs, adjusted means and adjusted mean difference adjusting for baseline for each cost category and including centre as a covariate. The complete case results for costs are reported in Appendix 3.

Table 29 Engager costs calculated using multiple imputation by chained equations (MICE) mean cost and adjusted difference

	Engager		Usual Care					
	N=129							
	mean	SD						
Cost of the intervention								
Training and supervision (per person)	424							
Prison component	149	124						
At release	61	76						
Community	256	384						
Total cost per participant (exc training)	467	475						
Total cost per participant (inc training)	891	475						
	N=140		N=139					
	mean	SE	mean	SE	Adjusted difference[a]	95% CI	95% CI	p value
Specialist Mental Health								

6 months	116	47	67	30				
12 months	965	592	21	10				
Total (unadjusted)	1081	598	88	32				
Total (adjusted)	1071	503	98	327	973.139	-209.542	2155.820	0.106
Physical Health Inpatient-planned								
6 months	17	17	158	147				
12 months	284	116	0					
Total (unadjusted)	302	117	158	147				
Total (adjusted)	301	142	158	122	143.458	-226.278	513.195	0.445
Physical Health Inpatient-unplanned								
6 months	300	86	202	89				
12 months	342	137	393	149				
Total (unadjusted)	642	171	596	176				
Total (adjusted)	615	178	622	167	-6.976	-494.176	480.224	0.977
Outpatient appointments								
6 months	50	22	38	17				
12 months	38	17	63	31				
Total (unadjusted)	88	27	101	33				
Total (adjusted)	87	30	102	31	-15.231	-100.520	70.059	0.724
Community Health Care								
Pre-release	371	71	316	63				
6 months	1105	161	913	177				
12 months	1483	285	1722	431				

Total (unadjusted)	2959	373	2951	502				
Total (adjusted)	2942	406	2969	466	-26.637	-1195.089	1141.815	0.964
Medication								
Total (unadjusted)	196	152	58	18				
Total (adjusted)	193	108	61	109	132.695	-169.549	434.939	0.388
Total health care								
6 months	1838	232	1515	289				
12 months	3783	750	2257	476				
Total health care (unadjusted)	5019	812	3842	733				
Total (adjusted)	5937	787	4144	687	1793.183	-257.042	3843.409	0.086
Total inc. Engager (adjusted)	6789	788	4146	688	2643.315	590.127	4696.502	0.012
Criminal Justice Service Use								
Pre Release	30	23	35	31				
6 months	125	17	160	31				
12 months	135	25	272	118				
Total (unadjusted)	289	40	467	128				
Total (adjusted)	291	73	465	112	-174.874	-442.159	92.410	0.196
Prison								
6 months	5179	744	3712	709				
12 months	6141	1182	4021	861				
Total (unadjusted)	11320	1568	7733	1108				
Total (adjusted)	11314	1500	7739	1183	3574.627	-104.371	7253.625	0.057
Police								

6 months	2130	460	1150	413				
12 months	2407	1249	1288	310				
Total (unadjusted)	4537	1332	2438	550				
Total (adjusted)	4499	1112	2476	912	2023.223	-842.815	4889.261	0.165
Total CJS								
6 months	7434	906	5021	866				
12 months	8683	1709	5581	943				
Total (unadjusted)	16146	2031	10637	1305				
Total (adjusted)	16057	1843	10728	1540	5329.257	464.327	10194.186	0.032
Total inc. Engager (adjusted)	16894	1941	10701	1534	6192.966	1083.378	11302.550	0.018
Accommodation								
6 months	3153	809	2943	917				
12 months	4735	1594	5899	1718				
Total (unadjusted)	7888	1869	8842	1971				
Total (adjusted)	7886	1916	8844	1921	-958.558	-6428.064	4510.947	0.726
Productivity								
6 months	3560	1013	3095	808				
12 months	3921	1133	4870	1454				
Total (unadjusted)	7481	1509	7965	1837				
Total (adjusted)	8282	1514	7157	1816	1124.992	-3491.543	5741.527	0.628
Education								
Pre Release	544	129	485	123				
6 months	117	45	49	29				
12 months	190	71	28	9				

Total (unadjusted)	852	149	563	128				
Total (adjusted)	849	138	566	138	282.865	-92.505	658.236	0.139
Other services								
Pre Release	56	12	41	9				
6 months	470	106	229	45				
12 months	400	196	433	134				
Total (unadjusted)	926	239	704	147				
Total (adjusted)	926	214	703	182	222.838	-318.854	764.531	0.416
All costs minus productivity								
Pre Release	1006	148	882	147				
6 months	9452	1738	6663	1722				
12 months	14067	2765	9387	2245				
Total (unadjusted)	24525	3376	16932	3090				
Total (adjusted)	23327	3254	18138	3109	5189.067	-3726.096	14104.231	0.250
Total inc. Engager (adjusted)	24177	3253	18142	3108	6034.631	-2878.161	14947.420	0.182

a Adjusted difference: adjusted for baseline and centre.

SD – Standard Deviation; SE – Standard Error; CI – Confidence interval; CJS – Criminal Justice System

The mean difference in all health care costs including the cost of the Engager intervention and training is £2,643 (95% CI £590 to £4,697) per participant , with missing data imputed using MICE and adjusting for baseline and centre. The adjusted imputed difference in criminal justice costs including the cost of the Engager intervention is £6,193 (95% CI £1083 to £11,303) per participant; for all costs minus productivity and including the costs of the intervention the imputed adjusted difference in costs is £6,035 (95% CI -£2,877 to £14,947) per participant.

8.4.4 QALYs and Capability gains

Descriptive statistics for the imputed CORE-6D, EQ-5D-5L (cross-walk and TTO tariff) and ICECAP-A tariff are reported in Table 30. There was no significant difference in QALYs or YFC for any of the analyses. The complete case results are reported in Appendix 4.

Table 30 Engager Results multiple imputation by chained equations utilities, capability and QALYs,

	Engager		Usual Care					
	N=140		N=139					
	mean	SE	mean	SE	Adjusted difference[a]	95% CI	95% CI	p value
CORE6D								
1 month	0.743	0.022	0.761	0.024				
3 months	0.741	0.020	0.768	0.020				
6 months	0.753	0.019	0.780	0.019				
12 months	0.752	0.024	0.693	0.036				
QALYs (unadjusted)	0.749	0.013	0.751	0.015				
QALYs (adjusted)	0.743	0.012	0.757	0.014	-0.014	-0.052	0.023	0.455
EQ-5D-5L Crosswalk								
3 months	0.695	0.026	0.679	0.028				
6 months	0.695	0.022	0.707	0.026				
12 months	0.733	0.031	0.631	0.042				
QALYs (unadjusted)	0.703	0.017	0.675	0.019				
QALYs (adjusted)	0.698	0.015	0.680	0.016	0.019	-0.023	0.039	0.379
EQ-5D-5L Tariff								
3 months	0.778	0.021	0.765	0.022				

6 months	0.768	0.021	0.785	0.021				
12 months	0.796	0.028	0.757	0.034				
QALYs (unadjusted)	0.777	0.016	0.769	0.017				
QALYs (adjusted)	0.774	0.013	0.772	0.014	0.002	-0.036	0.027	0.919
ICECAP-A								
3 months	0.636	0.026	0.632	0.027				
6 months	0.651	0.022	0.694	0.024				
12 months	0.690	0.037	0.707	0.031				
YFC (unadjusted)	0.652	0.016	0.673	0.018				
YFC (adjusted)	0.652	0.015	0.673	0.015	-0.021	-0.064	0.022	0.335

a Adjusted difference: adjusted for baseline, with centre as a covariate.

SE – Standard Error; CI – Confidence interval; QALYs – Quality Adjusted Life Years; YFC – Years of Full Capability

8.4.5 ICER, CEAC and CEP

For the primary economic evaluation, within-trial cost-effectiveness analysis over 12 months, from a health and social care cost perspective with QALYs calculated using CORE-6D, MICE used for missing cost and utility data and seemingly unrelated regression to account for correlation between costs and outcomes, with adjustment for baseline and centre there was a mean cost difference of £2,738 (95% of iterations between £1,030 to £4,717) and a mean QALY difference of -0.014 (95% of iterations between -0.046 to 0.017): the Engager intervention is dominated by usual care. The CEP and CEAC are reported in Figure 20 and Figure 21 respectively. There is a 0% probability that the intervention is cost-effective for a £20,000 and £30,000 threshold for a QALY gained, if evaluated as a purely health care intervention where decision to implement would be decided along the standard conventions for other new technologies in the English NHS. The CEP and CEAC for the secondary and sensitivity analyses are reported in Appendix 5. The conclusions remain consistent for all of the analyses conducted.

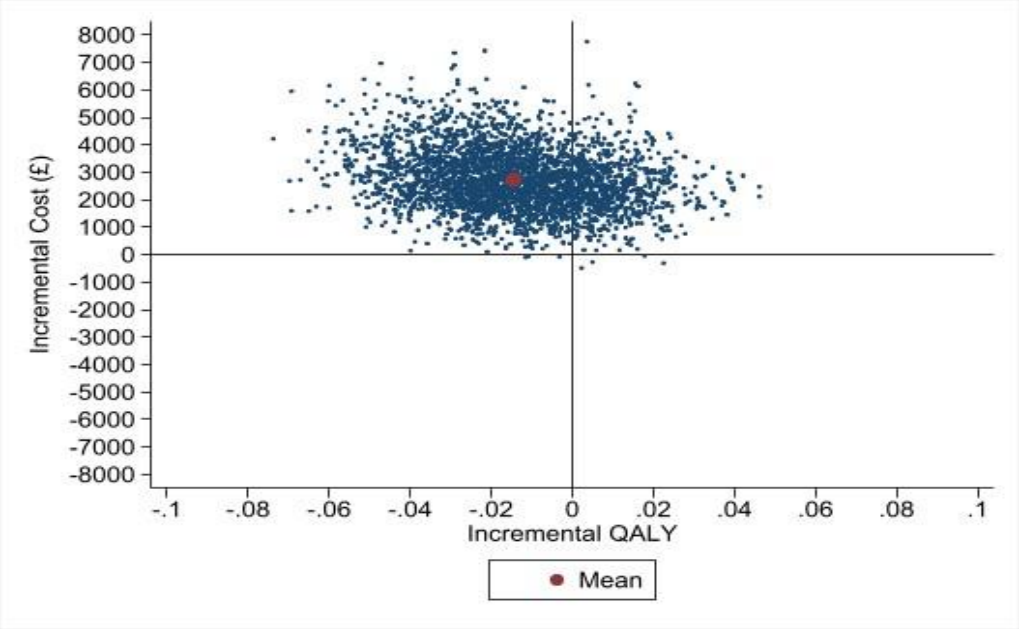


Figure 20 Cost-effectiveness plane of Engager compared to usual care from a health and social care cost-perspective over 12 months with QALYs calculated using the CORE-6D.

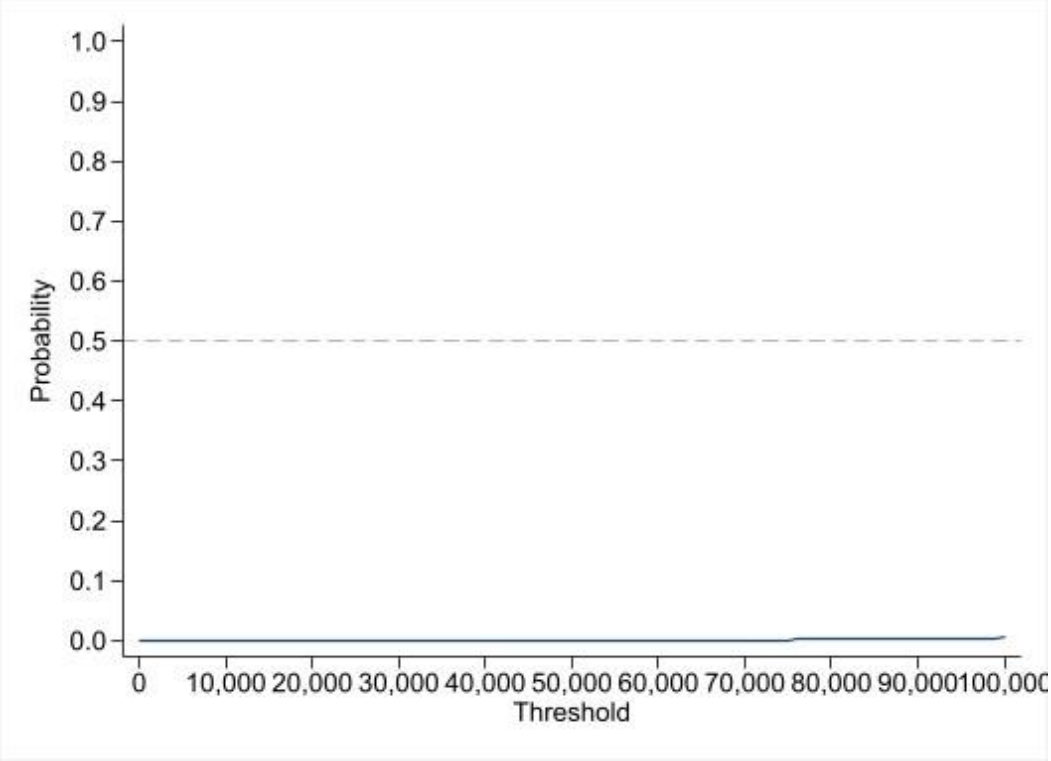


Figure 21 Cost-effectiveness acceptability curve of Engager compared to usual care from a health and social care cost-perspective over 12 months with QALYs calculated using the CORE-6D.

8.4.6 Cost-consequences

Table 31 reports the results of the consequences component of the cost-consequences analysis. Paid employment and contact with service use are reported as odds; planned and unplanned service use were analysed using general linear models and either negative binomial or Poisson depending on the most appropriate model as indicated by the AIC[57].

The odds of being in contact with substance misuse services were greater in the intervention group at 6 months after release (2.208 95% CI 1.197 to 3.633) and 12 months after release (2.244 95% CI 1.304 to 3.861). The results for unplanned service use are mixed, with more unplanned mental health contacts at 12 months after release in participants randomised to Engager (1.326 95% CI 0.059 to 2.593), an increase in physical health unplanned contacts at 6 months after release (0.723 95% CI 0.089 to 1.358), but a decrease in unplanned physical health contacts at 12 months after release (-0.701 95% CI -1.381 to -0.020). Unplanned contact with other services was also higher in the Engager group pre-release (0.379 95% CI 0.016 to 0.743). There was no significant impact on the odds of being in paid employment, accessing education, access to help with finances or accommodation.

Table 31 Consequences of Engager intervention compared to usual care: odds ratios and general linear models.

	Engager		Usual Care					
	n	%(n)	n	%(n)	OR[a]	95% CI Lower	95% CI Upper	p-value
Paid employment								
Pre incarceration	140	25.71% (36)	140	39.29% (55)				
Release to 6 months	92	19.57% (18)	90	25.56% (23)	0.952	0.437	2.078	0.903

Release to 12 months	92	25.00% (23)	90	27.78% (25)	1.28	0.591	2.753	0.535
Contact with substance services								
Pre Baseline	140	33.57% (47)	140	34.29% (48)				
Baseline to pre-release	128	29.69% (38)	129	22.48% (29)	1.565	0.856	2.859	0.146
Baseline to 6 months post release	136	44.12% (60)	135	31.11% (42)	2.085	1.197	3.633	0.010
Baseline to 12 months	136	49.26% (67)	135	34.07% (46)	2.244	1.304	3.861	0.004
Education								
Pre-Baseline	140	43.57% (61)	140	35.71% (50)				
Pre-release	128	26.56% (34)	129	24.81% (32)	1.065	0.606	1.871	0.828
Baseline to 6 months	130	34.62% (45)	129	27.13% (35)	1.395	0.8188	2.376	0.221
Baseline to 12 months	130	36.15% (47)	129	27.13% (35)	1.484	0.873	2.523	0.145
Help with finances								
Pre-Baseline	140	15.71% (22)	140	18.57% (26)				

Pre-release	128	23.44% (30)	129	19.38% (25)	1.337	0.708	2.524	0.370
Baseline to 6 months	136	43.38% (59)	135	40.00% (54)	1.143	0.704	1.855	0.589
Baseline to 12 months	136	47.79% (65)	135	47.41% (64)	1.010	0.626	1.629	0.967
Help with Accommodation								
Pre-Baseline	140	49.29% (69)	140	50.00% (70)				
Pre-release	128	25.78% (33)	129	22.48% (29)	1.336	0.680	2.625	0.400
Baseline to 6 months	136	46.32% (63)	135	42.22% (57)	1.223	0.729	2.053	0.445
Baseline to 12 months	136	53.68% (73)	135	48.15% (65)	1.277	0.776	2.101	0.336
Unplanned attendances	**n**	**Mean (SD)**	**n**	**Mean (SD)**	**AD[b]**	**95% CI Lower**	**95% CI Upper**	**p-value**
Mental Health								
Baseline	140	0.200 (0.614)	140	0.093 (0.414)				
6 months	92	0.196 (0.579)	90	0.100 (0.337)	0.487	-0.407	1.381	0.285
12 months	66	0.182 (0.579)	58	0.0517 (0.223)	1.326	0.059	2.593	0.040

Physical Health - unplanned								
Baseline	140	0.293 (0.594)	140	0.136 (0.344)				
6 months	92	0.446 (1.252)	90	0.211 (0.571)	0.723	0.089	1.358	0.025
12 months	66	0.197 (0.401)	58	0.397 (0.793)	-0.701	-1.381	-0.020	0.043
Other services								
Baseline	140	1.814 (4.551)	140	2.179 (5.206)				
Pre-release	128	1.141 (3.578)	129	0.729 (1.291)	0.379	0.016	0.743	0.041
6 months	92	2.348 (6.591)	90	1.856 (7.602)	0.039	-0.377	0.455	0.854
12 months	66	2.242 (12.449)	58	1.810 (4.847)	0.034	-0.498	0.565	0.902

a OR: Odds ratio adjusting for baseline and centre

b AD: Adjusted difference, adjusting for baseline and centre

CI – Confidence interval

8.5 Discussion

There was no evidence that the Engager intervention was cost-effective compared to usual care; this was the case across all secondary and sensitivity analyses. Overall there was no significant difference in QALYs or YFC between Engager intervention arm participants and usual care participants. The intervention group cost significantly more from a health service cost perspective, with almost half of the estimated incremental cost per person coming

from the Engager intervention itself. It also cost significantly more from other public service perspectives such as criminal justice. On the other hand, there was evidence for a productivity gain in the Engager group in the complete case analysis, although this difference was no longer significant in the imputed results and there was no evidence of increased employment in the analysis of consequences, suggesting this result may have been by chance.

As identified in chapter 5, very few economic evaluations are carried out in criminal justice settings, with even fewer that include primary data collection. Self-reported outcomes in this group can be particularly hard to collect due to the transient nature of the population. This analysis though presents a significant contribution to the health economic evidence base for this population group. It also demonstrates the complexity of economic evaluations in this area, with the results of the analysis having implications for a number of decision makers, including health care, criminal justice and local authorities (local authorities being responsible for commissioning social care and substance misuse services). Costs and outcomes have been reported in a disaggregated way to facilitate interpretation by each respective decision maker, although no one decision maker is likely to advocate for implementing Engager based on these results. The complexity of providing services to multi-need clients across a number of public sector agencies is not new, with individuals with needs relating to mental health, physical health, housing, substance misuse, monetary and family relations being common in criminal justice, substance misuse and specialist mental health settings. Given that addressing one need, such as substance misuse, may have benefits that fall on other providers, such as criminal justice, initiatives such as pooled budgets across providers have been trialled to allow for the free flowing of money and outcomes across traditional barriers to facilitate joined up working (Maynard et al., 2011). Results from pilots of these interventions though have been equivocal in finding evidence for improved effectiveness or efficiency as a result of these initiatives, primarily due to the challenges associated with implementing them (Callanan et al., 2012).

Although there was no evidence for benefit or cost-effectiveness for the Engager intervention, the cost-consequences analysis showed some signals for potential benefit, although the results are mixed. The most evident benefit was an increased odds of accessing substance misuse services seen in the participants randomised to Engager. Long term

studies such as the National Treatment Outcomes Research Study (NTORS) have shown the benefit of being in contact with substance misuse services in terms of reduced criminal activity and increased stable accommodation (Gossop, Marsden, Stewart, & Kidd, 2003; Gossop et al., 2005) In NTORS the evidence was that benefits accrued year on year over 5 years, hence the follow-up time of 12 months post release in Engager may not have been sufficient to identify the benefits to participants. The loss to follow-up may have also failed to capture some benefits. In NTORS routine data was used to capture criminal convictions. This was explored as part of Engager, but barriers to accessing data and time constraints in regards to the programme ending meant that this was not feasible. Ideally routine data should be obtained for participants in the trial at a later time point to observe if there are any long term benefits of the intervention.

As part of the HEAP, the predetermined choice was made to calculate QALYs using the CORE-6D for the primary CUA as opposed to using the NICE 'reference case' EQ-5D (National Institute for Health and Care Excellence, 2022). This was based on the results of the analyses described in chapter 7 that the CORE-OM and associated CORE-6D tariff are more sensitive to changes in the clinical measure of depression, the PHQ-9, in men in prison. Previous studies have found that the EQ-5D is acceptable for use in common mental health problems (Mulhern et al., 2014) and is reliable and valid in patients that access IAPT services in the NHS (Franklin et al., 2021). As the NICE 'reference case' it has the added advantage of allowing for comparison of the results of economic evaluations across disease areas. There is an issue though when the EQ-5D is not sensitive to changes in a specific clinical condition and/or patient group that this may result in less favourable resource allocation decisions for those areas. As shown in chapter 7, there is some evidence that the EQ-5D may not function as expected in prison populations, but additional research is required to explore this further. The ICECAP-A, designed to measure wider considerations than health related quality of life, also did not appear to capture anything additional in this trial. The results remain the same regardless though of the specific outcome measure used.

Overall there is a challenge when evaluating interventions such as Engager which are designed to improve access to health and social care services for hard to reach groups. There is strong evidence that people who have spent time in prison are less likely to access health care services than their peers in the general population (Byng et al., 2012). As was

discussed in chapter 2, this group also strongly overlap with homeless and substance misuse populations who also show less health care service use relative to need than the wider population (Seena Fazel, John R. Geddes, & Margot Kushel, 2014). The consequences component of the cost-consequences analysis provided some evidence for increased access to services such as substance misuse services, but it also showed an increase in unplanned service use, particularly for specialist mental health services (noting that only one mental health service use was identified as planned). What is difficult to evaluate from this result is if this is a sign of improved access to mental health services as a result of the Engager intervention, or if the Engager intervention was linked to worsening mental health. Also to note that this is complicated by people in the Engager intervention group being a more severe group at baseline by chance, and although baseline mental health contacts were adjusted for, this may have continued to skew the results.

In CUA the aim is that additional costs arising from increased service use to meet identified needs is usually balanced out by additional gains in HRQoL, such that for new treatments NICE has a threshold of paying £30,000 per additional QALY gained (National Institute for Health and Care Excellence, 2022). There was no evidence though for improved QALYs or YFC as a result of the intervention. This may be due to the intervention not being effective in these areas, but it may also be due to these measures not being suitable in this population group, bias as a result of loss to follow-up or the time-horizon of the analysis being too short, particularly if in the short term the intervention required people to work through painful mental health or substance misuse problems.

One of the challenges associated with conducting research in prisons is loss to follow-up for patient completed measures: this may explain why other trials in prisons have not included a preference based outcome as part of their economic evaluation. The follow-up up rate of 66% for the primary clinical outcome at 6-months is high compared to most studies in prisons (Byng, Kirkpatrick, et al., 2022). Contacting people following prison contains a range of issues including temporary housing, changing contact details as well as increased mental and physical problems that can make people difficult to contact. Unfortunately there is also a nefarious aspect to this: those who may have returned to substance misuse and the criminal activities to support it may be more difficult to contact and actively want to avoid being contacted (although noting self-reported substance misuse problems at baseline were

not a predictor of missing data at follow-up) indicating that missingness is informative. Related to this, one of the more unexpected findings of the trial is that the Engager intervention group had significantly higher criminal justice costs. Measuring criminal activity is notoriously difficult; self-report measures of crime, in addition to being unreliable, may also have a negative impact on the relationship between the researcher and the trial participant, regardless of what reassurances of anonymity are provided (Walker, 1983). Engager included no self-report measure of crime for this reason. The intention had been to obtain Police National Computer (PNC) data for the whole sample but this was, in the end, not possible. As a result only the proxy measure of crime of reported contact with police or being in custody could be used. Although arguably more objective than self-report involvement in crime, this only measures if people are caught being involved in criminal activity, not the frequency with which the criminal activity occurs. One of the potential benefits of the Engager intervention is improved contacts with services; the implications of this may have been that this made people more visible to criminal justice agencies and hence more likely to be picked up for crimes. It was also not possible to include implications of the wider costs, particularly to victims, of criminal activity as no specifics regarding the crime were collected for reasons stated above.

Finally, there were some challenges in the delivery of the Engager intervention, with not all participants engaging with the intervention, and some discontinuity in the practitioners delivering the intervention due to staff turn-over and illness (Byng, Kirkpatrick, et al., 2022). It is possible that embedding the training and delivery of Engager in already existing teams and making it part of normal delivery may reduce the cost of delivering the intervention and improve engagement. Further work is required to evaluate the implications for the cost and clinical effectiveness of these changes.

8.5.1 Conclusion

The above economic evaluation is one of the few CUA conducted for a prison based intervention. Although there was no evidence that the Engager intervention was cost-effective, it provides evidence for the feasibility of conducting CUA in this population. Future research though should consider supplementing the analysis with routine data and increasing the follow-up duration. It demonstrates the importance of including resource use

and cost information to cover a wide array of decision makers as health interventions for prison have implications beyond health care, and reporting the results in a disaggregated way.

9 DISCUSSION

9.1 Aim

This final chapter summarises what has been found in this thesis and makes recommendations for future research.

9.2 Summary of findings

The objectives of this PhD were to:

1) Conceptualise the characteristics of prison population and what the key determinants of ill health are for people in prison and related populations.
2) Identify areas of market failure in providing health care in prisons and actions that governments can take to overcome these.
3) Explore a case-study of market failure and prisons; mental health funding and prison numbers.
4) Summarise the evidence base for health economic evaluations in prison to inform an economic evaluation of a prison based intervention.
5) Identify the key health care costs and predictors of costs for people in prison.
6) Identify suitable outcomes to use in health economic evaluations for mental health interventions in prisons.
7) Conduct a full economic evaluation in prisons.

Objective 1, the characteristics of the prison population and determinants of health, was laid out in detail in Chapter 2, in that people in the prison population experience a wide array of physical and mental health inequalities compared to their peers in the community. These inequalities are closely tied to the fact that the prison population overlaps with the homeless population, people with serious mental illness and people who misuse illicit substances including injecting drug use. There is also likely to be a number of common social determinants of health that increase the risk of falling into one of these population groups and hence spending time in prison. Chapter 5, the systematic review, also highlighted the extent to which some interventions in prison are potentially cost-effective due to the health inequalities experienced by people in prison, such as the large number of people with communicable diseases. The data from COCOA and the Engager trial summarised in Chapters 6-8 reports demographics from three cohorts (COCOA, Engager pilot trial and Engager RCT) highlighting again the poor health of this relatively young population, with an average age of 34. The average EQ-5D-5L utility score at baseline for all participants in the Engager II study,

as calculated using the new formula (Hernández Alava, Pudney, & Wailoo, 2023) was 0.669 (95% CI 0.642 to 0.696). This is significantly lower than the population mean for 34 year old males of 0.915 (95% CI 0.911 to 0.925) calculated using the same utility formula (McNamara, Schneider, Love-Koh, Doran, & Gutacker, 2023), and is below that even of a 90 year-olds in the general population, suggesting that people in prison have significantly lower HRQoL than people in the general population.

Objective 2, regarding market failure in prison, is addressed in Chapter 3, where I demonstrate the inefficiencies associated with providing health care in prisons. This market failure of health care provision in prisons is primarily due to the orthogonal objectives of prison and health care, the objective of the first being the removal of liberty for punishment or the safety of the community and the objective of the second to improve health. Where efficiencies do lie, it is either where objectives overlap, such as substance misuse treatment which addresses both a health and criminal justice objective, or for areas such as infectious diseases, where the burden of health is so high and the risk to the community is so great that it becomes efficient to intervene both to reduce the health impact on people in prison but also again to protect the wider community. Both of these issues though continue to be linked to social determinants of health, and as a result addressing earlier determinants of health, such as housing, education and employment, may be a more efficient use of resources than interventions that address problems that occur as a result of these societal failures.

The analysis set out in Chapter 4, looking at the impact of increasing mental health funding to reduce the number of people sentenced to prison, addresses Objective 3. I find that although increasing funding for psychosis related services may potentially be effective at reducing the number of people sentenced to prison in the following year, it may not be an efficient use of resources. The current preliminary figures suggest that it would cost more than £1 million pounds to divert a single person away from prison. Depending on the total societal cost of prison this may or may not represent a good use of resources depending on the total societal cost of sending a single person to prison. Further research is required though to determine what the wider societal cost to an individual of prison is, potentially utilising linked administrative datasets. This would include lost HRQoL, productivity and impact on family and close others as a result of being sentenced to prison in addition to the cost to the criminal justice system and victims of crime. To add up to £1 million pounds, assuming that the average age that someone goes to prison is between 25 and 30 and a life expectancy at the lower end

for men in England of 77 (Office for National Statistics, 2021), hence 50 years of life available for cost-savings to accrue, this would need to add up to £20,000 per person, per year of going to prison versus not. For someone with serious mental illness though, the available life expectancy could be even lower, given that people with serious mental illness die up to 20 years earlier than their peers (Ilyas, Chesney, & Patel, 2017). This raises important questions though about the interacting role of contact with the criminal justice, homelessness and mental ill health on HRQoL and life expectancy that warrants further research. In particular, more evidence is needed as to what the key determinants are in the drop in life expectancy to determine at what point in the life course it occurs and why. A retrospective cohort study in the UK found that the additional risk of cancer and cardiovascular disease experienced by people with SMI is not wholly explained by anti-psychotic medication, lifestyle risk factors or deprivation, suggesting that the factors contributing to the increased mortality risk for people with SMI is complex (Osborn et al., 2007). A recent systematic review looking at only cancer risk found a similar story for people with SMI as people in prison, with people with SMI having a lower likelihood of receiving curative treatments (Charlesworth, Fegan, & Ashmore, 2023). The cost of £1 million pounds to divert one individual may be a reasonable estimate though given that for the DSPD programme, the cost per serious offence prevented was £2.24 million (Barbara Barrett & Byford, 2012). Overall there is limited evidence of significant cost-savings to health care as a result of mental health diversion programmes, with a significant additional cost falling on mental health services and any cost savings seen by criminal justice services only (Schucan Bird & Shemilt, 2019).

Objective 4, addressed in chapter 5, found that, compared to other areas of research, there is a paucity of economic evaluations in prisons, with the example given in chapter 8 in this thesis one of the few based on the results of a randomised trial and the only one I am aware of to have utilised primary data collection for the calculation of QALYs and YFC. The evidence available though and the theory suggests that there is limited efficiency in providing health interventions in prison unless they are to detect a high prevalence of communicable disease or to treat substance misuse, with the majority of evidence suggesting that it is better to divert people from entering prison in the first place, although the methods for this are not straightforward. Substance misuse treatment is currently the intervention that has the best evidence base for reducing the risk of people entering the prison system, followed by

improved housing provision, as detailed in chapter 3, although more work on this area is needed.

Chapters 6-8 addressed objectives 5-7, looking at the methods for calculating costs and outcomes for use in economic evaluations in prisons and culminating in a full economic evaluation alongside a randomised control trial in prison. That depression rather than physical health predicted health care costs was surprising, but fit with the narrative found in the rest of the COCOA study that people in prison do not tend to acknowledge or address depression or see it as a medical problem with treatment available. It also highlighted the importance of the intervention evaluated in Chapter 8, designed to address common mental health problems, particularly depression, in prison. The way that people and prison experience depression also provided evidence that the EQ-5D and the domain depression or anxiety may not function as expected. As highlighted in Chapter 7, for the 90% of participants that screened positive for anxiety and/or depression, 39% of those participants reported no problems for anxiety or depression on the EQ-5D-5L. An intervention that was designed to address one of the key issues in prisons, depression and anxiety, using a manualised wrap around service was found to have a low probability of being cost-effective. This fits with the narrative that many health problems in prison may potentially require significant resources to address and hence may not be cost-effective based on standard cost-effectiveness thresholds.

9.3 How it fits with the current literature

One of the first writers to identify the relationship between health, economics and prisons was Jeremy Bentham, who, in the late 18th century, wrote extensively on an economic model for prisons he called the *Panopticon*. A key premise of this model was that people in prison should be kept under constant watch by an inspector, and the term *panopticon* has since been appropriated as the name for the prison design to facilitate this, something which inspired the design of a number of prisons still in use today, such as Pentonville prison. Within his writings on the *Panopticon* he identifies the complex relationship between the need to apprehend people who commit crimes and punish them, but also the need to potentially reform people and the impact this may have on the public purse. He noted though the issue that monopolistic power may play in achieving the outcomes best suited to society and hence a hierarchy of rules to stick by, including noting the importance of maintaining the health of the prison population (Guidi, 2004).

Considering the relatively long history regarding economics, prisons and health it is surprising then that very little has been written until relatively recently on the matter. What has been written has continued to focus on how prisons impact on the public purse, including the costs and benefits of reform and addressing key public health issues such as infectious diseases. Very little has been written on the economic theory in regards to the provision of prison health though. As a result, this thesis is one of the first attempts at constructing a theory around the key characteristics of the prison health care market.

The economic evaluation in Chapter 8 is also one of the few economic evaluations alongside a randomised control trial conducted in prisons, and hence sets out the challenges associated with doing research in this area.

9.4 Strengths and Weaknesses

A key strength of this thesis is that it addresses the under researched area of health economics in prisons.

One of the key challenges of conducting research in prisons is access to high quality data, something that was echoed in the systematic review in chapter 5. In chapter 4 I utilised routine data published by government sources to evaluate the relationship between mental health funding and the number of people sentenced to prison as a way to determine if the Penrose effect was explained beyond just bed numbers. Chapter 6 utilised data from COCOA, a longitudinal cohort of people in contact with the criminal justice system and chapters 7 and 8 use data from the Engager pilot and full RCTs. One of the key issues with the COCOA and Engager data is the challenges associated with following up people who have been in prison. Work that I have done elsewhere has also looked at utilising hospital episode statistics to evaluate cancer care in prisons, with people in prison identified by their address being that of a prison. Overall though further work is required to examine how best to utilise routine data to determine how best to address the health inequalities faced by people in prison, or how to best ensure interventions so that people are not sentenced to prisons in the first place.

The systematic review in Chapter 5 was conducted in 2016 with the aim of informing the subsequent three chapters in this thesis. I've continued to keep abreast of the literature since the systematic review was published, and am aware of only a few additional high

quality studies that have been published in this area. This includes mostly a few economic evaluations of methadone maintenance in prisons (Horn, Li, McCrady, Guerin, & French, 2020; Onuoha et al., 2021; G. A. Zarkin et al., 2020). The paper by Onuoha et al (2021) is a systematic review of economic evaluations of pharmacological treatments for opioid addiction and finds no additional papers in a prison population other than those mentioned. A systematic review of economic evaluations of mental health interventions in criminal justice published in March 2023 found no additional studies have been published in mental health related to prison since this review other than the one that is the subject of chapter 8 of this thesis (Knapp & Wong, 2023). The review by Knapp & Wong (2023) though does not include a paper published in 2017 on a time critical intervention for people in prison with serious mental illness (Shaw et al., 2017), a study that would be included in this review were it to be conducted again. The time critical intervention found increased engagement as well as higher costs in the intervention group. It may have been excluded from the Knapp & Wong systematic review as they did not collect any patient reported outcomes. A systematic review of mental health court diversion programmes published in 2019 also found no additional studies that were not already included in this review (Schucan Bird & Shemilt, 2019). It is possible that some poorer quality studies published in smaller, criminal justice journals have been published since this review was completed. It is not clear what added value identification of these studies would have to this thesis as they would not inform any of the methods used.

9.5 Methodological implications

One of the questions that has arisen from this thesis has been, is the QALY the most suitable outcome in an economic evaluation in prison? The second is if the same cost-effectiveness threshold should apply? This leads to the question of if the NICE reference case set-out in the methods for technology assessment (NICE, 2022) is relevant to health care interventions delivered in prison? As set out in chapter 3 and Figure 2, there is a potential inefficiency in providing health care in prisons. If one is to test the relative health loss of providing health care in prisons compared to the community, or evaluate the most appropriate interventions to provide in prison versus the community, then a common metric, such as the QALY, needs to be used. This is demonstrated in chapter 8, where a manualised, person-centred approach to addressing mental health needs intervention that fits with the NICE guidance

for the treatment of depression (Kendrick et al., 2022), and hence one would assume is cost-effective in a community setting, has a low probability of being cost-effective when delivered in a prison context. This is in contrast to substance misuse treatment, which is similar in cost-effectiveness whether delivered in prison or in the community (Warren et al., 2006). When thinking about the health production function then depicted in Figure 2 this means that treatment for common mental disorders follows a similar pattern to what is depicted in the figure, where the same spending on mental health in the community would result in more health than when the intervention is delivered in prisons. The difference between the two health production functions in Figure 2 is not due to different needs for health care. Instead it is that non-health care related inputs (housing, diet, exercise, relationships with peers etc.) potentially have a greater impact than health care inputs on the total possible health production for people in prison compared to their peers in the community. The implications of this for NICE guidance are that, although people in prison should have access to the same health care as is available in the community, how and what health care is delivered may need to be qualitatively different for people in prison to address their more complex needs. When assessing the cost-effectiveness of a new prison intervention the perspective will need to go beyond the perspective recommended in the NICE reference case of health and PSS (NICE, 2022) to capture the wider societal costs and benefits. Instead guidance related to economic evaluations in public health interventions (Edwards et al, 2013; NICE, 2012), how to conduct multi-sectoral health economic evaluations (Vallejo-Torres, 2023) and distributional cost-effectiveness analysis to account for equity considerations (Cookson et al, 2021) may be more relevant when evaluating the cost-effectiveness of prison interventions.

Overall though, using a standardised health economic evaluation method allows for the analysis conducted in prison to be compared to the results of a similar study conducted in the community to compare and contrast the relative cost-effectiveness of each. The issue of suitable questionnaires to calculate the QALY though is an interesting one, with evidence in chapter 7 that the EQ-5D does not function the same way in prison as it does in the community. Recent work looking at suitable outcomes for social care in prisons highlights similar issues. The commonly used measure in social care, the Adult Social Care Outcomes Toolkit (ASCOT), asks people about their control over their life, their environment or

appearance. In prison, responses to these questions might not be valid or relevant. Activities of daily living is equally hard to measure given the reduced access to most daily tasks in prison. It may be that prison specific tools with prison specific preference elicitation need to be developed to address this. As discussed in section 5.5.2, this potentially perpetuates the issue of the lack of comparability between studies in criminal justice because of the large number of different outcome measures used.

In regards to the cost-effectiveness threshold, this may be dependent on how one defines the threshold. If one uses a decision maker threshold, such as the threshold set by NICE, it's hard to determine the reason for not extending this to prisons. If instead a supply side threshold is used, where the opportunity cost of producing an additional QALY is calculated then potentially a different threshold should be used, such as a prison specific cost per QALY gained. Ironically this would lead to a potentially higher threshold in prisons given the higher resources required to achieve a QALY. If efficiency should be commensurate across prisons and the community though, then potentially the same opportunity cost threshold should be used across both settings.

Both the outcome and threshold reasoning described here assume that the outcome of interest is health given the focus is health care spend, and that the money could be spent elsewhere in the health system and achieve a greater health outcome. In reality all health care interventions delivered in prison relate to some criminal justice costs, whether it is as small as the cost of the prison officer escorting the person to health care, or if it is a large as preventing return to prison. As a result it is reasonable that criminal justice outcomes and costs should also be taken into account when looking at economic evaluations in prisons. This moves away from the view by NICE of economic evaluations having a pure health and PSS perspective for technology assessments. It suggests that for some interventions, such as substance misuse and mental health care, recidivism and criminal justice outcomes are also important, particularly if it points to the efficiency of the intervention in achieving an aim that overlaps with that of the criminal justice system.

9.6 Policy implications

This thesis adds to the evidence that prison is not good for your health, and that it houses the most vulnerable people in society. As a result the government has a moral and legal obligation to ensure that people in prison receive high quality care. This needs to be

considered though within the framework that access to care needs to be balanced alongside need, demand and supply, as set out in the recent paper by Santana et al., (2023). This then draws on two key principles.

Firstly, should the person be in prison in the first place? For people with serious mental illness there is the potential that they are in prison because systems in the community have failed them. Overall there is increasing evidence that diverting people from prison through the use of mental health and drug courts is effective in reducing ongoing criminal justice contacts (Trood, Spivak, & Ogloff, 2021). The evidence for the cost-effectiveness of these interventions though is still lacking (Bird & Shemilt, 2019).

Secondly, does the intervention represent an effective and cost-effective use of resources? In the case of a treatment for common mental health problems in prison, the current evidence based on chapter 8 is that it is unlikely to be cost-effective. For substance misuse, if the individual does need to be in prison it is likely to be cost-effective to treat them there. Communicable diseases require being assessed on a case by case basis as it is highly dependent on a range of factors including prevalence, transmissibility (in prison and in the community), the cost of screening and the cost and effectiveness of treatment. What is less clear is what to do about non-communicable disease including cardiovascular disease and cancer. Little is known as well about respiratory issues like asthma and chronic obstructive pulmonary disease, which are likely to be highly prevalent in prisons. Asthma for example was the primary cause of preventable death in a California prison prior to the implementation of a chronic care model to improve the management of asthma symptoms (Ha & Robinson, 2011). It's also not clear what evidence there is for neurological conditions such as epilepsy in prisons. There is emerging evidence though that the combination of poor lifestyle and an aging prison population means that dementia diagnosis and treatment will be a key issue in the coming years (Maschi et al., 2013). These areas though are likely to be where the biggest inefficiencies in the system lie given their interaction with the prison environment, and the challenges associated with diagnosis and management.

9.7 Future Research

During my time doing this thesis I have become involved in a range of work tangential to the thesis but related to prison health economics. This includes work on telemedicine in prison,

something that gained particular importance during the COVID-19 pandemic given that most appointments with the NHS became remote.

One of the key gaps in evidence is regarding women in prisons, something that was very poorly covered by the economic evaluations. This is particularly concerning given that women in prisons have even greater needs than their male counterparts. They also have the capacity to cause even greater intergenerational trauma as a result of their time in prison given their traditional role of women as the primary care giver. Related to this I'm a member of a trial steering committee for a research project that includes a full economic evaluation looking at placements for women outside of prison. Women in prison are also at high risk of invasive cancer. As a result more work is required looking at cancer screening, particularly in women's prisons.

As was noted in chapter 2, prisons also have an aging population. These problems are further compounded by the same issues that affect health care delivery in all other aspects of the prison including greater life style risks that increase severity and poor access to care. Dementia in particular is likely to become a key issue in prisons, although no treatment pathways for dementia in prisons currently exist. As a result I'm currently involved with work alongside Manchester University looking at social care and dementia in prisons. The models that are likely to be employed in this are likely to be along the lines of self and peer management given the challenges of care delivery as well as the potential efficiencies of these models (Leaman et al., 2016).

The analysis of the relationship between mental health funding and the number of people sentenced to prison conducted in chapter 4 was based on publicly available programme budgeting data at a CCG and PFA level. Future research should look at using more granular data where sentenced individuals are identified at a lower level, be that LSOA, ICBs or local authority. This would also allow for a more robust analysis with a larger number of data points, and would allow for London to be included in the analysis. This is potentially possible using data from the new Data First project, which provides access to a wealth of Ministry of Justice data linked to other datasets (Ministry of Justice, 2022). More recent NHS spend data, particularly related to mental health, could also be used to bolster the analysis.

Further work is required to determine the relationship between expenditure on health care and health outcomes in prison, or the marginal productivity of health care in prison. It may then be possible to compare that with the marginal productivity in the community, which has been calculated at between £5000 and £15,000 to produce a QALY (Lomas, Martin, & Claxton, 2019). This though would require data of a reasonable quality on prison health care expenditure, as well as data on health outcomes in prison, something which is currently lacking. Data linkage between criminal justice and health as part of the Data First project (Ministry of Justice, 2022), could potentially facilitate this work. As part of a project I am working on looking at the cost of cancer care in prisons; some of this has been possible using HES data, but further work is required.

Overall though further work is required on costing prison health care and valuation of outcomes. Most of the work looking at valuation of outcomes in prisons has mostly focused on how to value the cost of crime (Marsh, 2010). It is likely that further work in this area could assist with more appropriate outcome measures which better reflect societal valuations of what is a complex area.

9.8 Final thoughts

This thesis adds to the wealth of literature available that systemic inequalities are likely to perpetuate throughout the life course. This is not just problematic for people who experience these inequalities, but for society as a whole. Not addressing the inequalities earlier in the life course can result in less efficient use of resources later, in the context of finite resources. Once these problems have become entrenched though it is the responsibility of governments to ensure that people receive the care that they need. In the case of prisons, identifying needs and providing access to care is fraught with even greater challenges than is the case in standard health care markets, where market failure and the need for governments to intervene is par for the course. Very little research has been done though on how to address this in a more structured way in prisons. This thesis as a result is just the tip of the iceberg of the research that is required in the area of prison health economics. This is not least because the issues that impact on wider society tend to hit even harder in prisons, as was demonstrated by COVID-19 and as we will see with issues regarding the aging population.

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APPENDIX 1

engager

healthy minds, healthy choices

Evaluation of a complex intervention (Engager) for prisoners with common mental health problems, near to and after release – Full trial**.**

HEALTH ECONOMIC ANALYSIS PLAN (HEAP)

VERSION 0.1, 1ST FEBRUARY 2019

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11 AIM

The primary aim of the health economic analysis is to calculate the mean incremental cost per quality adjusted life year (QALY) gained of the Engager intervention plus usual care compared to usual care. The primary analysis using patient level data will be for a 12 month time horizon and from a National Health Service (NHS) cost perspective. A secondary analysis from a public sector budgetary perspective (including: social services, police and criminal justice, national probation service, housing) will also be conducted to the extent that reliable and complete data from relevant services is available and usable.

A second aim is to conduct a cost-consequences analysis, reporting costs for the two groups alongside their respective outcomes.

The health economic analysis will follow the statistical analysis plan (SAP v1.4 December 2018) in retaining the validity of the randomisation process and Protocol version 5 (19/04/2017). All analyses will be intention-to-treat (ITT) where all randomised patients are analysed in their allocated group whether or not they received their allocated treatment. Although the primary outcome for the trial is at 6 months, the health economics analysis will only be undertaken using 12 month data.

12 OUTCOMES

A full description of all outcomes and analysis are provided in the SAP and Trial Protocol.

The following outcomes will be used for the trial based component of the economic evaluation:

- Client services receipt inventory (CSRI)[1] adapted – patient completed questionnaire asking about health care use (physical health and mental health) and medication completed at baseline, 6 and 12 months post release from prison asking about the last 6 months. The CSRI also includes details on the delivery of the intervention.
- CORE-OM baseline, 1, 3, 6 and 12 months post release from prison to calculate utility for cost per QALY analysis;
- EQ-5D-5L baseline, 3, 6 and 12 months post release from prison to calculate utility for cost per QALY analysis;

- ICECAP-A baseline, 3, 6 and 12 months post release from prison to calculate years of full capability equivalent;
- Accommodation, education, training, employment, money, relationship and criminal related service use – self reported at baseline and 6 and 12 months post release;
- Reoffending collected using the Police National Computer Offending Data at baseline and 12 months post release.

13 COST DATA

Cost of the Engager Intervention

The cost of the Engager intervention will include the cost of training and supervision divided by the number of patients per practitioner to calculate the cost per patient. The cost of providing the intervention will be based on a combination of process of care data collection and intervention practitioner care records and diaries (bottom-up costing approach), and the total costs of service provision (top-down costing). For the bottom up costing, the number and time spent on appointments and other Engager related activities will be multiplied by the average hourly cost from the most recent Unit Costs of Health and Social Care published by the Personal Social Services Research Unit (PSSRU)[2] to calculate the average cost per patient of Engager. Additional information from the PSSRU document *Unit Costs in Criminal Justice*[3], inflated to the same year as the most recent publication of the Unit Costs of Health and Social Care, will also be used for costing where necessary.

Physical and mental health service resource use

Descriptive statistics for the percentage of patients and mean number of contacts for each type of physical and mental health care resource use collected by the CSRI will be reported for patients that have completed the CSRI at baseline and 6 and/or 12 months post release. Information on data completeness will also be reported. Statistics will also be broken down by planned and unplanned health care use. Descriptive statistics will be reported (a) for

patients that have completed the measures at each time point; (b) using multiple imputation for ITT analysis (see section 6 below for more details).

Cost of health and social care service use and medication

The cost of acute and community health care service use for the Engager versus usual care will be calculated from patient completed CSRI at baseline and 6 and 12 months post release. These will be costed for each patient using unit costs from the most recent PSSRU[2] *Unit Costs in Criminal Justice*[3], reference costs[4] and published sources where needed. Costs from previous years will be inflated to the year of publication of the most recent version of the PSSRU and reference costs using the PSSRU hospital and community health services (HCHS) index[2]. Medication will be costed using the most up to date version of the British National Formulary (BNF)[5]. Mean cost per patient for the Engager versus usual care will be reported by type of service use and by planned and unplanned service use at baseline and 6 and 12 months post release and (a) for patients that have completed the measures at each time point; (b) using multiple imputation for the ITT results.

To calculate the difference in costs at 12 months between Engager and usual care, costs will be adjusted by baseline values, with study centre included as a covariate. 95% CIs will be calculated based on bootstrapped bias corrected results[6]. Only the ITT difference will be reported.

Accommodation, education, training, employment, money, relationship and criminal related service use

Accommodation, education, training, employment, money, relationship and criminal related service use will be calculated from patient responses baseline and 6 and 12 months post release. These will be costed for each patient using *Unit Costs in Criminal Justice*[3] and other published sources, with all costs being inflated to the most recent year of publication of the PSSRU using the PSS Pay and Price Index[2].

Mean cost per patient for the Engager versus usual care will be reported by type of service use at baseline and 6 and 12 months post release and (a) for patients that have completed the measures at each time point; (b) using multiple imputation for the ITT results.

The difference in costs at 12 months between Engager and usual care will be calculated with an adjustment for baseline values, with study centre included as a covariate. 95% CIs will be calculated based on bootstrapped bias corrected results[6]. Only the ITT difference will be reported.

Reoffending

Reoffending data will be used to calculate the patient level cost of crime in Engager compared to usual care. This will be achieved by multiplying each crime recorded in the PNC by its cost and relevant inflator index for police recorded crime as obtained from the most up to date version of *The Economic and Social Costs of Crime*[7]. All costs will be inflated to the most recent year of publication of the PPSRU using the PSS Pay and Price Index[2]. QALY losses expressed as –(QALY loss)* willingness to pay (WTP) for a QALY gained will also be calculated for each crime and for a range of values of WTP for a QALY gained.

Based on the assumption that all trial participants are successfully followed up in the Police National Computer, we will calculate the (a) mean cost per participant of crime (total crime costs divided by the number of patients randomised to each arm); (b) mean cost per participant of QALY losses (total QALYs loss times WTP for a QALY divided by the number of patients randomised to each arm); and (c) the mean cost per participant of crime and QALY losses (a+b) for Engager compared to usual care. Difference in costs between Engager and usual care and 95% CIs will be calculated based on bootstrapped[6] bias corrected linear regression with study centre as a covariate.

14 QUALITY OF LIFE DATA COLLECTION

The primary measure used to calculate QALYs will be the primary outcome, the CORE-OM, converted to the CORE-6D so that it can be used to calculate QALYs. QALYs will be calculated

as the area under the curve using the CORE-6D responses at baseline and 1, 3, 6 and 12 months post release and applying by Mavranezouli et al[8] at each time point. For the Engager versus usual care we will report the mean utility values at each time point; mean unadjusted QALYs from baseline to 12 months; and mean QALYs adjusting for baseline using regression analysis[9]. A covariate for study centre will also be included in the regression analysis.

QALYs will also be calculated reported in a similar manner using responses to the EQ-5D-5L at baseline and 3, 6 and 12 months post release and (a) the van Hout mapping algorithm to the EQ-5D-3L recommended by that National Institute of Health And Care Excellence (NICE)[10]; (b) the EQ-5D-5L value set[11].

Years of Full Capability (YFC) (equivalent) will be calculated for Engager compared to usual care using patient level responses to the ICECAP-A at baseline and 3, 6 and 12 months post release, the tariff developed by Flynn et al[12] and the methods for ICECAP-A and decision making set out by the University of Birmingham[13].

95% confidence intervals for all analyses above will be calculated from bootstrapping[6] with bias correction. Results will be reported for (a) complete cases; and (b) ITT based on section 6 below.

15 PRIMARY WITHIN-TRIAL ANALYSIS

The primary economic evaluation will be a within-trial cost-effectiveness analysis over 12 months post release from a health and social care cost perspective.

Incremental cost-effectiveness ratio (ICER)

The primary result will be the mean incremental cost per QALY gained adjusting for baseline differences and with study centre as a covariate. Costs will be bootstrap adjusted costs as reported in section 3 and will include the cost of the Engager intervention in the Engager arm and the cost of health and social care services in both arms. QALYs will be bootstrap adjusted costs calculated using the CORE-6D and the methodology described in section 4. Seemlingly unrelated regression will be used to account for the correlation between costs and outcomes. The primary analysis will be based on ITT with imputation conducted as described in 6 below.

Cost-effectiveness acceptability curve (CEAC) and Cost-effectiveness Plane

The bootstrap results will be used to calculate the CEAC[14]: the probability that Engager is cost-effective compared to usual care for a range of values of willingness to pay for a QALY gained. A cost-effectiveness plane of the bias corrected bootstrap results will also be reported.

16 MISSING DATA

The primary analysis will be ITT. For patients missing an ICER we will examine the data for predictors of missingness assuming that data are missing at random. If predictors of missingness can be identified these will be used to impute data using multiple imputation by chained equations[15]. The primary ICER, CEAC and CEP will be reported based on imputed results, seemingly unrelated regression and the methodology set out in Leurant et al[16].

17 SECONDARY WITHIN-TRIAL ANALYSES

ICERs, CEACs and CEPs will be reported for the following analyses:

i) Health and social care cost perspective using the EQ-5D-5L for the calculation of QALYS.

ii) Health and social care cost perspective using the ICECAP-A for the calculation of YFC.

iii) Health and social care, accommodation, education, training, employment, money, relationship and criminal related service use using the CORE-6D calculation of QALYS

iv) Health and social care, accommodation, education, training, employment, money, relationship and criminal related service use using the EQ-5D-5L calculation of QALYS.

v) Health and social care, accommodation, education, training, employment, money, relationship and criminal related service use using the ICECAP-A calculation of YFC.

vi) All costs including reoffending using the CORE-6D for the calculation of QALYS.

vii) All costs including reoffending using the EQ-5D-5L for the calculation of QALYS.

viii) All costs including reoffending using the ICECAP-A for the calculation of YFC.

18 COST CONSEQUENCES ANALYSIS

Within the cost-consequence approach the estimated incremental health and social care costs including the cost of the Engager intervention in the treatment arm will be compared with:

- The number of people provided with the service/intervention
- Incremental differences in the number of ex-prisoners who: have resettled; are in employment; have no re-convictions; are not homeless.
- Estimated lifetime gains in Quality-Adjusted Life-Years (QALYs) – presuming the persistence of any short-term measured gains and the inclusion of estimated gains associated with social inclusion outcomes such as effective resettlement, increased employment, or reduced re-conviction rates.

Both deterministic and probabilistic sensitivity analysis will be conducted to explore uncertainty in the model assumptions and parameters, with exploration of key sources of structural uncertainty where feasible.

The analyses will be conducted according to current guidance (ISPOR) on best practice for conducting and reporting model-based economic evaluation[17].

19 DISCOUNTING

As the trial based analysis covers a 12 month duration none of the costs or quality of life outcomes will be discounted. Costs and outcomes in the cost-consequences analysis will be discounted at a rate of 3.5% in line with NICE guidance[18].

20 SENSITIVITY ANALYSIS

In addition to the CEAC and CEP analysis described in section 5 above, one- and two-way sensitivity analyses will be used to explore the impact of key cost assumptions on the findings. For example, some sensitivity analyses may be conducted excluding any rare but highly costly episodes of service use (for example, hospital admissions) if it seems plausible that they are unlikely to be related to the outcomes or Engager intervention and they heavily influence the magnitude of incremental costs.

Exploratory analyses will be used to investigate whether the costs associated with the Engager intervention produce a shift in the proportion of planned versus unplanned care and other service use. Exploratory analyses will also investigate whether additional costs or savings associated with having received Engager are incurred soon after release from prison, or are delayed or accrued over a longer period.

Exploratory subgroup analyses will be used to investigate whether certain groups receiving the Engager intervention account for higher or lower levels of post-intervention service use and costs; for example, those achieving stable accommodation (compared with those not); those gaining a stable occupation (compared with those not) and those obtaining ongoing care for mental health problems or substance misuse.

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APPENDIX 2

	Engager					Usual care				
	n	**n=yes**	**%**	**Mean***	**SD**	**n**	**n=yes**	**%**	**Mean***	**SD**
Emergency mental health attendance										
Baseline	140	18	13%	1.56	.92	140	9	6%	1.44	.88
6 months	92	14	15%	1.36	.84	140	9	6%	1.11	.33
12 months	66	10	15%	1.3	.95	58	3	5%	1.	.
Emergency mental health admissions				**Mean LOS**					**Mean LOS**	
Baseline	140	12	9%	4.17	4.67	140	4	3%	1.75	1.5
6 months	92	5	5%	4.2	4.55	140	4	3%	3.	3.37
12 months	66	7	11%	20.86	31.45	58	1	2%	1.	
Planned mental health attendances										
Baseline	140	3	2%	1.	.	140	3	2%	1.	.
Emergency physical health attendances										
Baseline	140	32	23%	1.28	.52	140	19	14%	1.	.
6 months	92	21	23%	1.95	2.01	90	14	16%	1.36	.74
12 months	66	24	36%	1.17	.38	58	20	34%	1.4	.82
Emergency Physical health admissions				**Mean LOS**					**Mean LOS**	
Baseline	140	11	8%	3.36	2.42	140	5	4%	2.	1.
6 months	92	9	10%	3.67	3.32	90	5	6%	33.6	61.93
12 months	66	6	9%	3.67	2.5	58	4	7%	6.75	9.54
Planned physical health attendances										
Baseline	140	10	7%	1.4	.7	140	5	4%	1.	.
6 months	92	1	1%	1.		90	2	2%	1.5	.71
12 months	66	8	12%	1.	.	58		0%		
Planned physical health admissions				**Mean LOS**					**Mean LOS**	

Baseline	140	2	1%	5.5	6.36	140		0%		
6 months	92	1	1%	3.		90	1	1%	35.	
12 months	66	3	5%	5.67	2.08	58		0%		
Outpatient appointments										
Baseline	140	12	9%	1.33	.78	140	11	8%	1.	.
6 months	92	11	12%	2.73	2.94	90	13	14%	1.69	1.25
12 months	66	9	14%	1.78	.83	58	9	16%	2.11	2.98
Pre-release Service Use										
Pre-release	115	108	94%	28.17	43.75	113	101	89%	19.07	33.5
Community Mental Health										
Baseline	140	84	60%	8.93	15.29	140	86	61%	7.6	12.56
6 months	92	62	67%	14.32	19.01	90	60	67%	19.45	37.91
12 months	66	45	68%	12.71	18.03	58	34	59%	16.82	29.49
Community Physical Health										
Baseline	140	112	80%	7.37	17.24	140	106	76%	7.5	21.77
6 months	92	73	79%	5.64	5.55	90	57	63%	6.93	13.38
12 months	66	42	64%	7.5	9.4	58	35	60%	6.89	7.05
CJS Service Use										
Baseline	140	59	42%	5.32	5.6	140	68	49%	2.84	3.32
6 months	92	87	95%	13.18	11.39	90	81	90%	12.31	9.32
12 months	66	47	71%	11.11	10.03	58	46	79%	11.83	12.18
Accommodation Services										
Baseline	140	69	49%	4.1	7.71	140	69	49%	5.87	18.87
6 months	92	49	53%	6.29	7.73	90	41	46%	5.2	6.85
12 months	66	27	41%	11.96	39.83	58	20	34%	4.85	6.18
Education services										
Baseline	140	99	71%	25.48	45.94	140	91	65%	23.18	30.02
6 months	92	29	32%	8.55	10.66	90	24	27%	7.04	10.39
12 months	66	18	27%	5.89	6.41	58	21	36%	6.67	9.11

Financial advice										
Baseline	140	22	16%	1.45	.96	140	24	17%	2.21	2.02
6 months	92	38	41%	4.29	5.1	90	34	38%	3.18	3.43
12 months	66	20	30%	5.45	6.12	58	16	28%	3.25	3.77
Relationships										
Baseline	140	36	26%	4.61	4.65	140	41	29%	3.2	3.37
6 months	92	9	10%	4.33	4.36	90	14	16%	4.5	5.39
12 months	66	10	15%	5.8	7.61	58	10	17%	13.2	16.07
Other services										
Baseline	140	117	84%	2.74	2.77	140	99	71%	3.54	5.23
6 months	92	54	59%	7.96	13.96	90	40	44%	7.38	15.67
12 months	66	27	41%	9.63	20.36	58	26	45%	10.31	25.64
Prison				**Mean LOS**					**Mean LOS**	
Baseline	140	13	9%	50.85	25.	140	11	8%	58.27	23.12
6 months	92	38	41%	96.34	58.4	90	27	30%	97.67	64.9
12 Months	66	28	42%	97.96	75.26	58	17	29%	84.71	59.22
Police Contacts										
Baseline	140	75	54%	1.81	1.38	140	65	46%	1.71	2.47
6 months	92	48	52%	1.02	.14	90	28	31%	1.04	.19
12 months	66	21	32%	1.	.	58	16	28%	1.06	.25
Employment				**Mean Hours Worked p/week**					**Mean Hours Worked p/week**	
Baseline	140	35	25%	36.29	16.51	140	55	39%	46.31	19.09
6 months	92	18	20%	41.08	22.78	90	24	27%	36.46	16.85
12 Months	66	14	21%	36.21	20.56	58	9	16%	35.56	23.31
Days off work										
Baseline	140	35	25%	4.53	11.27	140	55	39%	3.78	13.03

6 months	92	18	20%	2.7	8.74	90	24	27%	2.66	6.65
12 Months	66	14	21%	6.71	20.21	58	9	16%	1.9	3.52
Duration of employment (weeks)										
6 months	92	18	20%	18.39	11.22	90	24	27%	15.08	9.28
12 Months	66	14	21%	16.75	14.27	58	9	16%	26.44	16.39

SD - Standard Deviation; LOS - Length of Stay; CJS - Criminal Justice Services

APPENDIX 3

Complete Case mean cost per participant and adjusted difference.

	Engager			Usual Care						
	n	mean	SD	n	mean	SD	Adjusted difference[a]	95% CI Lower	95% CI Upper	p value
Specialist Mental Health										
Baseline	140	183	870	140	32	149				
6 months	92	119	593	90	63	331				
12 months	66	881	5166	58	13	58				
Total	60	981	5412	54	112	424	-854.744	-615.426	2324.914	0.252
Physical Health Inpatient-planned										
Baseline	140	74	508	140	32	233				
6 months	92	18	175	90	234	2146				
12 months	66	206	922	58	0	0				
Total	60	226	965	54	14	100	213.168	-50.680	477.017	0.112
Physical Health Inpatient-unplanned										

Baseline	140	180	592	140	72	255				
6 months	92	260	823	90	226	1210				
12 months	66	257	920	58	306	1279				
Total	60	413	1301	54	590	1940	-236.815	-833.296	359.667	0.433
Outpatient appointments										
Baseline	140	23	102	140	11	47				
6 months	92	50	250	90	39	201				
12 months	66	27	95	58	56	269				
Total	60	94	317	54	76	290	11.193	-102.883	125.269	0.846
Community Health Care										
Baseline	140	738	2014	140	557	1145				
Pre Release	110	370	827	102	299	612				
6 months	92	1034	1487	90	920	1753				
12 months	66	940	1691	58	1299	3143				
Total	46	2519	3270	41	3555	5030	-776.579	-2441.87	888.711	0.361

Medication										
Baseline	140	37	73	140	57	188				
12 months	113	231	1994	111	58	215	153.315	-223.313	529.942	0.423
Total health care										
Baseline	140	2179	5551	140	1086	1979				
6 months	92	1727	2241	90	1634	3514				
12 months	60	2890	5888	56	1762	3608				
Total	46	5174	7503	41	4901	6258	459.312	-2280.11	3198.739	0.742
Criminal Justice Service Use inc. Probation										
Baseline	140	94	537	140	30	97				
Pre Release	110	35	294	102	40	376				
6 months	92	118	154	90	135	272				
12 months	66	95	169	58	195	780				
Total	46	284	516	41	504	1124	-243.008	-644.594	158.578	0.236
Prison										

Baseline	140	528	1850	140	512	1893				
6 months	92	4453	6771	90	3279	6385				
12 months	66	4651	7698	58	2778	5592				
Total	60	9636	13073	54	5750	10016	-3799.415	-488.324	8087.154	0.082
Police										
Baseline	140	1879	3171	140	1562	5552				
6 months	92	2224	5678	90	1113	4212				
12 months	66	2478	12624	58	835	2060				
Total	60	5112	15237	54	2151	5561	-3062.806	-1200.72	7326.33	0.157
Total CJS										
Baseline	140	2501	3813	140	2105	5859				
6 months	92	6795	9401	90	4527	8004				
12 months	66	7224	15450	58	3808	6071				
Total	46	14260	16231	41	9397	13902	4854.617	-1597.565	11306.799	0.140
Accommodation										
Baseline	140	762	2442	140	735	2878				
Pre-release	110	5	15	102	4	14				

6 months	92	2827	7349	91	2503	7634				
12 months	66	3086	9473	61	3356	9159				
Total	55	5983	12270	54	6970	15861	-1265.509	-6804.432	4273.415	0.654
Productivity										
Baseline	140	1780	3683	140	3819	5506				
6 months	92	3057	8404	90	2625	6457				
12 months	66	2529	7124	58	2640	8286				
Total	60	6637	13110	54	4628	12200	4398.993	597.403	8200.584	0.023
Education										
Baseline	140	682	2069	140	629	1727				
Pre-release	110	514	1349	102	465	1185				
6 months	92	110	459	90	53	323				
12 months	66	91	375	58	24	89				
Total	46	722	1304	41	643	1164	52.667	-484.036	589.369	0.847
Other services										
Baseline	140	297	468	140	568	3139				
Pre-release	110	53	137	102	42	103				

6 months	92	486	1196	90	212	437				
12 months	66	343	1347	58	372	1143				
Total	46	1187	2964	41	764	1433	356.859	-524.969	1238.687	0.428
All costs minus productivity										
Baseline	140	4640	8454	140	1304	9673				
Pre-release	110	977	1613	102	851	1434				
6 months	92	8887	16998	90	6315	15104				
12 months	66	10915	20650	58	6741	15878				
Total	46	19928	30925	41	18937	29604	-1027.67	-13520.59	11465.25	0.87

a Adjusted difference: adjusted for baseline, with centre as a covariate. Based on 5,000 bootstrap iterations.

SD – Standard Deviation; CI – Confidence interval; CJS – Criminal Justice System

Table SM2: Complete case utilities, capability and QALYs,

APPENDIX 4

	Engager			Usual Care						
	n	mean	SD	n	mean	SD	Adjusted difference[a]	95% CI Lower	95% CI Upper	p value
CORE-6D										
Baseline	140	.75	.168	140	.713	.181				
1 month	80	.746	.215	75	.774	.198				
3 months	82	.746	.211	86	.781	.172				
6 months	94	.753	.197	90	.795	.178				
12 months	68	.764	.22	60	.738	.236				
QALYs	42	.74	.194	31	.729	.185	-0.018	-0.099	0.064	0.672
EQ-5D-5L Crosswalk										
Baseline	140	.679	.234	140	.657	.225				
3 months	82	.687	.266	86	.685	.274				
6 months	94	.677	.259	89	.711	.261				
12 months	62	.734	.265	58	.682	.291				
QALYs	44	.676	.218	48	.666	.222	-0.028	-0.102	0.045	0.449
EQ-5D-5L Tariff										
Baseline	140	.767	.186	140	.754	.182				
3 months	82	.766	.243	86	.766	.226				
6 months	94	.752	.242	89	.782	.22				
12 months	62	.804	.237	58	.764	.272				
QALYs	44	.76	.2	48	.748	.209	-0.012	-0.075	0.050	0.701

ICECAP-A										
Baseline	140	.613	.221	139	.613	.226				
3 months	80	.634	.222	86	.658	.254				
6 months	92	.656	.21	88	.708	.233				
12 months	60	.717	.233	56	.728	.231				
YFC	42	.661	.162	46	.703	.199	-0.038	-0.094	0.018	0.184

a Adjusted difference: adjusted for baseline, with centre as a covariate. Based on 3,000 bootstrap iterations.

SD – Standard Deviation; CI – Confidence interval; QALYs- Quality Adjusted Life Years; YFC – Years of Full Capability

APPENDIX 5

Secondary Analysis 1a: EQ-5D-5L, Crosswalk Tariff, health care cost perspective.

Using the EQ-5D-5L crosswalk tariff to calculate QALYs over 12 months and from a health and social care cost perspective with MICE used for missing cost and utility data and seemingly unrelated regression to account for correlation between costs and outcomes, with adjustment for baseline and site there was a mean cost difference of £2,301 (95% of iterations between £1,289 to £3,439) and a mean QALY difference of 0.010 (95% of iterations between -0.016 to 0.036) with an incremental cost-effectiveness ratio of £237,707. The CEAC and CEP are reported in Figure SM2-SM3. There is a 0% probability that the intervention is cost-effective for a £20,000 and £30,000 threshold for a QALY gained.

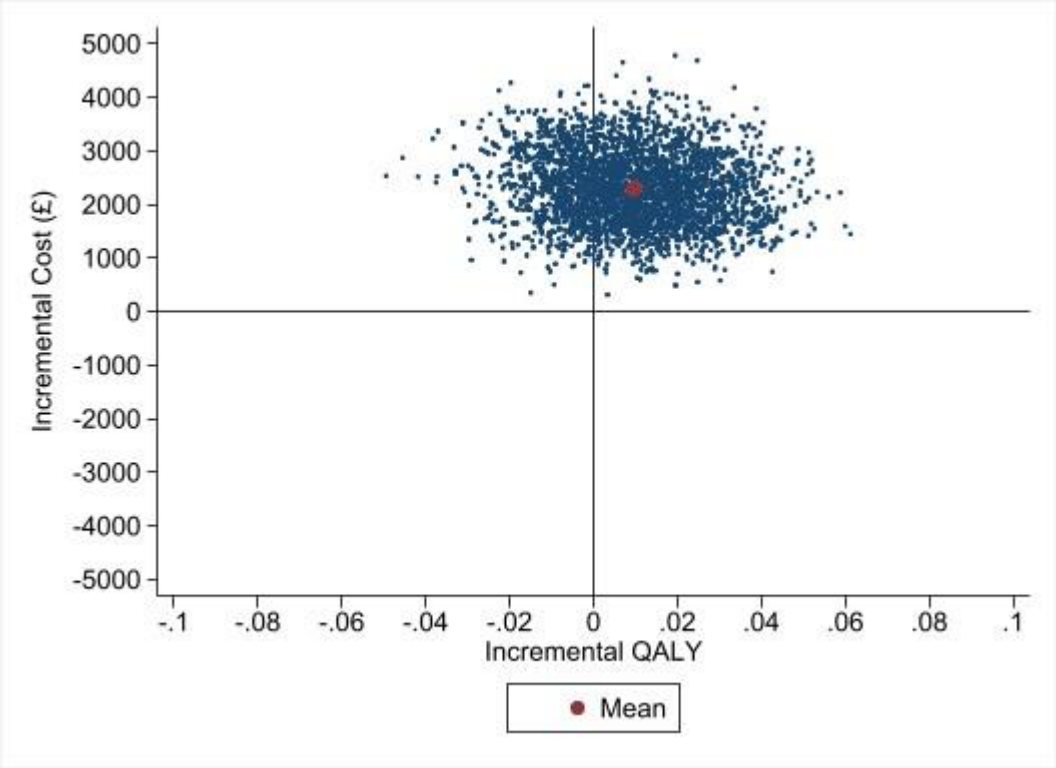

Figure A1: Cost-effectiveness plane of Engager compared to usual care from a health and social care cost-perspective over 12 months with QALYs calculated using the EQ-5D-5L crosswalk tariff.

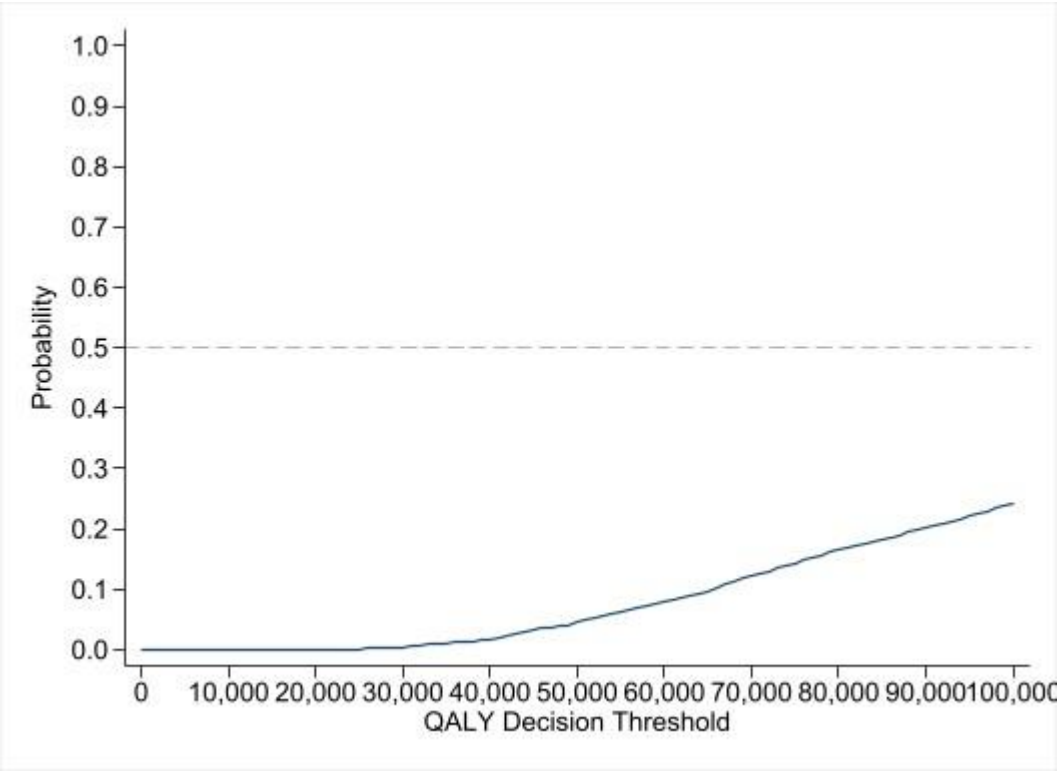

Figure A2: Cost-effectiveness acceptability curve of Engager compared to usual care from a health and social care cost-perspective over 12 months with QALYs calculated using the EQ-5D-5L crosswalk tariff.

Secondary Analysis 1b: EQ-5D-5L, time trade off tariff, health care cost perspective.

Using the EQ-5D-5L time trade off tariff to calculate QALYs over 12 months and from a health and social care cost perspective with MICE used for missing cost and utility data and seemingly unrelated regression to account for correlation between costs and outcomes, with adjustment for baseline and site there was a mean cost difference of £2,301 (95% of iterations between £1,293 to £3,444) and a mean QALY difference of 0.001 (95% of iterations between -0.021 to 0.024) with an incremental cost-effectiveness ratio of £2,301,000. The CEAC and CEP are reported in Figure SM4-SM5. There is a 0.2% and 1% probability that the intervention is cost-effective

for a £20,000 and £30,000 threshold for a QALY gained, respectively.

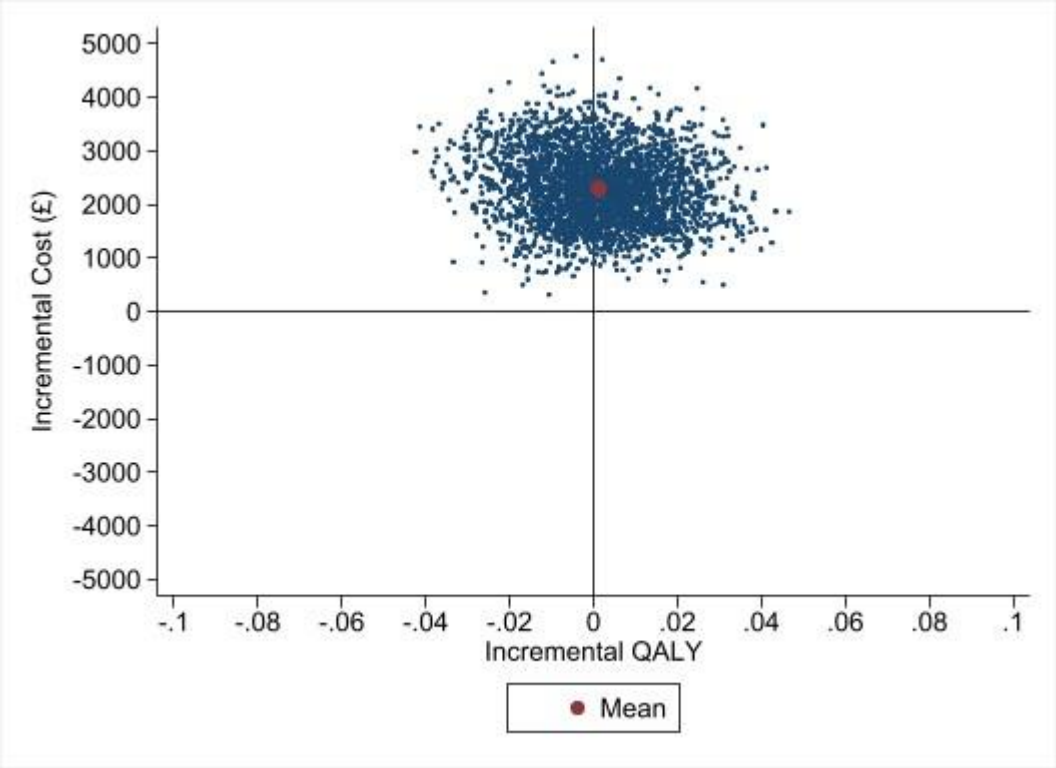

Figure A3: Cost-effectiveness plane of Engager compared to usual care from a health and social care cost-perspective over 12 months with QALYs calculated using the EQ-5D-5L utility tariff.

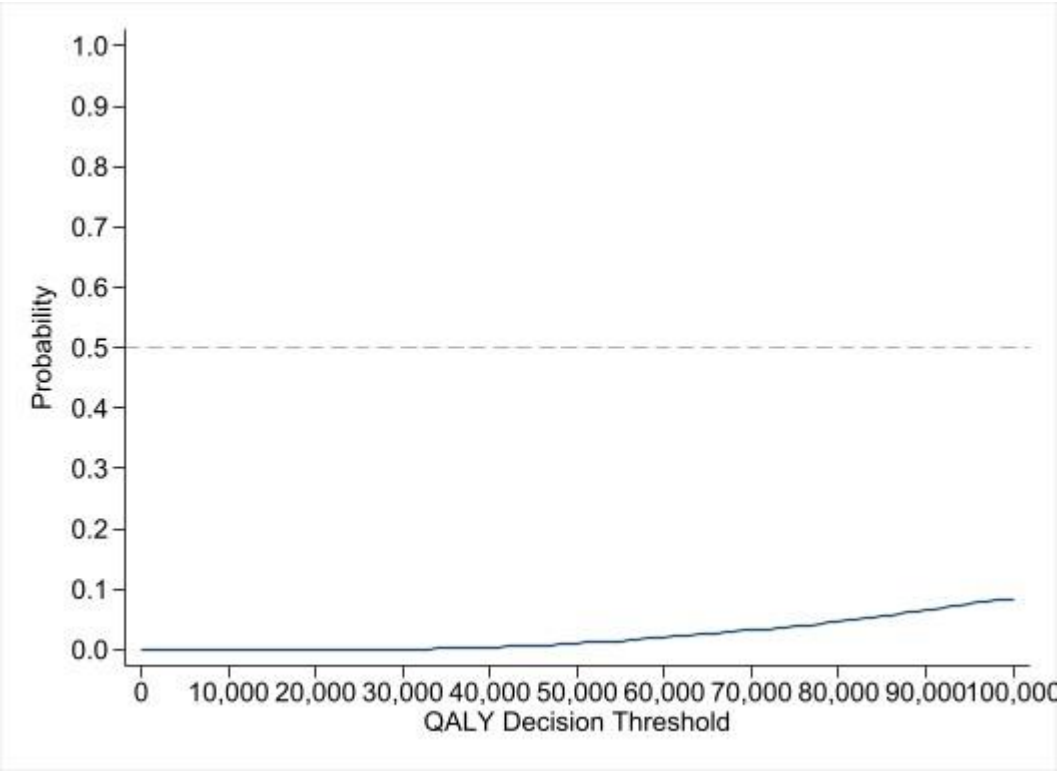

Figure A4: Cost-effectiveness acceptability curve of Engager compared to usual care from a health and social care cost-perspective over 12 months with QALYs calculated using the EQ-5D-5L utility tariff.

Secondary Analysis 2: ICECAP-A and tariff, health care cost perspective.

Using the ICECAP-A and related tariff to calculate years of full capability (YFC) over 12 months and from a health and social care cost perspective with MICE used for missing cost and capability and seemingly unrelated regression to account for correlation between costs and outcomes, with adjustment for baseline and site there was a mean cost difference of £2,184 (95% of iterations between £1,173 to £3,354) and a mean YFC difference of -0.030 (95% of iterations between -0.061 to 0.003); Engager is dominated by usual care. The CEAC and CEP are reported in Figure SM6-SM7. There is a 0% probability that the intervention is cost-effective for a £20,000 and £30,000 threshold for a QALY gained.

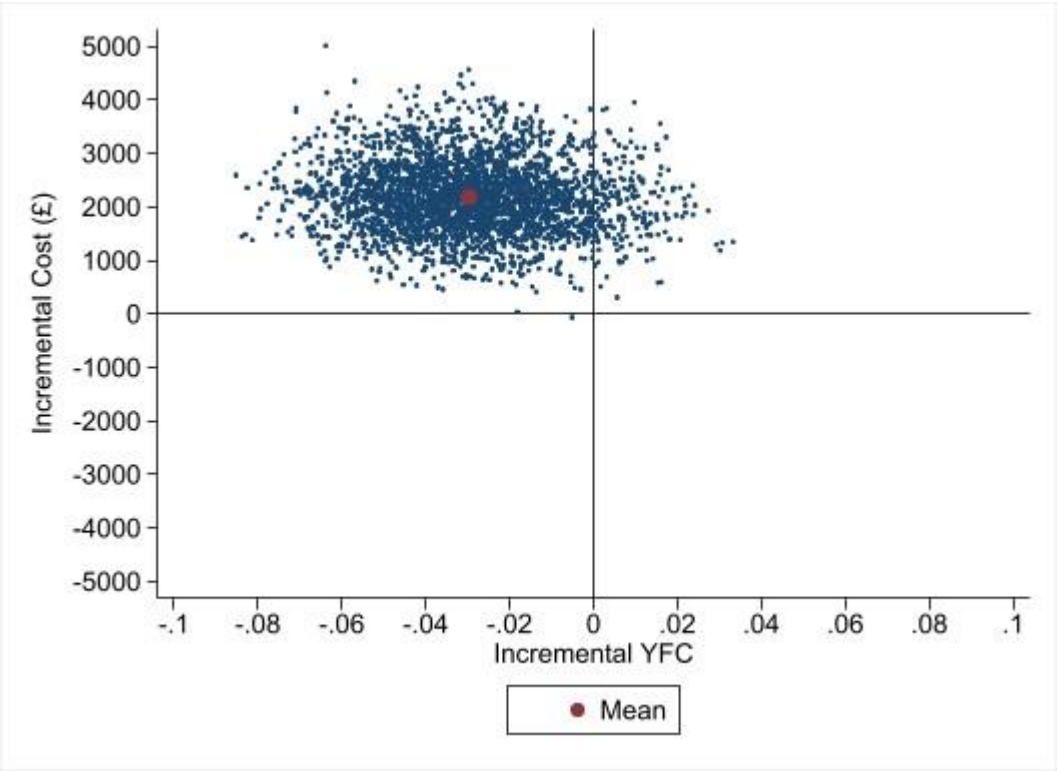

Figure A5: Cost-effectiveness plane of Engager compared to usual care from a health and social care cost-perspective over 12 months with YFC calculated using the ICECAP-A tariff.

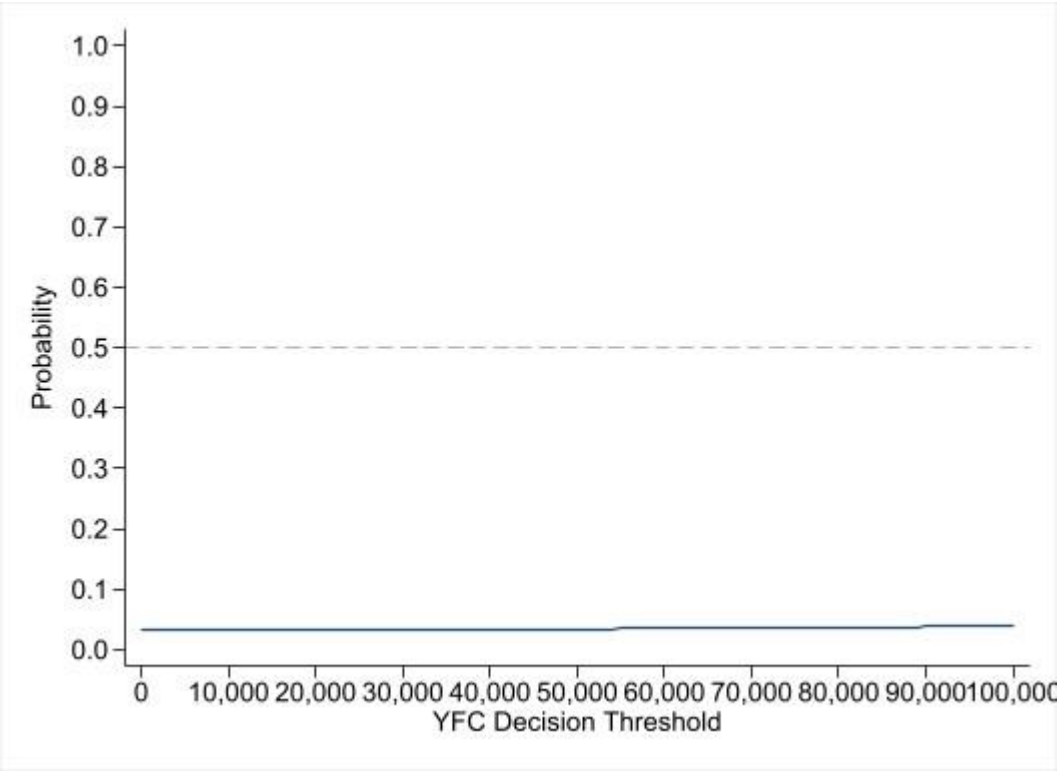

Figure A6: Cost-effectiveness acceptability curve of Engager compared to usual care from a health and social care cost-perspective over 12 months with YFC calculated using the ICECAP-A tariff.

Secondary Analysis 3: CORE-6D and tariff, wider cost perspective.

Using the CORE-6D tariff to calculate QALYs over 12 months and from a health and social care cost perspective with MICE used for missing cost and utility data and seemingly unrelated regression to account for correlation between costs and outcomes, with adjustment for baseline and site there was a mean cost difference of £6,428 (95% of iterations between -£1,308 to £13,894) and a mean QALY difference of -0.015 (95% of iterations between -0.046 to 0.016); Engager is dominated by usual care. The CEAC and CEP are reported in Figure SM8-SM9. There is an 8% probability that the intervention is cost-effective for a £20,000 and £30,000 threshold for a QALY gained.

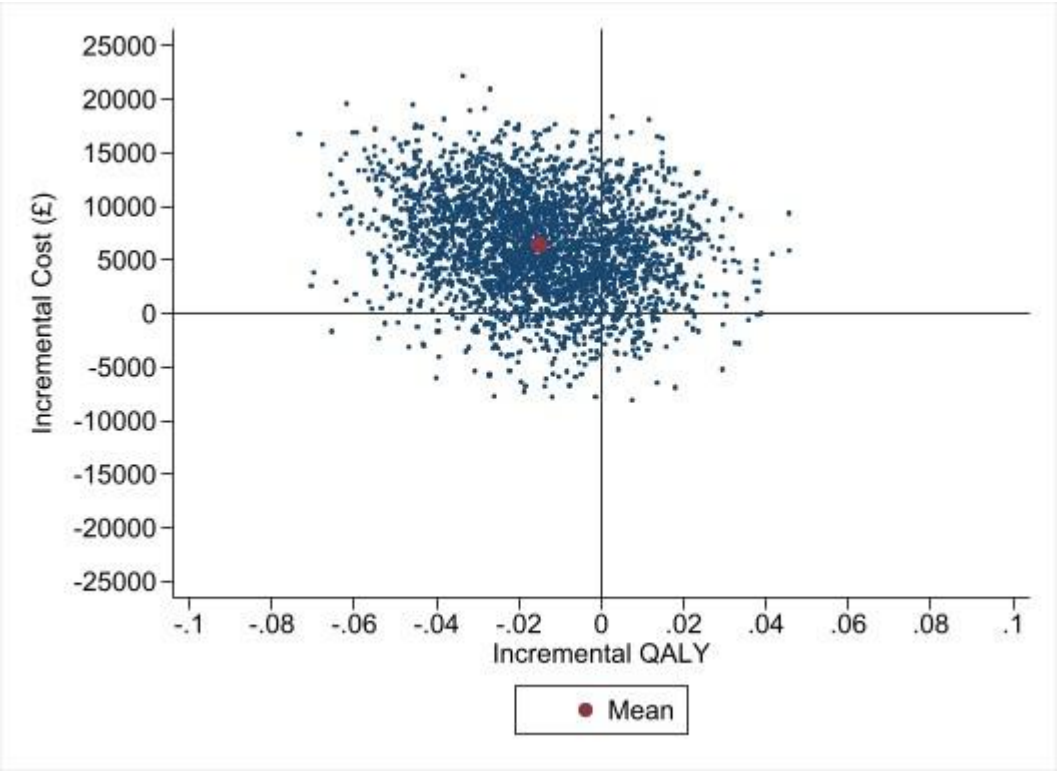

Figure A7: Cost-effectiveness plane of Engager compared to usual care from a wider cost-perspective over 12 months with QALYs calculated using the CORE-6D tariff.

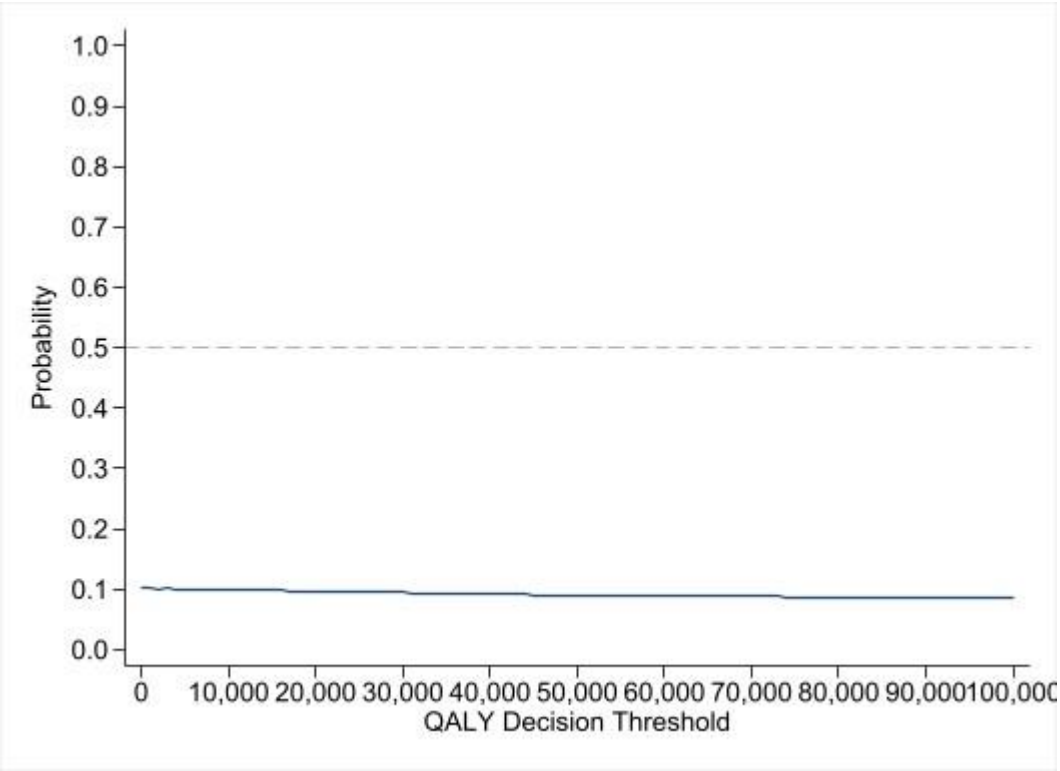

Figure A8: Cost-effectiveness plane of Engager compared to usual care from a wider cost-perspective over 12 months with QALYs calculated using the CORE-6D tariff.

Secondary Analysis 4a: EQ-5D-5L, Crosswalk Tariff, health care cost perspective.

Using the EQ-5D-5L crosswalk tariff to calculate QALYs over 12 months and from a wider cost perspective with MICE used for missing cost and utility data and seemingly unrelated regression to account for correlation between costs and outcomes, with adjustment for baseline and site there was a mean cost difference of £4,775 (95% of iterations between -£1,370 to £10,231) and a mean QALY difference of 0.003 (95% of iterations between -0.025 to 0.035) with an incremental cost-effectiveness ratio of £1,591,667. The CEAC and CEP are reported in Figure SM10-SM11. There is an 11% probability that the intervention is cost-effective for a £20,000 and £30,000 threshold for a QALY gained.

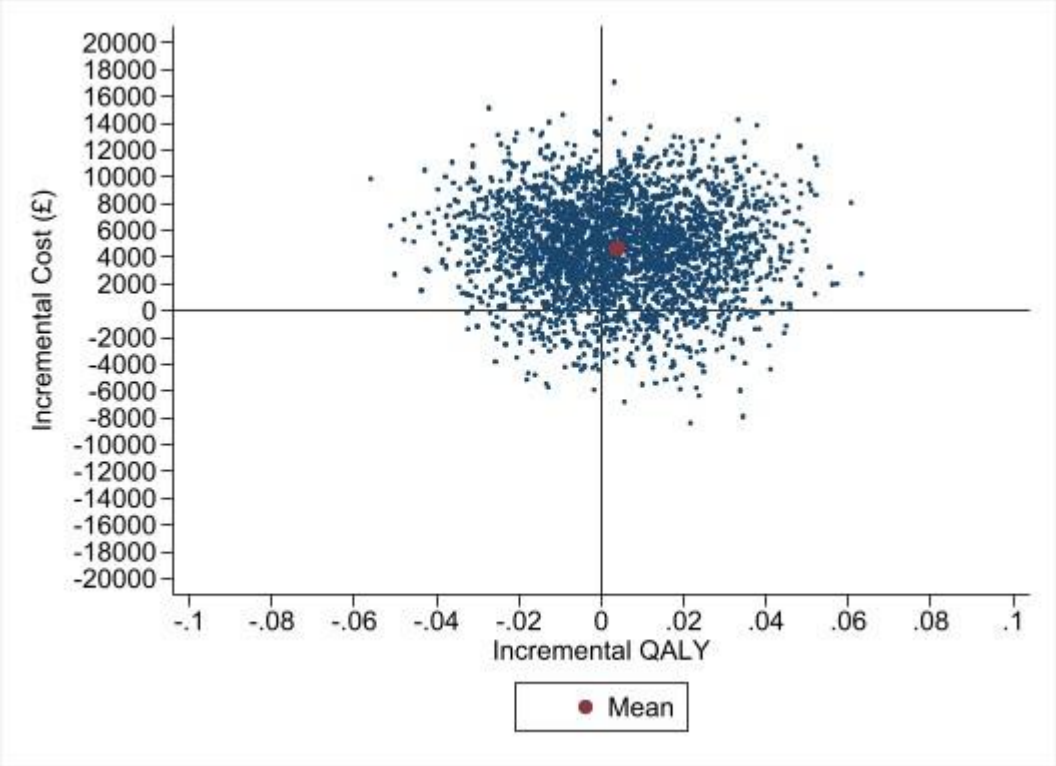

Figure A9: Cost-effectiveness plane of Engager compared to usual care from a wider cost-perspective over 12 months with QALYs calculated using the EQ-5D-5L crosswalk tariff.

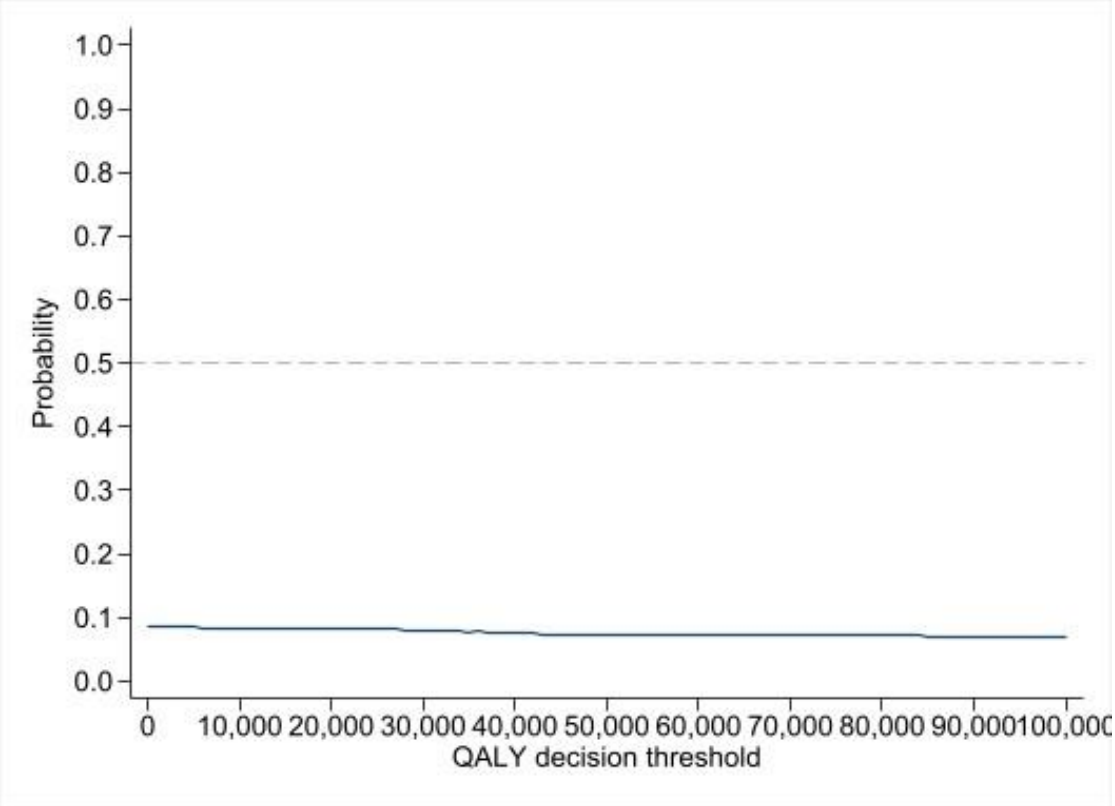

Figure A10: Cost-effectiveness acceptability curve of Engager compared to usual care from a wider cost-perspective over 12 months with QALYs calculated using the EQ-5D-5L crosswalk tariff.

Secondary Analysis 4b: EQ-5D-5L, time trade off tariff, health care cost perspective.

Using the EQ-5D-5L time trade off tariff to calculate QALYs over 12 months and from a health and social care cost perspective with MICE used for missing cost and utility data and seemingly unrelated regression to account for correlation between costs and outcomes, with adjustment for baseline and site there was a mean cost difference of £4,758 (95% of iterations between -£1,400 to £10,208) and a mean QALY difference of -0.007 (95% of iterations between -0.034 to 0.020); Engager is dominated by usual care. The CEAC and CEP are reported in Figure SM12-SM13. There is a 10% probability that the intervention is cost-effective for a £20,000 and £30,000 threshold for a QALY gained.

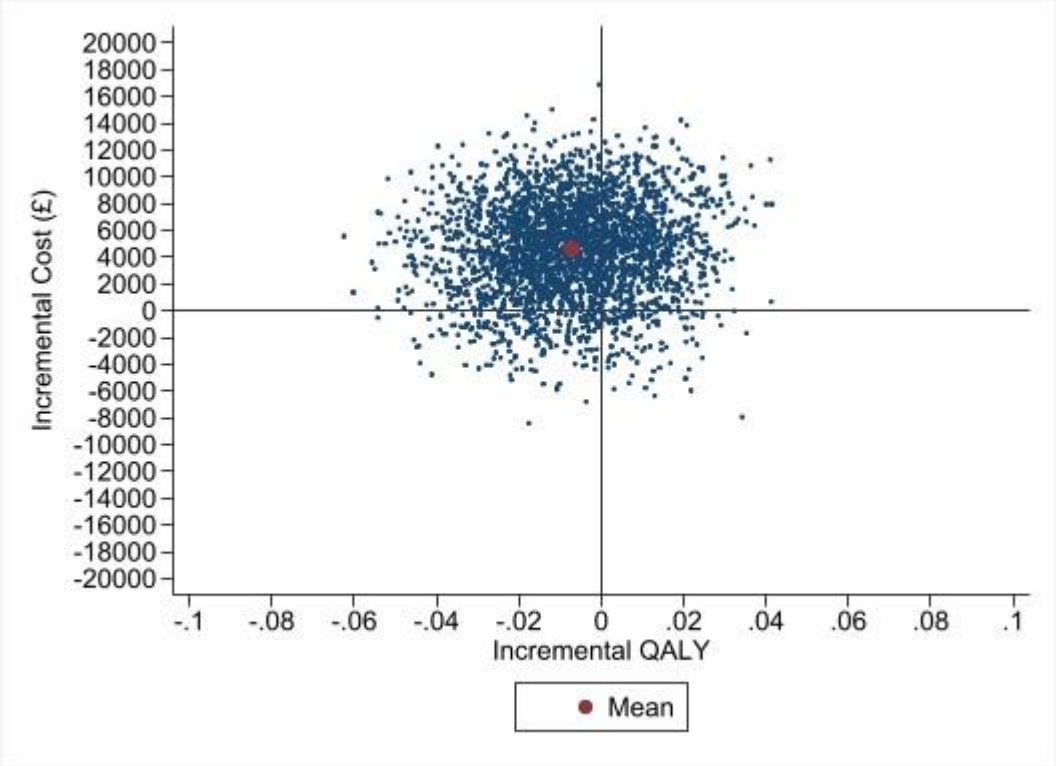

Figure A11: Cost-effectiveness plane of Engager compared to usual care from a wider cost-perspective over 12 months with QALYs calculated using the EQ-5D-5L utility tariff.

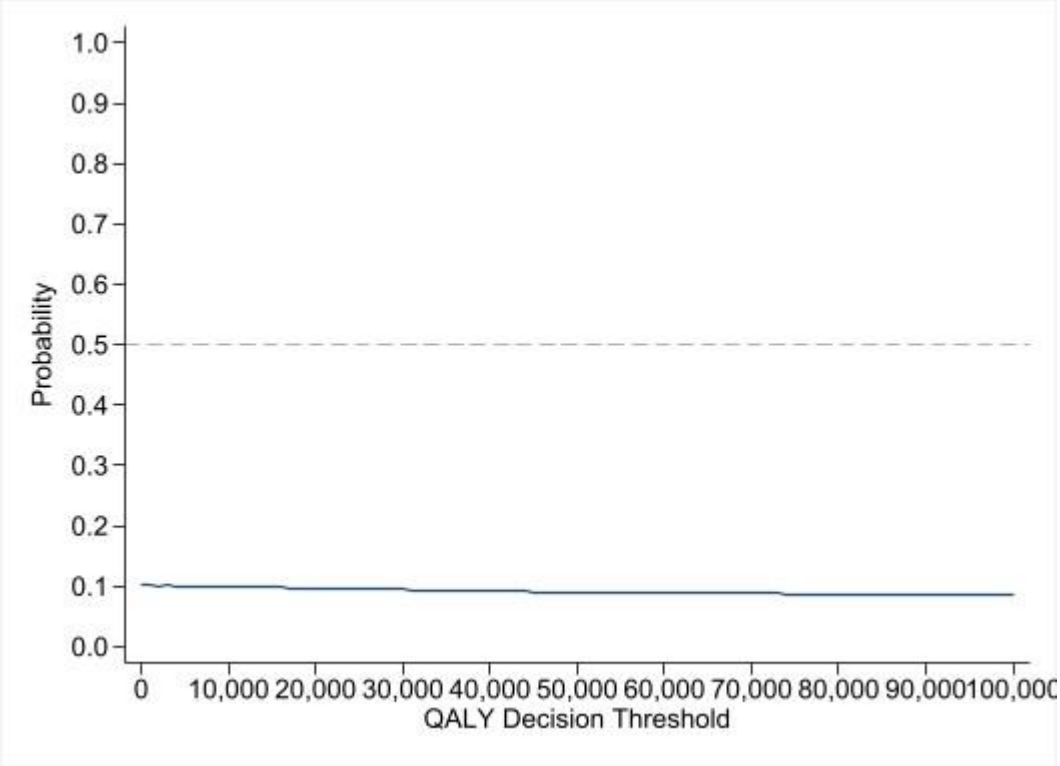

Figure A12: Cost-effectiveness acceptability curve of Engager compared to usual care from a wider cost-perspective over 12 months with QALYs calculated using the EQ-5D-5L utility tariff.

Secondary Analysis 2: ICECAP-A and tariff, health care cost perspective.

Using the ICECAP-A and related tariff to calculate years of full capability (YFC) over 12 months and from a health and social care cost perspective with MICE used for missing cost and capability and seemingly unrelated regression to account for correlation between costs and outcomes, with adjustment for baseline and site there was a mean cost difference of £5,391 (95% of iterations between -£1,239 to £11,084) and a mean YFC difference of -0.030 (95% of iterations between -0.063 to 0.003); Engager is dominated by usual care. The CEAC and CEP are reported in Figure SM14-SM15. There is a 7% probability that the intervention is cost-effective for a £20,000 and £30,000 threshold for a QALY gained.

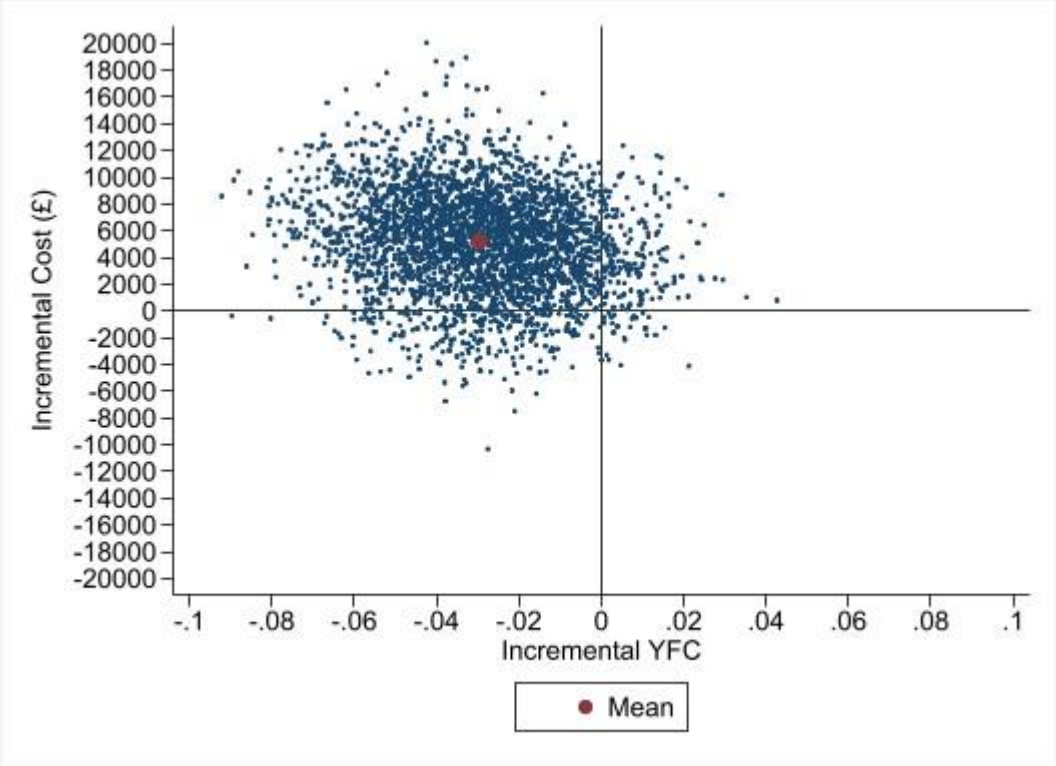

Figure A13: Cost-effectiveness plane of Engager compared to usual care from a wider cost-perspective over 12 months with YFC calculated using the ICECAP-A tariff.

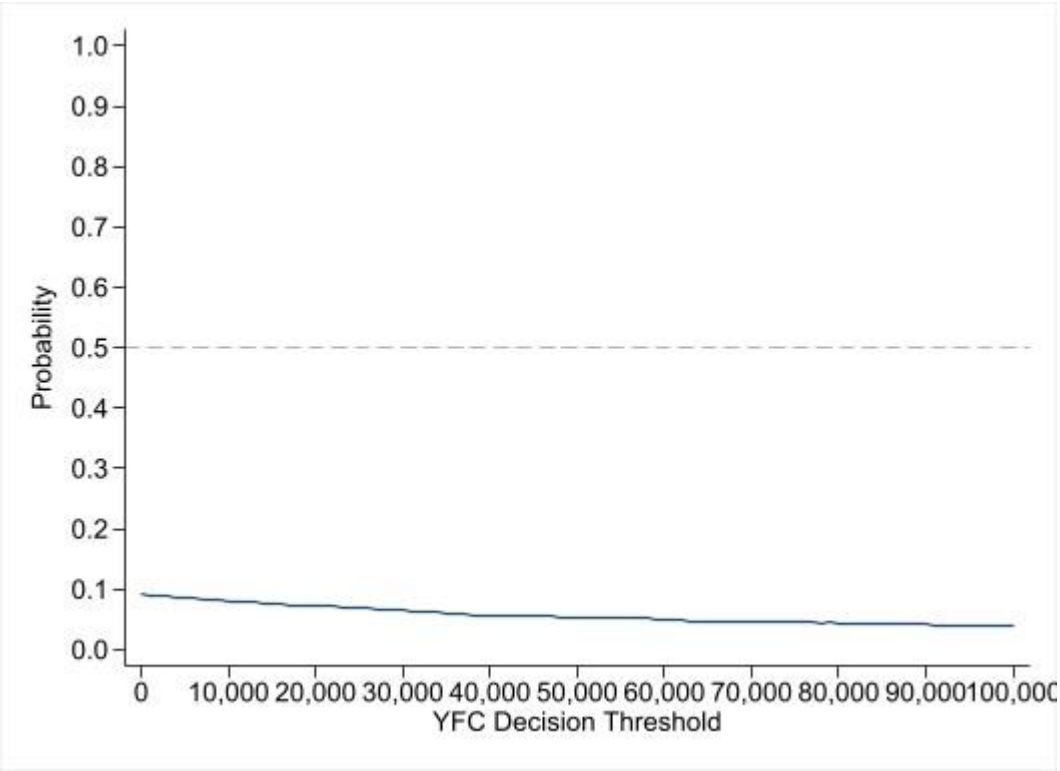

Figure A14: Cost-effectiveness acceptability curve of Engager compared to usual care from a wider cost-perspective over 12 months with YFC calculated using the ICECAP-A tariff.

Sensitivity analysis 1: If the cost of the Engager intervention is calculated using top-down costs, and costs an additional £3784 per participant randomised to Engager, the total additional cost of the Engager intervention from a health care perspective is £5272 (95% CI £3747 to £6799) per participant, adjusting for baseline costs and centre and using MICE to account for missing data.

Sensitivity analysis 2: If meta-supervision is removed from training and supervision costs, the total cost of training and supervision is £54,563, or £392 per participant. The total additional cost of the Engager intervention from a health care cost-perspective is £2,201 (95% CI £787 to £3615) per participant, adjusting for baseline costs and centre and using MICE to account for missing data.

Sensitivity analysis 3: If practitioner supervision is reduced from weekly to fortnightly, the total cost of training and supervision is £42,759, or £305 per participant. The total additional cost of the Engager intervention from a health care cost-perspective is £2,114 (95% CI £700 to £3528) per participant, adjusting for baseline costs and centre and using MICE to account for missing data.

Sensitivity analysis 4: If pre-release health care costs, ones that the intervention potentially had no ability to influence, are removed from the total health care costs, the total additional cost of the Engager intervention from a health care cost-perspective is £2,971 (95% CI £1605 to £4337) per participant, adjusting for baseline costs and centre and using MICE to account for missing data.

Sensitivity analysis 5: When the duration from randomisation until prison release is included as covariate in the analysis the mean difference in QALYs calculated using the CORE-6D is -0.017 (95% CI -0.053 to 0.019) per participant, with a total additional mean cost of the Engager intervention from a health care cost-perspective of £2,119 (95% CI £686 to £3552) per participant, adjusting for baseline and centre and using MICE to account for missing data.