Opioid substitution treatment in prison and post-release: Effects on criminal recidivism and mortality

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A thesis submitted in accordance with the requirements
for admission to the degree of Doctor of Philosophy

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Declaration of originality

I hereby declare that this submission is my own work and to the best of my knowledge it contains no materials previously published or written by another person, or substantial proportions of material which have been accepted for the award of any other degree or diploma at UNSW or any other educational institution, except where due acknowledgement is made in the thesis. Any contribution made to the research by others, with whom I have worked at UNSW or elsewhere, is explicitly acknowledged in the thesis. I also declare that the intellectual content of this thesis is the product of my own work, except to the extent that assistance from others in the project's design and conception or in style, presentation and linguistic expression is acknowledged.

Signed

Sarah Larney
October 2010

Acknowledgements

Thank you to my enthusiastic supervisory triumvirate: Associate Professor Kate Dolan, for suggesting the idea of a ten-year follow-up of the prisoner cohort and generously allowing access to the cohort baseline data, for providing me with significant opportunities to advance my standing as an independent researcher, and for reading, commenting and re-reading as necessary; Dr. Lucy Burns, for offering calm advice in the face of various crises, and providing perceptive commentary on written work; and Dr. Alex Wodak, for being an unfailing promoter of my work and attending to bureaucratic entanglements as needed.

Special thanks must go to Katie Irvine and Michael Smith at the Centre for Health Record Linkage for their patience and persistence in obtaining and linking the various datasets, and in responding to my many queries. Thank you also to the individuals who organised the release of data for this thesis: Craig Jones and staff at the NSW Bureau of Crime Statistics and Research; Pia Salmelainen at the Pharmaceutical Services Branch, NSW Health; and Elias Choueifati of the Information, Communication and Technology Division of Corrective Services NSW.

Many people willingly gave advice on data analysis. Kathleen Falster provided valuable advice on "many-to-many" dataset merges and preparation of such data for analysis; Deb Randall explained time-dependent variables; Barbara Toson pinpointed the appropriate statistical models and SAS code under the supervision of Tim Slade; and Garnett McMillan provided thoughtful comments and advice on the coding and interpretation of results.

Financial support for this PhD was provided by a National Health and Medical Research Council Postgraduate Scholarship (no. 510400) and the National Drug and Alcohol Research Centre. Funding for the broader data linkage project was provided by the National Drug Law Enforcement Research Fund.

Abstract

Heroin dependence is a chronic condition associated with significant health and social harms. The most effective treatment for heroin dependence is opioid substitution treatment (OST), in which long-acting opioid medications such as methadone or buprenorphine are prescribed with the goal of reducing heroin use and associated harms. Internationally, OST is rarely available in prisons, despite the high proportion of heroin users among prisoners. Furthermore, limited research attention has been given to examining how prison-based OST can reduce the harms of heroin dependence.

This thesis reports on two systematic literature reviews and three data linkage studies on the effects of prison-based and post-release OST. The first systematic review found that there is good evidence that prison OST reduces heroin use and needle and syringe sharing among prison inmates. The second review found that the evidence relating to the effects of prison OST on post-release outcomes is inconsistent and has limitations. As such, four data linkage studies were undertaken to assess incarceration, offending and mortality outcomes for a cohort of 375 male heroin users recruited in prisons in New South Wales (NSW), Australia, in 1996-7. Data were linked for the nearly ten-year period 1 June 1997 – 31 December 2006.

The first data linkage study assessed whether the baseline data for the cohort could be linked to other databases with sufficient sensitivity and specificity to obtain reliable and valid results regarding episodes of OST. Results showed that maximum sensitivity and specificity were achieved when participants' aliases were included as identifiers during the linkage process, and that enrolment in OST during the observation period had been reliably ascertained by linkage.

The second data linkage study demonstrated that exposure to OST while in prison did not in itself reduce risk of re-incarceration; rather, it was continuation of treatment as the individual returned to the community that reduced the risk of

returning to prison. Among participants who remained in OST post-release, risk of re-incarceration was, on average, 80% that of participants not in OST. The third study, assessing re-offending, did not find a relationship between OST exposure and criminal convictions; however, there were indications of bias in the analysis as a result of informative censoring.

The fourth data linkage study analysed mortality outcomes for the cohort. Participant mortality was six times that seen in the age-, sex- and calendar-adjusted NSW population, but was moderated while in OST and while in prison. Although mortality was elevated in the 28 days immediately after release from prison in comparison to all other time at liberty, this difference was not statistically significant; a larger sample size may have resulted in a significant finding in this regard.

Although OST has been studied extensively, few studies have employed data linkage to examine long-term treatment outcomes, particularly in relation to treatment participation while in prison. The evidence presented in this thesis provides support for the provision of OST in prisons, and for programs that facilitate prisoners' access to post-release OST. Integration of prisoner healthcare into public health systems may assist in improving continuity of OST as well as general standards of care. Future research should explore how the duration of pre-release treatment affects post-release outcomes and how OST can be combined with therapeutic approaches that address other risk factors for offending. Further follow-ups of the cohort would provide insights into the course and consequences of heroin use in Australia.

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Acronyms

ABS	Australian Bureau of Statistics
AIDS	acquired immune deficiency syndrome
BOCSAR	Bureau of Crime Statistics and Research
CHeReL	Centre for Health Record Linkage
CMR	crude mortality ratio
HAART	highly active antiretroviral therapy
HCV	hepatitis C virus
HIV	human immunodeficiency virus
ICD-10	International Classification of Diseases 10th Edition
MIN	Master Index Number
MLK	Master Linkage Key
NSW	New South Wales
OIMS	Offender Integrated Management System
OST	opioid substitution treatment
PHDAS	Pharmaceutical Drugs of Addiction System
PSB	Pharmaceutical Services Branch
PWP-GT	Prentice-Williams-Peterson gap-time (statistical model)
QRCT	quasi-randomised controlled trial
RCT	randomised controlled trial
ROD	Re-offending Database
SMR	Standardised mortality ratio
WHO	World Health Organization

1. Introduction: Heroin use, dependence and treatment

Heroin dependence is a chronic condition associated with poor health outcomes and criminality. Opioid substitution treatment (OST) effectively addresses many of the negative outcomes of heroin dependence, but there remain questions about the utility of OST in relation to prisons. This thesis comprises a series of quantitative studies designed to examine in detail whether providing OST in prisons can assist in reducing re-incarceration, offending and mortality among heroin users. The thesis is structured as follows:

This introductory chapter outlines some of the major harms associated with heroin use and dependence. The rationale for OST is outlined, and the evidence for its effectiveness is presented. The global implementation of OST, and OST use in Australia, are briefly described.

Chapter 2 builds on the Introduction by exploring the use of OST in prisons. The rationales for prison OST are considered, and the global implementation of prison OST is outlined. A brief history of the New South Wales prison OST program, the setting for the empirical studies presented in later chapters, is given.

Chapters 3 and 4 are systematic reviews of the research evidence that has accumulated in relation to prison-based OST programs. Chapter 3 focuses on in-prison outcomes of OST, namely, drug injection, sharing of needles and syringes, and HIV transmission. Chapter 4 considers post-release outcomes of prison OST: re-offending, re-incarceration and mortality. This chapter concludes the literature review portion of the thesis.

Chapter 5 provides an overview of the use of linked, administrative data to conduct longitudinal research. The term 'administrative data' refers to data that are routinely collected when individuals access services (e.g. demographic information collected when a person is hospitalised), or which are maintained by government agencies for information purposes (e.g. mortality statistics). This chapter describes

how data for an individual are linked across disparate administrative datasets, and outlines the administrative datasets used for the data linkage studies that follow.

Very few data linkage studies assess the validity of the data linkage process used. Chapter 6 presents the results of an analysis of the validity of the linkage between two of the administrative datasets that were used for this thesis.

Chapter 7 uses the linked data to describe the cohort under study, and examines the natural history of OST and incarceration for the cohort. This chapter then presents analyses of the role of prison OST in reducing risk of re-incarceration following release from prison. Statistical models are developed to assess the effect of prison OST status at time of release, and the effect of retention in OST post-release, on re-incarceration.

Chapter 8 uses a similar methodology to Chapter 7, this time examining the effects of prison-based and post-release OST on re-offending. It is perhaps counter-intuitive that re-offending results are presented after those for re-incarceration; results are presented in this order due to the difficulties associated with data linkage and analysis of offending compared to incarceration.

Chapter 9 is the final empirical chapter in this thesis, and considers mortality among the cohort. Mortality is assessed in relation to OST participation and incarceration, with mortality rates for various states (e.g. in and out of OST; in and out of prison; and in the 28 days post-release) being calculated.

Finally, Chapter 10 contains a summary and general discussion of results. The original contributions to the literature that have been made by this thesis are highlighted, policy implications are discussed and suggestions for further research are offered.

Heroin use and dependence

Heroin is an opiate drug that is consumed through injection, smoking or snorting. Its effects include feelings of euphoria and relaxation. Heroin is an illegal drug in most societies, and its use is widely stigmatised (Degenhardt, et al., 2009b). Despite this, it has been estimated that in 2008, between 13 and 22 million people globally used illicit opiates of some form, most commonly heroin (UNODC, 2010).

In developed nations, where most of the relevant research has been conducted, onset of heroin use occurs in late adolescence or the early 20s (Best, et al., 2008; Chen & Kandel, 1995; Day, et al., 2005; Nordt, et al., 2009), typically following early initiation to alcohol and cannabis use, and heavy use of these substances during adolescence (Fergusson, et al., 2006; Fergusson & Horwood, 2000). There has been limited research examining factors associated specifically with the uptake of heroin use; however, a wealth of evidence has consistently identified a number of factors associated with illicit drug use in general. Family conflict and inconsistent supervision and discipline in childhood and adolescence contribute to increased risk of illicit drug use, as does parental substance use. Poor educational performance and association with drug-using peers in adolescence also increases risk of illicit drug use (Fergusson & Horwood, 2000; Guo, et al., 2002; Hawkins, et al., 1992). These factors tend to be correlated, such that families with high levels of conflict are more likely to contain adults who use drugs themselves and/or have poor parenting skills; children from these families are more likely to perform poorly at school and to have socially deviant peers (Degenhardt, et al., 2009b).

With repeated, ongoing use of heroin, dependence on the drug can develop. In heroin dependence, the brain's opioid receptors become habituated, or tolerant, to the presence of heroin, and greater amounts of the drug are required to experience the desired effects. Neurobiological systems that regulate, among other things, emotion, mood and sleep, are disrupted, and in the absence of heroin, the individual experiences withdrawal symptoms such as dysphoria, lethargy and

persistent drug cravings (Kosten & George, 2002; Stimmel & Kreek, 2000). Behaviourally, dependence manifests in persistent drug-seeking, often to the exclusion of other activities, and difficulties in controlling use (American Psychiatric Association, 2000).

It has been estimated that between one-fifth and one-third of people who ever use heroin go on to develop dependence (Anthony, et al., 1994; Huang, et al., 2006; Swendsen, et al., 2009); however, data used to develop these estimates were from one country (the United States), and rates of progression to dependence may vary across countries. Furthermore, data for these estimates were obtained from general population household surveys. The lifestyle associated with heroin dependence means that these individuals are less likely to live in conventional housing, making it less likely that they will be contacted for participation in a household survey. If contacted, they may be reluctant to report illegal and stigmatising behaviours such as heroin use (Hall, et al., 2000b). As such, it is likely that current heroin users were under-sampled in the studies referenced above, thereby underestimating the proportion of heroin users who go on to develop dependence.

Sustained abstinence from heroin following the development of dependence is uncommon (Calabria, et al., 2010; Scherbaum & Specka, 2008). For example, a 33-year follow-up of a heroin dependent cohort recruited in the 1960s found that less than a quarter had been able to completely cease heroin use; almost half had died, largely of drug overdoses (Hser, et al., 2001). It has been demonstrated that the dysregulation of neurobiological systems that occurs in heroin dependence persists even after heroin use has ceased (Kreek, 2001); these persistent changes in brain functioning are implicated in the high rates of relapse that are seen in abstinent heroin users, even after many months or even years of abstinence (Kosten & George, 2002; Stimmel & Kreek, 2000). Thus, heroin dependence is best characterised as a chronic, sometimes lifelong, condition, punctuated by periods of

relative or total abstinence as a result of treatment or incarceration (Hser, et al., 2001).

Harms related to heroin use and dependence

There are significant harms associated with heroin use and dependence. Some of these harms relate to the route of administration of the drug, with injection of heroin associated with the spread of blood borne viral infections and increased risk of overdose. Other harms relate to the legal status of the drug and the activities that are associated with its acquisition.

Blood borne viral infections

One of the most prominent harms associated with heroin use is exposure to blood borne viral infections, such as human immunodeficiency virus (HIV) and hepatitis C virus (HCV), through sharing of contaminated needles, syringes and other equipment used to inject drugs. Data on prevalence of blood borne viral infections are generally collected in relation to injecting drug use, without reference to the drug being injected. However, heroin is the most commonly injected drug in all regions of the world except for South America and the Caribbean (Cook & Kanaef, 2008); hence, the data presented below refer to HIV and HCV prevalence among injecting drug users, of whom a large proportion are heroin users.

HIV infection among injecting drug users

It has been estimated that approximately 19%, or three million, of the world's 16 million injecting drug users are HIV positive (Mathers, et al., 2008). This figure hides a large amount of variability between countries, with HIV prevalence among people who inject drugs ranging from less than one per cent in countries such as Greece and Slovenia to as high as 72% in Estonia (Mathers, et al., 2008). Even within countries, infections are typically concentrated in particular geographical areas; for example, in China around 12% of all injecting drug users are HIV positive (Mathers,

et al., 2008), but province-level estimates of HIV prevalence range from 0% to over 50% (Bao & Liu, 2009).

In Australia, HIV transmission through injecting drug use has remained low, largely due to the introduction of needle and syringe programs and other harm reduction measures in the early stages of the global HIV epidemic (Commonwealth Department of Health and Ageing, 2002; Wodak & Lurie, 1997). Between one and two percent of drug injectors are HIV-positive, with injecting drug use accounting for only three per cent of new HIV infections in Australia in 2008 (Mathers, et al., 2008; National Centre in HIV Epidemiology and Clinical Research, 2009b).

HCV infection among injecting drug users

Hepatitis C virus infection among injecting drug using populations has been described as 'hyperendemic' (Lelutiu-Weinberger, et al., 2009). One estimate places global prevalence of HCV in injecting drug users at 70% (Hocking, et al., 2001), while a systematic review found HCV prevalence among injecting drug users exceeded 90% in 17 countries (Aceijas & Rhodes, 2007).

HCV has been highly prevalent in injecting drug using populations in Australia since at least the early 1970s (Freeman, et al., 2000; Moaven, et al., 1993); that is, before the introduction of harm reduction strategies such as needle and syringe programs. With high background prevalence and highly efficient transmission of HCV through sharing of needles and syringes (Falster, et al., 2009) and other injecting paraphernalia (Garfein, et al., 1998), hepatitis C has not been contained in Australia as HIV has been (Crofts, et al., 1999). Among people attending needle and syringe programs, prevalence is around 62% (National Centre in HIV Epidemiology and Clinical Research, 2009a).

Mortality

Heroin use and dependence are associated with a greatly increased risk of death (Darke, et al., 2007a). In a comparison of all-cause mortality among heroin users in

eight European cities, the risk of death for men ranged from six to 21 times that of the general population, and for women, from ten to over 50 times (Bargagli, et al., 2006). Leading causes of death are infectious diseases and overdose (Ferri, et al., 2007; Oppenheimer, et al., 1994; Sanchez-Carbonell & Seus, 2000), although suicide is also a significant contributor to excess mortality (Darke, et al., 2007a; Maloney, et al., 2007).

Mortality related to infectious diseases

AIDS-related illnesses are a significant cause of death among people who use heroin (Bargagli, et al., 2001; Sanchez-Carbonell & Seus, 2000; Solomon, et al., 2009). In European studies, mortality rates among heroin users rose sharply in the late 1980s and 1990s as a result of increasing HIV infection and subsequent AIDS-related fatalities. In one Spanish cohort, all-cause annual mortality ranged between zero and 1.5% from 1985-1989, increasing to 3.8% in 1990 and remaining between three and eight per cent until 1995. In total, 51% of all deaths in this cohort were due to AIDS (Sanchez-Carbonell & Seus, 2000). Similarly, AIDS deaths in an Italian cohort of heroin users rose steadily from 1985-86, peaking in 1991-92 and remaining high to 1997 (Bargagli, et al., 2001). With improved access in developed countries to effective antiretroviral therapies for HIV infection, AIDS-related mortality among heroin users is declining (Manfredi, et al., 2006; Pavarin, 2008).

The contribution of AIDS to deaths among people who use heroin in developing countries is largely unknown; however, very high prevalence of HIV infection among people who inject drugs (Mathers, et al., 2008), poor access to treatment (Cook & Kanaef, 2008; UNAIDS, 2008a) and generally poorer health outcomes in comparison to developed countries are likely to combine to produce extremely elevated mortality. For example, in a recent study in Chennai, India, the all-cause crude mortality rate among a cohort of heroin and buprenorphine injectors was 43 per 1000 person-years (Solomon, et al., 2009), in comparison to 12 to 38 per 1000 person-years in Western European nations (Bargagli, et al., 2006). Despite free

availability of highly active antiretroviral treatment (HAART), none of the HIV-positive participants were receiving treatment and AIDS-related illnesses were the second leading cause of death after overdose (Solomon, et al., 2009).

As noted above, in Australia less than one per cent of people who inject drugs are HIV-infected. Consequently, the contribution of HIV infection to mortality among Australian heroin users is negligible; in 2008, of 23 reported adult deaths due to AIDS nationally, only two decedents had a history of injecting drug use (National Centre in HIV Epidemiology and Clinical Research, 2009b).

In comparison to HIV-related mortality, there has been little analysis of the contribution to HCV infection to mortality among heroin users. A Norwegian cohort study of an injecting drug user population found that 4% of deaths were due to liver disease and concluded that HCV-related disease contributes minimally to overall mortality (Kielland & Dalgard, 2008). A similar finding was reported in an Australian cohort of heroin users in treatment, with hepatitis C virus sequelae implicated in 5% of deaths (Zador & Sunjic, 2000).

Overdose-related mortality

Heroin depresses central nervous system functioning, most notably, respiration. In heroin overdose, respiration is depressed to the point where the individual finds it difficult to breathe, and may collapse and lose consciousness. In fatal cases of overdose, death is due to respiratory failure or complications that arise during unconsciousness, such as aspiration of vomit (Darke, et al., 2007a).

Only two to four per cent of heroin overdoses are fatal (Darke, et al., 2003); however, overdose events are extremely common, with around half to two-thirds of heroin users reporting a history of non-fatal overdose (Bergenstrom, et al., 2008; Darke, et al., 1996: 68%; Hakansson, et al., 2008: 55%; Warner-Smith, et al., 2002: 69%). As such, overdose accounts for a large proportion of mortality among heroin users (Darke, et al., 2007a). In an Australian cohort of heroin users seeking

treatment from 1990-1995, 44% of all deaths were due to overdose (Zador & Sunjic, 2000). In countries with high HIV prevalence among heroin users, the competing risk of death from AIDS-related illnesses means overdose deaths are less prominent, accounting for between one-quarter and one-third of mortality (Bargagli, et al., 2001; Ferri, et al., 2007; Sanchez-Carbonell & Seus, 2000; Solomon, et al., 2009).

Suicide

Heroin-using populations have elevated rates of a number of risk factors for suicide, including childhood sexual and physical abuse (Conroy, et al., 2009; Heffernan, et al., 2000; Lynskey, et al., 2006), psychiatric disorders (Darke, et al., 2007b; Mills, et al., 2008; Teesson, et al., 2005) and social isolation (Conner, et al., 2007). Accordingly, heroin users are 7-14 times more likely to die of suicide than non-heroin using peers (Bjornaas, et al., 2008; Darke & Ross, 2002; Harris & Barraclough, 1997). Among heroin-using cohorts, deaths by suicide account for between 3 and 35% of all mortality (Darke, et al., 2007a).

Criminal activity and incarceration

In addition to health-related harms, heroin dependence is associated with increased involvement in criminal activity (Bennett, et al., 2008). Purchase and use of heroin are, in themselves, offences in most countries. Heroin users also frequently engage in income-generating crimes such as theft and drug-dealing (DeBeck, et al., 2007). Among samples of heroin users entering treatment, a majority report recent criminal activity (Loebmann & Verthein, 2008, van der Zanden, 2007 #353, Davstad, 2009 #356). In Australia, 55% of a sample entering treatment for heroin dependence reported past month offending, with level of heroin use positively correlated with level of criminal activity. One-fifth of this sample reported criminal activity to be their main source of income (Ross, et al., 2005).

As a consequence of high levels of criminal activity, many heroin users experience periods of incarceration, and heroin users are over-represented among prisoner populations. In the United States, it has been conservatively estimated that

between one-quarter and one-third of all heroin dependent individuals pass through a correctional facility each year (Boutwell, et al., 2007). No similar estimates exist for Australia, but in the treatment cohort cited above, 41% reported a history of incarceration (Ross, et al., 2005). Among prisoners in New South Wales (NSW), Australia, 40% report having ever used heroin, and 10% report daily or almost daily heroin use prior to incarceration (Indig, et al., 2010); in comparison, only 0.2% of the general NSW population report heroin use in the past year (Australian Institute of Health and Welfare, 2008a).

Prisons[1] are important to the understanding and prevention of drug-related harms due to the role these institutions play in producing these harms (World Health Organization, 2005). Most importantly, prisons are associated with increased risk of blood borne viral infections (Falster, et al., 2009; Werb, et al., 2008b) and overdose mortality (Christensen, et al., 2006; Kariminia, et al., 2007c).

Blood borne viral infections in prison

Levels of HIV and HCV infection are elevated in prisons in comparison to the general community, largely as a result of the concentration of people who inject drugs among prisoner populations (Butler, et al., 2004; Dolan, et al., 2007). In the United States, where over half of prisoners report regular illicit drug use prior to incarceration (Mumola & Karberg, 2006), HIV prevalence in prisons is just under two per cent (Maruschak, 2006), in comparison to a general population prevalence of around 0.4% (Campsmith, et al., 2008). In parts of Asia, high levels of injecting drug use combine with a reliance on incarceration and 'compulsory treatment' as a response to drug use (Cohen & Amon, 2008; Human Rights Watch, 2010; Larney &

[1] In keeping with international usage, the word 'prison' is used throughout this thesis to denote any facility for the incarceration of individuals convicted of or awaiting trial for a criminal offence. The words 'prisoner' and 'inmate' are used interchangeably to refer to incarcerated individuals, whether convicted or awaiting trial.

Dolan, 2009a) to produce HIV prevalence as high as 20-50% among injecting drug users in detention (Thaisri, et al., 2003; Winarso, et al., 2006). In Australia, HIV prevalence among people entering prisons is around 0.7% (Butler & Papanatasiou, 2008), which although low, is still higher than the general population prevalence of 0.1-0.3% (National Centre in HIV Epidemiology and Clinical Research, 2009b; UNAIDS, 2008b).

In contrast to HIV, the prevalence of HCV infection among the Australian prison population is very high, with 35% of all prison receptions HCV-antibody positive in 2007 (Butler & Papanastasiou, 2008). Prevalence climbs higher when considering only inmates with a history of injecting drug use; nationally, 58% are HCV-positive, while in New South Wales, the state with the largest prison population, 68% of inmates who inject drugs have HCV infection (Butler & Papanastasiou, 2008).

Although many people who enter prison are HIV- or HCV-positive, risk behaviours within prison contribute to further transmission of these infections. People who have regularly used drugs while at liberty will often continue to do so, albeit with reduced frequency, while incarcerated (Calzavara, et al., 2003; Dolan, et al., 1996). Compared to other illicit drugs, heroin use in particular is likely to persist during periods of imprisonment; in one study, 36% of heroin users reported ongoing use during their first month in prison, compared to 11% of cocaine users and five per cent of amphetamine users (Strang, et al., 2006).

Injection of heroin in prisons has been widely reported (Calzavara, et al., 2003; Dolan, et al., 1996; Gore, et al., 1995; Strang, et al., 2006; Thaisri, et al., 2003), but lack of access to sterile needles and syringes (Jurgens, et al., 2009) means that re-use and sharing of injecting equipment is highly prevalent (Calzavara, et al., 2003; Pickering & Stimson, 1993; Small, et al., 2005). Given the pool of extant blood borne viral infections, sharing of injecting equipment can lead to transmission of these infections within prisons (Champion, et al., 2004; Christensen, et al., 2000; Dolan, et al., 2010; Dolan & Wodak, 1999; Jahani, et al., 2009; Suntharasamai, et al., 2009;

Taylor, et al., 1995). For example, in May 2002 in Alytus prison, Lithuania, 207 of 2000 inmates were diagnosed with HIV. Repeat testing was conducted one month later, identifying a further 77 cases, including 60 for whom transmission within prison was likely. In total, 300 inmates were found to be HIV positive, doubling the total number of identified HIV cases in the entire country (Caplinskiene, et al., 2003; Likatavicius, et al., 2002). In a recent Australian study, HCV incidence among continuously incarcerated injecting drug users was 34.2 per 100 person years, demonstrating that intra-prison HCV transmission plays a significant role in sustaining the HCV epidemic among injecting drug users (Dolan, et al., 2010).

Post-release mortality

Prisoners and ex-prisoners have a higher relative risk of death than their never-incarcerated peers (Binswanger, et al., 2007; Kariminia, et al., 2007a). In New South Wales, Australia, male prisoners and ex-prisoners are four times, and female prisoners/ex-prisoners eight times, more likely to die than non-incarcerated individuals of the same age (Kariminia, et al., 2007a). Elevated mortality is seen across the range of causes of death, but drug-related, accidental and suicide deaths are particularly over-represented in prisoner populations (Binswanger, et al., 2007; Farrell & Marsden, 2007; Kariminia, et al., 2007a; Rosen, et al., 2008), as they are in heroin users (Darke, et al., 2007a).

The elevated risk of death among prisoners varies over time and is particularly extreme during the period immediately after release from prison (Binswanger, et al., 2007; Bird & Hutchinson, 2003; Farrell & Marsden, 2007; Hobbs, et al., 2006; Kariminia, et al., 2007b; Rosen, et al., 2008). For example, in Washington, USA, the overall risk of death for individuals with a history of incarceration was 3.5 times that of never-incarcerated persons; however, in the two weeks following release from prison, risk of death from any cause was 13 times that of never-incarcerated persons (Binswanger, et al., 2007).

The two primary causes of death during the weeks after release from prison are suicide (Binswanger, et al., 2007; Kariminia, et al., 2007c; Pratt, et al., 2006) and drug, largely heroin or other opioid, overdose (Binswanger, et al., 2007; Bird & Hutchinson, 2003; Christensen, et al., 2006; Farrell & Marsden, 2007; Kariminia, et al., 2007c). It has been postulated that the increased risk of suicide at this time is a result of social isolation and lack of support in meeting the many challenges of returning to the community from prison; in many cases, these difficulties would be compounded by existing psychiatric illness (Kariminia, et al., 2007c; Pratt, et al., 2006). In the case of drug overdose, reduced frequency and dose of heroin use while in prison results in reduced opioid tolerance; it is generally assumed (although difficult to test empirically) that this is the reason for the increased risk of overdose in the event of post-release heroin use (Wakeman, et al., 2009). In large studies in the UK and Denmark, over 90% of mortality among prisoners in the two weeks post-release was a result of overdose (Christensen, et al., 2006; Farrell & Marsden, 2007). In an Australian cohort of prisoners, the risk of fatal overdose in the immediate post-release period was nine times that at six months post-release (Kariminia, et al., 2007c); several other studies have reported similar findings (Bird & Hutchinson, 2003; Odegard, et al., 2010).

Opioid substitution treatment for heroin dependence

Opioid substitution treatment (OST) is a thoroughly evaluated and well established treatment for heroin dependence that involves long-term, regular consumption of a long-acting opioid agonist[2] medication. OST was first formally described in the

[2] An agonist is a chemical that binds to a receptor cell in the brain, activating a response. Thus, an opioid agonist, such as methadone or heroin, activates the brain's opioid receptors, producing effects such as euphoria, sedation, analgesia and respiratory depression (Kreek, 1997, 2000; Stimmel & Kreek, 2000).

literature in the 1960s by two physicians, Drs. Dole and Nyswander. They reasoned that a heroin dependent person is unable to cease heroin use because withdrawal from the drug causes physiological and psychological distress; in their efforts to avoid withdrawal, the individual's life is dominated by drug seeking and consumption. Provision of long-acting, slow-onset opioid medications at high or 'blockade' doses would relieve heroin withdrawal symptoms and cravings, thereby reducing the need for heroin and activities associated with its procurement (Dole & Nyswander, 1965, 1967; Kreek, 2000). Crucial to Dole and Nyswander's treatment model was their conceptualisation of treatment success and the long-term nature of treatment. The most important treatment outcome was not abstinence from opioids, but improved social functioning of the patient (Dole & Nyswander, 1967). The time taken to achieve this outcome varied (Dole & Nyswander, 1965); hence, there was no reason to arbitrarily limit the duration of treatment. Rather, treatment was to be ongoing so as to maintain gains in social functioning and reduce the risk of relapse to heroin use (Dole, et al., 1968; Newman, 1995).

Methadone, a synthetic opioid with effects lasting 24-36 hours (Gordon, et al., 2009), was the medication first used for substitution treatment (Dole & Nyswander, 1965; Dole, et al., 1968). Other opioid agonists, particularly buprenorphine (a partial opioid agonist), have also been investigated for their potential in the treatment of heroin dependence, with similarly promising results (Anglin, et al., 2007; Ling, et al., 1998; Mattick, et al., 2008). Diamorphine, or pharmaceutical heroin, is available in a limited number of countries as a second-line substitution treatment for individuals who do not respond to treatment with methadone or buprenorphine (Lintzeris, 2009). In the absence of a universally accepted term that encompasses these various medications, this thesis adopts the term 'opioid substitution treatment' to refer to all treatments for heroin dependence that follow the Dole & Nyswander model of provision of an opioid agonist over an extended period.

Effectiveness of opioid substitution treatment

In the first clinical trial of opioid substitution treatment, long-term heroin users were provided with a daily dose of methadone, and participants showed increased employment and decreases in criminal behaviour (Dole & Nyswander, 1965, 1967). In the intervening decades, there have been dozens of studies of methadone maintenance, with the evidence overwhelmingly supporting this treatment approach (Ward, et al., 2009). Studies have examined the efficacy of OST in terms of reducing heroin use, as well as a range of outcomes related to the health and social consequences of heroin dependence, including blood borne virus transmission, criminality and mortality. The literature reviewed below focuses on OST using methadone or buprenorphine, as these are the forms of treatment available in Australia.

Heroin use

Significant reductions in heroin use have been reported in dozens of studies of the various forms of OST (e.g., Dolan, et al., 2003; Fudala, et al., 2003; Gruber, et al., 2008; Kakko, et al., 2003; Kinlock, et al., 2009; Ling, et al., 1998). Systematic reviews of the literature have concluded that OST using adequate doses of methadone or buprenorphine reduces heroin use more effectively than placebos or non-pharmacological treatments, with methadone somewhat more effective than buprenorphine (Mattick, et al., 2009; Mattick, et al., 2008).

HIV and hepatitis C virus risk behaviours and transmission

A corollary of reduced heroin use while in OST is reduced HIV and hepatitis C virus risk behaviours, such as sharing of needles and syringes (Millson, et al., 2007). A systematic review of the effect of OST on HIV risk behaviours and transmission concluded that OST significantly reduces needle and syringe sharing , and that this translates to a reduced rate of HIV seroconversion among heroin users in OST (Gowing, et al., 2008). For example, in one study with an 18-month follow-up

period, participants receiving no or limited OST became infected with HIV at more than three times the rate of those in continuous OST (Metzger, et al., 1993).

OST is of less utility in preventing hepatitis C virus infection. With high background prevalence and low risk awareness among new injectors, HCV infection is typically acquired within months of initiation to injecting drug use (Maher, et al., 2006; Maher, et al., 2007). Thus, there is a high prevalence of HCV among individuals seeking OST, leaving limited opportunities for HCV prevention through OST. There have been several studies that have found no statistically significant difference in HCV incidence between those in OST and those not (Chamot, et al., 1992; Crofts, et al., 1997; Selvey, et al., 1997). However, one study has reported that HCV incidence was lower in those receiving continuous, as opposed to interrupted, OST (Hallinan, et al., 2004). Another study reported that HCV incidence was reduced only when participants engaged with both needle and syringe programs and OST (Van Den Berg, et al., 2007). These latter two findings suggest the need for further analysis of the specific conditions under which OST may be protective against HCV infection.

Criminality and incarceration

Studies of the relationship between OST and criminal activity have produced conflicting results. An analysis of offending records of people who had received OST in New South Wales found significantly lower rates of criminal charges during treatment compared to periods out of treatment (Lind, et al., 2005). There have also been a number of studies of self-reported offending that identified reduced criminal activity during periods of OST (Digiusto, et al., 2006b; Hser, et al., 1988; Pang, et al., 2007; Sheerin, et al., 2004). In contrast to these findings, Best *et al*. (2001) reported that there was no clear relationship between being in methadone maintenance treatment (MMT) and level of offending in their sample of treatment-seeking heroin users. In a systematic review of the effectiveness of MMT, the authors concluded that although criminal activity was reduced during treatment, there was no statistically significant advantage of treatment over control conditions

(Mattick, et al., 2009). Finally, recent studies suggest that OST does reduce offending, but only when individuals remain in treatment continuously over a period of many months (Deck, et al., 2009; Oliver, et al., 2010).

Results relating to the effect of OST on incarceration have been more consistent than those for offending, although this may be related to the small number of studies examining this outcome. Two recent studies of Canadian injecting drug users found reductions of one-quarter to almost one-half in risk of incarceration among IDU who were in OST, compared to those not in treatment (Milloy, et al., 2008; Werb, et al., 2008a). In the United Kingdom, a small retrospective study of OST clients receiving treatment in a general practice setting found that participants spent significantly less time in prison after commencing treatment (Keen, et al., 2000); this finding was replicated with a prospective study design that followed OST clients in general practice for five years (Oliver, et al., 2010).

Mortality

In comparison to untreated heroin users, individuals in OST have significantly reduced mortality. In a study of 40,000 individuals receiving OST in Australia, risk of death was halved for periods in treatment compared to out of treatment (Degenhardt, et al., 2009c); a similar level of risk reduction was identified in a Norwegian cohort (Clausen, et al., 2008). Another large cohort study found a dose-response relationship between treatment exposure and survival times, with each year of treatment corresponding to a 10% reduction in probability of dying (Kimber, et al., 2010). Reductions in mortality while in treatment are greatest for drug-related, accidental and suicide deaths; reductions in these types of deaths are thought to reflect reduced engagement in the chaotic and risky lifestyle of an active heroin user (Degenhardt, et al., 2009c).

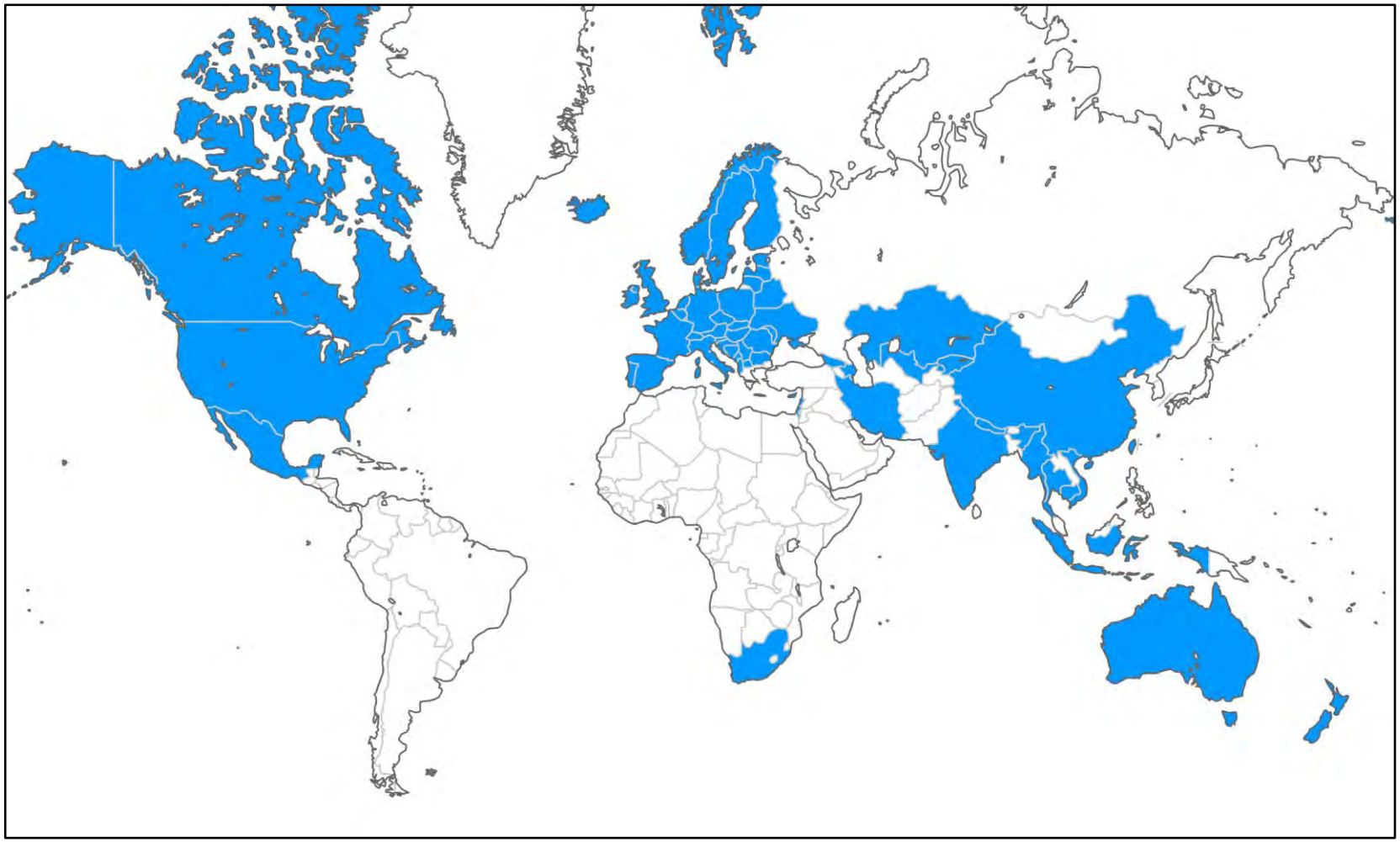
Global implementation of opioid substitution treatment

As of 2010, of the 151 countries globally in which injecting drug use has been reported, some form of OST was available in only 66 (International Harm Reduction

Association, 2010) (Figure 1.1), and it has been estimated that only eight of every 100 injecting drug users is in OST (Mathers, et al., 2010).[3] Even in countries that have OST programs, access may be restricted by geographic factors such as low numbers of dispensing sites located only in major cities (Cook & Kanaef, 2008; Mathers, et al., 2010). Restrictive treatment entry criteria are often reported; for example, in China, clients wishing to enter OST must be over 20 years of age and have previous unsuccessful attempts at abstinence (Philbin & Zhang, 2010), while in Croatia, OST clients must be aged over 25 and have a 10-year history of drug use, including at least 5 years of heroin use (Carrieri, et al., 2006). Beyond program factors, heroin users may be reluctant to attend OST programs due to fear of arrest, with law enforcement officers known to target OST clinics as places where they can easily identify drug users (Cook & Kanaef, 2008; Philbin & Zhang, 2010). Additionally, OST clinics may be avoided due to the potential of being identified by the wider community as a drug user, or discrimination and judgement on the part of clinic staff (Cook & Kanaef, 2008).

[3] The data required to estimate the number or proportion of heroin or opioid users (as opposed to injecting drug users generally) who are in OST, such as estimates of the size of heroin/opioid using populations, are largely unavailable (Mathers, et al., 2010)

Figure 1.1: Global implementation of opioid substitution treatment



Shaded countries and territories offer OST from at least one site. Data from International Harm Reduction Association (2010). *Global State of Harm Reduction 2010*. London: International Harm Reduction Association. Countries and territories with OST are listed in Appendix A.

The poor coverage of OST programs has major implications for HIV epidemics, with modelling studies showing that increased OST coverage could avert significant numbers of new HIV infections. For example, it has been estimated that if 60% of injecting drug users in Karachi, Pakistan, were given OST, the number of new HIV infections to 2015 could be reduced by 28%; similar actions in Odessa, Ukraine, would reduce the number of new infections by 10% (Strathdee, et al., 2010).

Opioid substitution treatment in Australia

Opioid substitution treatment is available in all Australian states and territories. The first use of OST in Australia was in Sydney, New South Wales (NSW), in 1970. Methadone maintenance was prescribed as part of a residential treatment program, with prescribing continuing after inpatient treatment ceased (Caplehorn & Batey, 1992). Throughout the 1970s and early 1980s, methadone maintenance remained a minor component of the drug treatment system in Australia (Caplehorn & Batey, 1992; Ritter & Chalmers, 2009). In 1986, the federal government initiated the National Campaign Against Drug Abuse and significant funding was provided to increase the number and capacity of methadone maintenance programs (Wodak, 1992). The number of patients in methadone treatment increased rapidly (Caplehorn & Batey, 1992; Wodak, 1992), likely contributing (along with the early and widespread introduction of needle and syringe programs) to the low HIV prevalence among Australian injecting drug users (Wodak & Lurie, 1997).

To 2000, methadone was the only medication used for OST. Buprenorphine[4] was formally licensed for use in OST programs in 2000 (NSW Health Department, 2001),

[4] Buprenorphine is a partial opioid agonist; if both a full opioid agonist (e.g. heroin, methadone) and a partial opioid agonist are present at an opioid receptor site, the partial agonist will act to decrease receptor activation. Furthermore, unlike methadone, increasing a buprenorphine dose does not increase respiratory depression. As such, buprenorphine is considered to have lower overdose potential than methadone (Auriacombe, et al., 2001; Bell, et al., 2009).

and in 2005, buprenorphine-naloxone[5] was added to the armamentarium of substitution medications used in the treatment of heroin dependence in Australia (Ritter & Chalmers, 2009). In 2009, there were 43,445 clients in Australian OST programs; around two-thirds were being treated with methadone, with the remainder split between buprenorphine and buprenorphine-naloxone (Australian Institute of Health and Welfare, 2010b). Australia lacks a formal system for assessing demand for OST, but is has been suggested that there may be between 10,000 and 30,000 heroin users who would enter treatment if sufficient places were available (Ritter & Chalmers, 2009).

Summary

This introductory chapter has described some of the harms associated with heroin use and dependence, most notably:

- The risk of infection with blood borne viruses such as HIV and hepatitis C virus as a result of sharing equipment used to inject drugs;
- The elevated risk of death, particularly as a result of the above-named blood borne viral infections, drug overdose and suicide; and
- The likelihood of criminal activity and subsequent incarceration, which potentially exacerbates the above risks.

[5] Naloxone is an opioid antagonist, meaning that it binds to the brain's opioid receptors, but does not trigger a response in itself; rather, it interferes with the action of opioid agonists. Buprenorphine-naloxone was designed to limit diversion to the black market. When taken sublingually (i.e. as indicated), its effects are as for buprenorphine; however, when injected by a person dependent on a full opioid agonist (e.g. heroin or methadone) who is not currently in opioid withdrawal, the medication precipitates an aversive withdrawal syndrome (Bell, et al., 2004; Degenhardt, et al., 2009a) .

The second half of the chapter outlined the evidence relating to the effectiveness of opioid substitution treatment in reducing these harms. Opioid substitution treatment:

- Significantly reduces heroin use, providing adequate doses of the substitute medication are prescribed;
- Significantly reduces injecting-related blood borne virus risk behaviours, which appears to translate to reduced HIV transmission;
- Potentially reduces criminal activity, as long as participants remain in treatment for an adequate length of time, and significantly reduces risk of incarceration; and
- Significantly reduces the risk of death.

Despite the strong evidence supporting OST as an effective method for reducing harms associated with heroin dependence, there are major issues of treatment coverage internationally and potentially, within Australia also. The provision of OST among prisoner populations has not been examined in this chapter. Given the high prevalence of incarceration among people who use heroin, the following chapter considers the rationales for and against OST in prisons, and examines the extent to which OST has been implemented in prisons internationally and in Australia.

2. Opioid substitution treatment in prisons[6]

As described in Chapter 1, incarceration is a common event among people who use heroin (Boutwell, et al., 2007; DeBeck, et al., 2009; Ross, et al., 2005; Werb, et al., 2008a), and heroin users comprise a substantial proportion of prisoner populations (Indig, et al., 2010; Mumola & Karberg, 2006). Incarceration is associated with a number of negative outcomes, including transmission of blood borne viral infections (Dolan, et al., 2010; Dolan & Wodak, 1999) and increased mortality risk after release from prison (Binswanger, et al., 2007; Farrell & Marsden, 2007; Kariminia, et al., 2007b). Incarceration is also associated with more general social harms such as dislocation from family and community, and reduced employability (Graffam, et al., 2008; Halsey, 2007; Pettit & Lyons, 2009). Despite this, incarceration can also be seen as an opportunity to offer treatment for heroin dependence in an effort to obviate further harms while in prison and post-release (Boutwell, et al., 2007).

Rationales for opioid substitution treatment in prison

Four main arguments have been advanced supporting the provision of opioid substitution treatment (OST) in prison, encompassing human rights, public health and crime-reduction rationales.

Equivalence of care

Under multiple international covenants and legal instruments, incarcerated persons are entitled to health services equivalent to those available to the general community within their country. For example, the United Nations Basic Principles for the Treatment of Prisoners note that "prisoners shall have access to the health services available in the country without discrimination on the grounds of their legal

[6] Some of the material in this chapter has been published as Larney, S., & Dolan, K. (2009). *European Addiction Research*, *15*, 107-112.

situation (United Nations General Assembly, 1990), and the United Nations Committee on Economic, Social and Cultural Rights has affirmed that states are obliged to refrain from "denying or limiting equal access to all persons, including prisoners or detainees…to preventive, curative and palliative health services" (United Nations Committee on Economic Social and Cultural Rights, 2000). Hence, countries treating heroin dependence with OST in community settings are obliged to make this treatment available to prisoners (Hall, et al., 1994).[7]

Prevention of HIV transmission

As noted in Chapter 1, OST in community settings reduces injecting-related HIV risk behaviours, which results in reduced HIV incidence among heroin users in treatment (Gowing, et al., 2008; Metzger, et al., 1993). It is argued that providing OST in prisons will similarly reduce risk behaviours such as injecting drug use and sharing of needles and syringes (Dolan, et al., 1998a; UNODC/WHO/UNAIDS, 2006). There is some evidence that this is indeed the case (Dolan, et al., 2003; Larney, 2010); this evidence will be examined in greater detail in Chapter 3.

Reductions in post-release crime and re-incarceration

Upon leaving prison, heroin-using inmates rapidly re-commence frequent heroin consumption (DeBeck, et al., 2009; Dolan, et al., 1996), and hence, are likely to commit further offences and be re-incarcerated. Providing OST in prison to treat heroin dependence can potentially reduce post-release relapse to regular drug use, and therefore reduce re-offending and subsequent incarceration. There have been conflicting findings regarding this proposition (Dolan, et al., 2005; Kinlock, et al.,

[7] Some authors have argued that, given the extremely poor health of prisoner populations, 'equivalence of care' is an insufficient standard of care. Rather, emphasis should be placed on equivalence of objectives; that is, improving prisoner health to the same standard as that of the community at large (Lines, 2006).

2009; Marzo, et al., 2009; McMillan, et al., 2008), which will be considered in greater detail in Chapter 4.

Reductions in post-release mortality

While in prison, an inmate's opioid tolerance decreases markedly as a result of abstinence or greatly reduced heroin use (Wakeman, et al., 2009). Thus, the risk of overdose is greatly increased should the inmate use heroin after release from prison (Bird & Hutchinson, 2003; Farrell & Marsden, 2007). It has been proposed that providing OST in prisons may assist in reducing the risk of post-release overdose by maintaining opioid tolerance in heroin-using inmates (Christensen, et al., 2006). This rationale has received limited attention in the literature, as will be shown in Chapter 4.

Arguments against opioid substitution treatment in prisons

Despite its endorsement by international bodies such as the World Health Organization (World Health Organization, 2007, 2009), there often remains a reluctance among correctional authorities to implement OST in prisons. There is some evidence that this stems from a philosophical position that methadone and buprenorphine are no different from illicit heroin and that abstinence from all opioids – even medically prescribed opioids – is the only legitimate outcome of treatment for heroin dependence (Alberti & Cowie, 2001; Boucher, 2003; Gjersing, et al., 2007). OST is conceptualised by its opponents as "facilitating addiction", whereas prisons are perceived as sites of opportunity to achieve abstinence (Nunn, et al., 2009); this is despite the evidence that many heroin users continue to use heroin while in prison (Calzavara, et al., 2003; Dolan, et al., 1996; Strang, et al., 2006), and that incarceration is negatively associated with cessation of drug use (DeBeck, et al., 2009; Kimber, et al., 2010). Opposition to prison OST comes not only from correctional authorities (Alberti & Cowie, 2001; McMillan & Lapham, 2005); negative attitudes towards OST and a preference for abstinence-based treatment

services have also been reported among prison healthcare staff (Gjersing, et al., 2007; Nunn, et al., 2009).

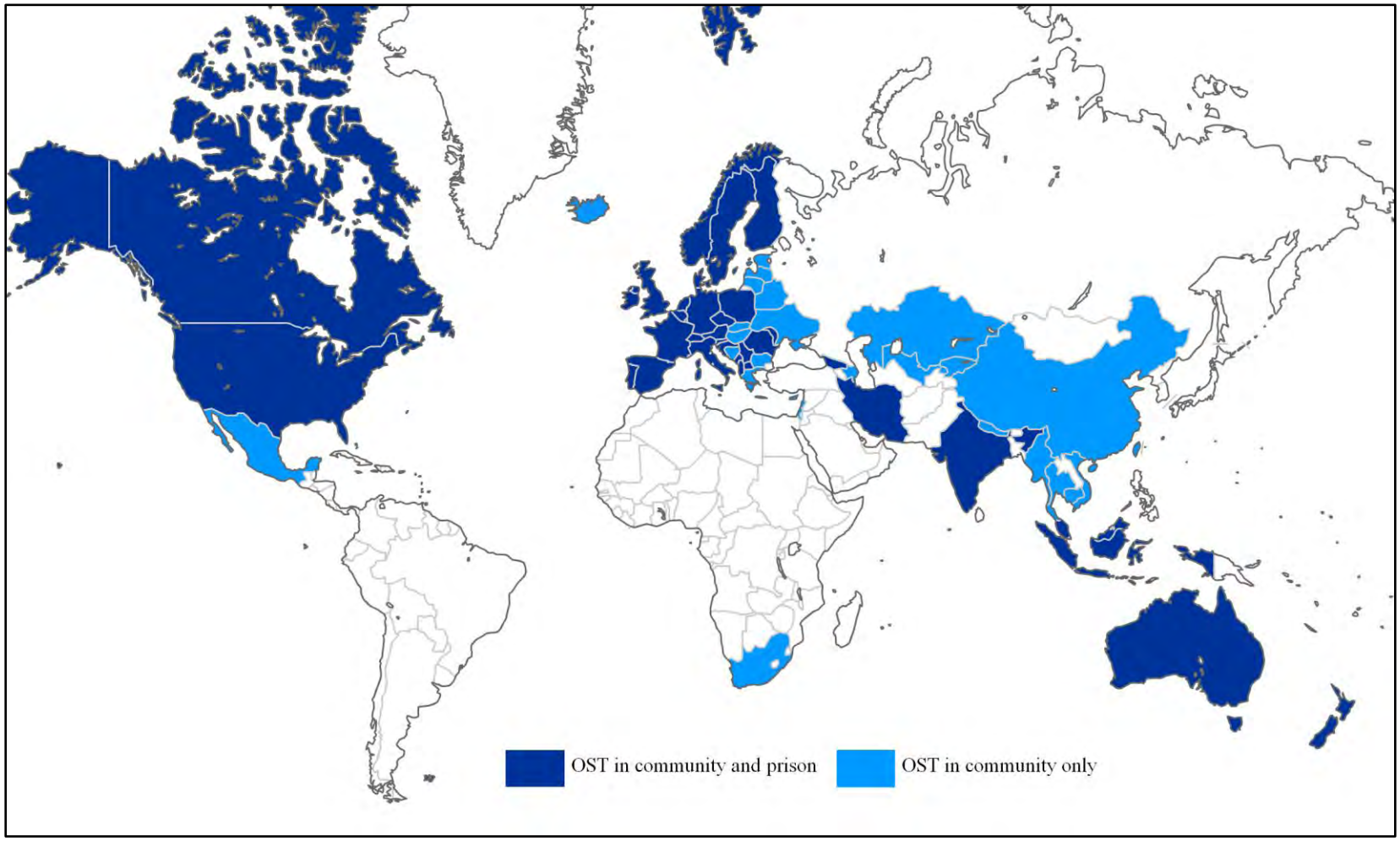
Beyond philosophical objections, there are potential safety concerns associated with the provision of OST in prisons, just as there are in community settings. Concern generally centres around the potential for violence and 'standover' tactics to force inmates receiving OST to provide their medications to other inmates, or the voluntary diversion of medication to other inmates in exchange for money or goods (Alberti & Cowie, 2001; Hume & Gorta, 1988; Nunn, et al., 2009). Several studies have examined this issue, finding that when programs are appropriately resourced and consumption of medications is supervised, diversion occurs infrequently (Alberti & Cowie, 2001; Gorta, 1987; Magura, et al., 1993; Wale & Gorta, 1987b). The fact that diversion may occur does not negate the potential benefits of prison OST programs; should diversion of medication be detected, it can be addressed as in community-based OST programs, for example, through discussion with the inmate to identify motivations for diversion, closer supervision of dosing and, if necessary, cessation of treatment for that individual (Alberti & Cowie, 2001).

Global implementation of prison OST

The first experimental use of methadone maintenance treatment (MMT) in prisons, in New York, was documented in 1969 (Dole, et al., 1969). In Australia, the first use of MMT in prisons was in New South Wales in 1986. Inmates with a history of heroin dependence were eligible to receive treatment in the three to four months prior to release (Wale & Gorta, 1987a). An international review published in 1996 identified only five countries in which opioid substitution treatment was provided in prisons: Australia; the United States (in New York only); Denmark (commencing in 1988); Switzerland (1989); and Spain (1992) (Dolan & Wodak, 1996; Nelles, et al., 1998; Stover, et al., 2004).

With the recognition of prisons as potential sites for HIV transmission, the number of correctional jurisdictions offering OST to heroin-dependent inmates rapidly expanded in the late 1990s, particularly in Western Europe (Stover, et al., 2004). By 2010, OST was available in prisons in at least 37 countries (Figure 2.1). However, as noted in Chapter 1, there are 66 countries that provide OST in community settings; hence, there are at least 29 countries that offer OST in the community, but not in prison, in breach of the basic right of prisoners to have access to healthcare equivalent to that available to the community at large.

Figure 2.1: Availability of prison OST in countries with community OST



N.B. Countries with OST in at least one prison. Data from International Harm Reduction Association (2010). *Global State of Harm Reduction 2010.* London: International Harm Reduction Association. Countries and territories with prison OST are listed in Appendix A.

Although the provision of OST in prisons is now more widespread (Dolan & Wodak, 1996; Larney & Dolan, 2009b), there are still significant issues in relation to the extent to treatment coverage. Many prison OST programs operate as pilot programs, open only to small numbers of inmates in one or two of a country's correctional institutions (Larney & Dolan, 2009b). This is particularly the case in developing countries (Cook & Kanaef, 2008; Larney & Dolan, 2009b). Where prison OST programs are available, program entry may be restricted to inmates who had been in OST immediately prior to incarceration, or to those with short sentences (Larney & Dolan, 2009b; Stevens, et al., 2010). There are also often jurisdictional differences within a country, such that inmates in one jurisdiction can access OST, but their peers elsewhere cannot (Nunn, et al., 2009; Stover, et al., 2004). Provision of treatment within an institution may even rely on the preferences and initiative of individual physicians (European Monitoring Centre for Drugs and Drug Addiction, 2009). Such restrictions and jurisdictional differences contribute to inequality in access to healthcare while in prison (Larney & Dolan, 2009b).

Although it is clear that coverage is poor in many countries (Larney & Dolan, 2009b), reliable data on the number of inmates receiving OST are scarce. A search of the literature identified recent (2007 onwards) point-prevalence figures for only 16 countries (Table 2.1). The data in Table 2.1 show that while some countries provide OST to upwards of 10% of inmates at any one time, others operate on an extremely limited basis, with treatment provided to less than 1%, or even less than 0.1%, of inmates. It is acknowledged that it would be more appropriate to compare the number of prisoners in OST to the number of prisoners with a history of heroin use or dependence, but such data are rarely available. Despite this limitation, the figures in Table 2.1 demonstrate that in many countries, it is unlikely that the level of treatment coverage is meeting demand. For example, in the United States, six percent of Federal prisoners reported regular heroin use in the month prior to incarceration (Mumola &

Karberg, 2006); yet less than 0.1% of Federal prisoners are in receipt of OST (Nunn, et al., 2009). Furthermore, one rationale for prison OST is to reduce injecting drug use, and hence reduce HIV transmission among prisoners (Dolan, et al., 1998a). It is unlikely that population-level results such as reduced HIV transmission can be achieved with so few inmates receiving treatment (Larney & Dolan, 2009b).

Table 2.1: Number of prisoners in OST, by country

Country	Number of prisoners receiving OST (year)*	% of all prisoners receiving OST^
Scotland	1605 (2009)	20
Iran	25407 (2009)	15
Ireland	509 (2007)	15
Denmark	450 (2008)	13
Spain	7769 (2008)	12
Australia	3328 (2009)	11
Austria	772 (2007)	9
France	3653 (2007)	6
Italy	1759 (2007)	4
Albania	10 (2007)	<1
New Zealand	60 (2007)	<1
Moldova	27 (2008)	<1
Montenegro	5 (2008)	<1
India	35 (2009)	<0.1
Serbia	10 (2008)	<0.1
United States	1671-1967 (2008)#	<0.1

References given in Appendix A. *Reported only for countries where it was clear in the source material that the number referred to inmates in OST on a specific day rather than annual throughput. ^Calculated using prison population figures from the International Centre for Prison Studies (http://www.kcl.ac.uk/depsta/law/research/icps/). The prison population for the year of the 'numbers in OST' figure was used for the calculation. #Inmates in federal institutions only.

Opioid substitution treatment in Australian prisons

Opioid substitution treatment is available in prisons in all Australian states and territories. 'Snapshot' figures of OST participation show that in 2009, there were 3,328 people receiving OST in Australian correctional facilities (Australian Institute of Health and Welfare, 2010b). This was around 11% of all people in prison, and 8% of all people in OST (Australian Bureau of Statistics, 2009c;

Australian Institute of Health and Welfare, 2010b). As shown in Table 2.2, all jurisdictions permit inmates to continue OST if they were enrolled in treatment immediately prior to incarceration, except for Queensland, which only allows female inmates to continue treatment. Three jurisdictions do not permit initiation of OST in prison (Table 2.2); these jurisdictions are also those with the smallest proportions of inmates in OST.

Table 2.2: Number of inmates receiving OST in Australian prisons, 2009, by jurisdiction

	OST availability[1]		n receiving prison OST[2]	% of all OST clients[2]	% of all prisoners[3]
	Continuing	Initiation			
New South Wales	✓	✓	1948	10.9	17.5
Victoria	✓	✓	728	5.8	16.7
Queensland	✓ (females only)	x	34	0.7	0.6
Western Australia	✓	✓	305	9.6	6.9
South Australia	✓	✓	255	8.1	13.0
Tasmania	✓	x	5	0.8	0.9
Aust. Capital Territory	✓	✓	51	6.4	25.1
Northern Territory	✓	x	2	1.7	0.2
Total			**3328**	**7.7**	**11.4**

[1]Australian Institute of Health and Welfare (2010a). [2] Australian Institute of Health and Welfare (2010b).
[3]Australian Bureau of Statistics (2009c).

The New South Wales prison OST program

The studies presented in chapters 6-9 utilise data from inmates enrolled in the New South Wales (NSW) prison OST program. The following provides context to these studies by describing the development of the NSW prison OST program.

Prior to 1986, OST (in the form of methadone maintenance) was only available in NSW prisons to remand[8] prisoners or those with sentences of less than six months who had been on OST prior to reception to prison. Prisoners with sentences of greater than six months who had been in treatment at entry to prison were required to withdraw from methadone over a three-week period. It was not possible to enter treatment while in prison (Gorta, 1992).

In 1986, a pilot, pre-release methadone maintenance program commenced in New South Wales prisons. The program was open to inmates with a history of heroin dependence who were within 12 to 16 weeks of release prison. Six aims for the program were specified:

> "The goal of methadone use, as with other treatment programs for drug abuse is to contribute towards:
>
> 1. Improving levels of social/behavioural functioning
>
> 2. An option which provides for the management of persons in custody
>
> 3. The stabilisation of persons on methadone prior to their release; the transition to a community based program and support services
>
> 4. Reducing involvement in criminal activities
>
> 5. Limiting the spread of drug use with the ultimate objective of a drug-free lifestyle

[8] Remand prisoners are those who have been charged with, but not yet found guilty, of a criminal offence.

6. Reducing morbidity and mortality."

- (unpublished policy document, c. 1986, cited in Gorta, 1992)

Examining these aims, it is notable that although morbidity and mortality are mentioned, there is no specific reference to HIV. This reflects the times; as the then director of prison medical services noted in his account of the development of the program, initial approval for prison methadone had been granted to allow examination of its effects on recidivism. Although HIV was recognised as an issue affecting injecting drug users, there was not yet widespread understanding of the role of prisons in HIV transmission (McLeod, 1990).

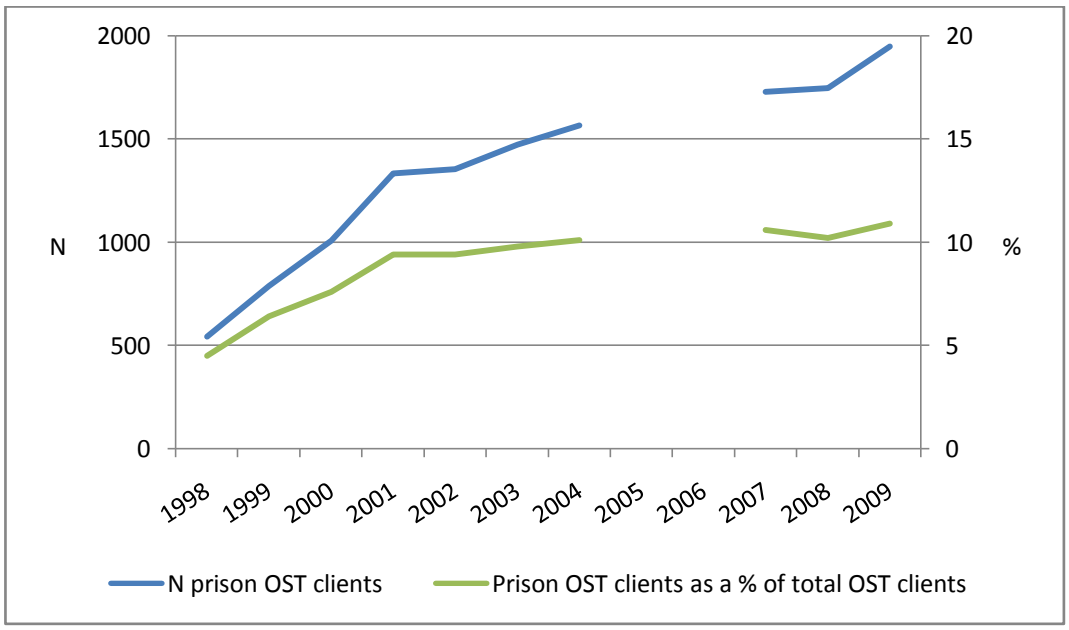
This situation changed rapidly. Following budget increases in 1987, the pre-release program was expanded to include long-term inmates, inmates with HIV or hepatitis B virus infection, and inmates at risk of infection due to needle and syringe sharing while in prison. The changes in program functioning were accompanied by a shift in program objectives, with prevention of HIV transmission becoming a stated aim of the prison methadone program (Gorta, 1992).

The program has largely continued under this model, with a shift in responsibility in 1990 from a joint Department of Corrective Services/Department of Health program, to being solely the responsibility of the Prison Medical Service (now Justice Health), a unit of the Department of Health. Buprenorphine maintenance treatment became available in NSW prisons in 2001, in line with its introduction in community OST programs (NSW Health Department, 2001). Under the current NSW opioid substitution treatment guidelines, all persons seeking treatment are assessed without regard to their legal status. Thus, if clinically indicated, people may commence OST in prison, and people entering prison while in OST will have their treatment continued. Inmates in OST at release from prison are to be

referred to community-based OST services to maintain continuity of care (NSW Health Department, 2006b).

As shown in Figure 2.2, the number of NSW inmates receiving OST has increased substantially over the last decade, from just over 500 in 1998 (NSW Health Department, 2006c), or around seven per cent of the prisoner population (Mariasson & Eyland, 2000), to 1,948 inmates, or 17.5% of the population, in 2009 (Australian Bureau of Statistics, 2009c; Australian Institute of Health and Welfare, 2010b). Figure 2.2 also shows the increasing importance of prisons in the overall OST system, with the proportion of OST clients receiving treatment in prison increasing from five per cent in 1998 to 11% in 2009 (Australian Bureau of Statistics, 2009c; Australian Institute of Health and Welfare, 2010b).

Figure 2.2: Number of prison OST clients, and prison OST clients as a percentage of total OST clients, New South Wales, 1998-2009



Data for 1998-2004 from NSW Health Department (2006c). Data for 2005-2006 not available. Data for 2007-2009 from Australian Institute of Health and Welfare (2008b, 2009, 2010b)

Summary

This chapter has considered the rationales for providing opioid substitution treatment in prison, including:

- The obligation of correctional authorities to provide healthcare equivalent to that available in the community;
- The potential for prison OST to reduce HIV transmission by reducing injecting drug use;
- The potential for prison OST to reduce post-release offending and re-incarceration; and
- The potential for prison OST to reduce the risk of post-release drug overdose by maintaining an individual's opioid tolerance.

This chapter also outlined the use of OST in prisons globally, and within Australia, with particular attention given to the prison OST program in New South Wales. This is one of the longest running prison OST programs in the world, and the empirical studies presented in Chapters 6-9 make use of data from this program.

The following two chapters move on from describing the use of OST in prison to considering the existing research evidence for this treatment approach. Chapter 3 considers the effect of prison OST on drug use and injecting-related risk behaviours while in prison, while Chapter 4 reviews the evidence regarding effects of prison OST on post-release outcomes; namely, re-offending, re-incarceration and mortality.

3. Systematic review of in-prison outcomes of opioid substitution treatment[9]

Abstract

Aim: To assess if prison-based opioid substitution treatment reduces heroin use, injecting drug use, needle and syringe sharing and HIV/hepatitis C virus (HCV) incidence.

Method: Systematic review of the published and unpublished literature, following Cochrane Collaboration guidelines.

Results: Only five studies were identified for inclusion in the review. Issues of bias in included studies, such as low levels of follow-up, were noted. There was good evidence that prison OST reduces heroin use, injecting drug use and needle and syringe sharing in prisons. No studies have directly shown that participation in prison OST significantly reduces HIV or HCV infection.

Conclusion: Although it has not been shown that prison OST reduces HIV and/or HCV transmission, reductions in injecting drug use and needle and syringe sharing while in treatment may potentially reduce HIV/HCV transmission. OST should be a part of comprehensive HIV prevention programs in prisons.

[9] A version of this chapter has been published as: Larney, S. (2010). Does opioid substitution treatment in prisons reduce injecting-related HIV risk behaviours? A systematic review. *Addiction, 105,* 216-223.

Introduction

As noted in Chapter 1, people who use heroin will often continue to do so while incarcerated (Calzavara, et al., 2003; Strang, et al., 2006; Thaisri, et al., 2003). Limited implementation of needle and syringe programs in prisons (Jurgens, et al., 2009) means that the majority of injecting drug use while incarcerated involves sharing needles and syringes (Darke, et al., 1998; Indig, et al., 2010; Pickering & Stimson, 1993; Small, et al., 2005). With high background prevalence of blood-borne viral infections among injecting drug users in prisons, needle and syringe sharing inevitably leads to intra-prison transmission of HIV (Dolan, et al., 1994; Jahani, et al., 2009; Taylor, et al., 1995) and hepatitis C virus (HCV) (Dolan, et al., 2010).

The World Health Organization recommends that opioid substitution treatment (OST) be made available in prisons and other correctional settings to treat heroin and other opioid dependence (World Health Organization, 2009). This recommendation is based on the finding that OST in community settings reduces HIV risk behaviours, such as injecting drug use and sharing of needles and syringes, and in doing so helps to reduce HIV transmission among people who inject drugs (Gowing, et al., 2008). The rationale presented by WHO makes a key assumption: that the protective effects of OST in the community will be mirrored in prisons. However, this may not be the case. In community settings, people in OST who continue to inject drugs can usually access sterile needles and syringes to do so; this is not the case for most people in prisons (Jurgens, et al., 2009). Hence, compared to a community-based peer, ongoing injecting drug use while in OST carries a higher risk of HIV or HCV infection for a prison inmate.

There has been limited assessment of whether OST affects blood borne virus transmission in prisons. One literature review reported that OST reduced the frequency of drug injecting in prison (Jurgens, et al., 2009). However, this review did not consider if OST had differential effects on heroin use as compared to

other drug use; neither did it report the effect of OST on sharing injecting equipment, which is the behaviour of concern in HIV and HCV transmission.

Aims

The aim of this chapter is to assess whether prison OST reduces the following:

a) Heroin use;
b) Injecting drug use;
c) Needle and syringe sharing; and
d) HIV and/or hepatitis C virus incidence

Method

This review was conducted in accordance with guidelines published by the Cochrane Collaboration (Higgins & Green, 2008) and the Cochrane Consumers and Communication Review Group (Cochrane Consumers and Communication Review Group, 2007a, 2007b).

Citations were identified through searching the online databases Scopus and Web of Science. The search string used for each database was *(methadone or buprenorphine or levo-alpha-acetylmethadol or LAAM or subutex or suboxone) AND (prison or jail or gaol or correction*)*. Database searches were supplemented by hand-searching an annotated bibliography of prison research (Jurgens, 2005) to identify grey literature.[10] No restrictions were placed on language or year of publication.

[10] 'Grey literature' refers to reports and other documents that are produced by institutions, organisations and government agencies.

Prior familiarity with the literature suggested that restricting the review to randomised studies would produce few results. Hence, both randomised and non-randomised studies were eligible for review. Inclusion criteria for studies were a two-group design that compared treated and untreated inmates with a history of illicit opioid use; and reporting results related to heroin use, injecting drug use, needle and syringe sharing or HIV/HCV incidence in prison.

Study quality was assessed using the Quality Assessment Tool for Quantitative Studies (Thomas, no year). This tool has been identified as suitable for use in systematic reviews and can be used to assess the quality of both randomised and non-randomised studies (Deeks, et al., 2003). It assigns a rating of weak, moderate or strong based on aspects of the study design and conduct. The tool and a guide to its use can be found at http://www.ephpp.ca/tools.html.

Outcomes for which data were extracted were heroin use, injecting drug use, sharing of needles and syringes and HIV/HCV incidence. Risk ratios and 95% confidence intervals were calculated using RevMan 5. Risk ratios were not pooled due to the low number of studies and differences in study designs.

Results

The results of the search strategy are summarised in Figure 3.1. Of 21 citations identified as potentially relevant to this review, five met inclusion criteria. The principal reason for excluding citations was lack of data on the relevant in-prison outcomes.

Characteristics and methodological quality of included studies are summarised in Table 3.1. Of the five included studies, three were determined to be of moderate methodological quality, with the remaining two rated as weak. Quality was not related to study design, with two non-randomised studies considered to be of higher methodological quality than a quasi-randomised controlled trial.

Methodological weaknesses that were noted in the quality assessment phase included selection bias and low follow-up rates (Table 3.1).

Figure 3.1: Systematic review search strategy

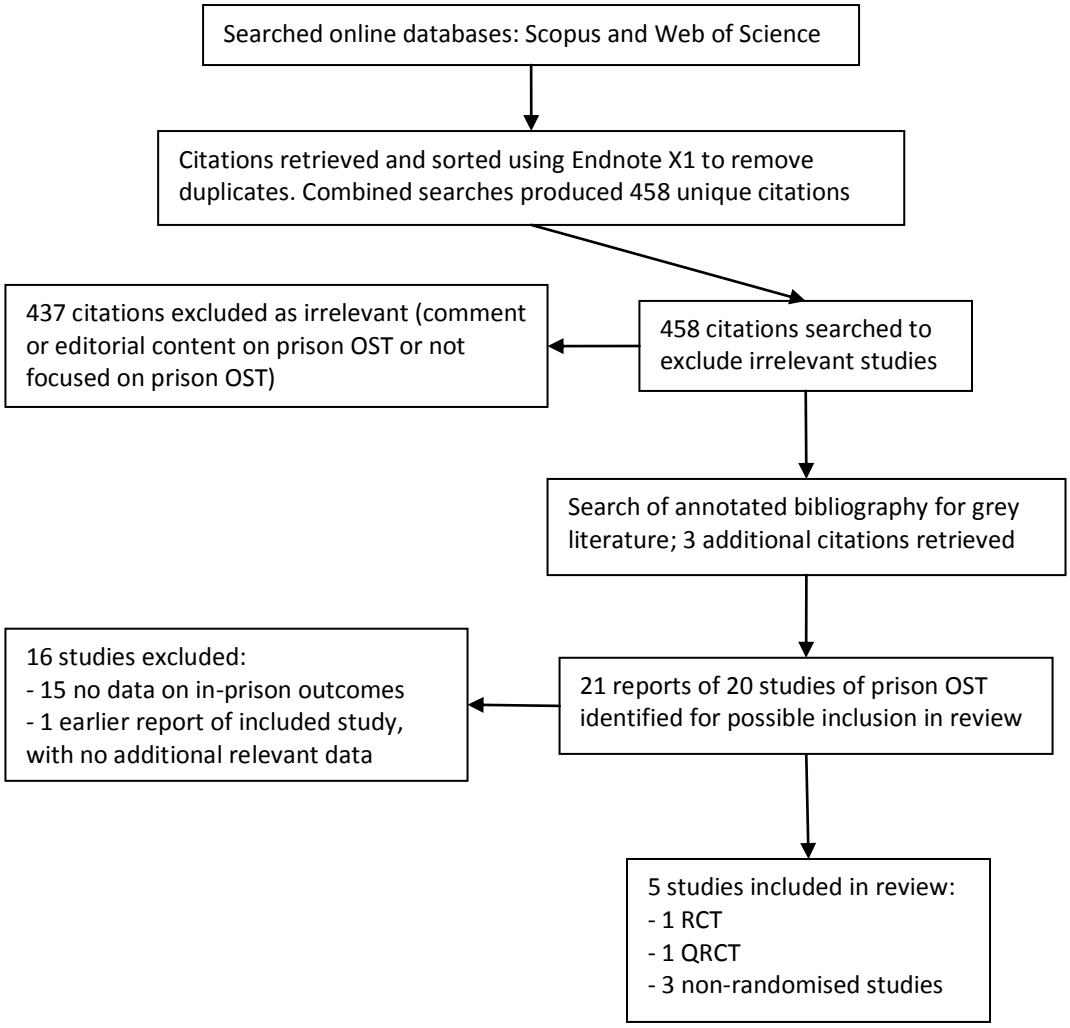


Table 3.1: Characteristics and quality of included studies

Author, Date	Location	Study design	Method of allocation	Groups comparable at baseline?	Follow-up rate		N at follow-up		Quality
					Treatment	Control/ no treatment	Treatment	Control/ no treatment	
Bayanzadeh, 2004	Iran	Quasi-randomised controlled trial	Participants sequentially numbered and allocated based on even/odd numbers	Yes	63%	52%	38	31	Weak
Dolan, 1998	Australia	Non-randomised study	Participants retrospectively grouped into counselling or OST*	Treatment participants older and less likely to be Indigenous	Data collected at one time point		48	105	Weak
Dolan, 2003	Australia	Randomised controlled trial	Block randomisation	Yes	68%	65%	129	124	Moderate
Heimer, 2006	Puerto Rico	Non-randomised study	Treatment: participants of OST program; Comparison: Random sample of heroin-using inmates[#]	Yes	Data collected at one time point		20	23	Moderate
Johnson, 2001	Canada	Non-randomised study	Treatment: participants of OST program; Comparison: heroin using inmates not receiving OST	Treatment participants older and less likely to be Indigenous	Data collected from administrative databases at one time point		303	215	Moderate

*Published study included three groups: counselling, intermittent OST and continuous OST. Data extracted for review were for counselling versus continuous OST only.
[#]Published study comparison group comprised a random sample of inmates, some of whom used heroin. Data extracted for review were for treatment versus heroin-using inmates not in treatment only.

Heroin use

Four studies reported on heroin use in prison. In Dolan (1998b), heroin use data were based on self-report. In two studies, heroin use was assessed by both self-report and biological testing; urine in the case of Heimer (2006) and hair in the second Dolan study (2003). Proportions of participants reporting heroin use for these studies were based on combined self-report/positive test results. In Bayanzadeh (2004) it was reported that participants were tested for morphine, but the testing method was not specified and it was unclear whether the heroin use results were based on self-report or testing.

All four of these studies reported significant reductions in risk associated with treatment. Compared to non-treated participants, the risk of heroin use among treated participants was reduced by 62-91% (Table 3.2).

The fifth study included in the review did not report directly on illicit opioid use but did report a statistically significant reduction over time in the number of institutional drug charges against treated participants as compared to non-treated participants (Johnson, et al., 2001). Drug type was not specified.

Injecting drug use

Three studies provided data on self-reported injecting drug use in prison. Two were significantly in favour of OST, with reductions in risk of 75% (Bayanzadeh, 2004) and 55% (Dolan, et al., 2003). In the third study, there was no difference in prevalence of injecting drug use between treated and non-treated participants (Dolan, et al., 1998b) (Table 3.2).

Needle and syringe sharing

Three studies provided data on needle and syringe sharing, with all reporting significant reductions in risk of needle and syringe sharing. Compared to non-treated participants, the risk of needle and syringe sharing among treated participants was reduced by 47-73% (Table 3.2).

Table 3.2: Heroin use, injecting drug use and needle and syringe sharing results

	% reporting event			
	Treatment	Control	Risk ratio	95% CI
Heroin use				
Bayanzadeh	21	94	0.23	0.12-0.42
Dolan, 1998	15	38	0.38	0.19-0.79
Dolan, 2003	25	67	0.37	0.27-0.51
Heimer	6	65	0.09	0.01-0.59
Injecting drug use				
Bayanzadeh	11	42	0.25	0.09-0.69
Dolan, 1998	31	46	0.68	0.43-1.09
Dolan, 2003	34	75	0.45	0.35-0.59
Needle and syringe sharing				
Bayanzadeh	8	29	0.27	0.08-0.92
Dolan, 1998	21	39	0.53	0.29-0.97
Dolan, 2003	20	54	0.37	0.26-0.55

HIV/HCV incidence

No studies reported data on the impact of OST in a correctional setting on HIV or HCV incidence. In Dolan (2003), HIV prevalence was zero at both baseline and follow-up, reflecting the very low HIV prevalence in Australian prisons (<1%; Butler, et al., 2007). HIV incidence was not assessed in Dolan (1998b) or Johnson (2001), and in the case of Heimer (2006) the one month follow-up period precluded analysis of HIV seroconversion in relation to OST status. Finally, although self-reported HIV prevalence was seven per cent at baseline in the Bayanzadeh (2004) study, this was not disaggregated by group and was not reported at follow-up.

The only study to report details of HCV status of participants was Dolan (2003). Baseline HCV prevalence was 76% in treatment participants and 72% in control participants. There was no significant effect of OST on HCV incidence, with four treatment participants and four control participants seroconverting during the follow-up period (Dolan, et al., 2003).

Discussion

This study has highlighted that there is a paucity of evidence in relation to the effects of OST in prisons on HIV risk behaviors and incidence. The few studies that have been conducted have suffered from small sample sizes and poor follow-up rates. The evidence available suggests that there is a role for OST in prevention of HIV in prisons; however, in saying this, care should be taken not to overstate the evidence. It is clear that methodologically rigorous studies that specifically address the role of OST in reducing HIV risk behaviours and/or incidence are needed to guide further development and implementation of prison-based OST.

Study quality

The studies included in this review were of varying methodological quality, with only one true randomised controlled trial. Given the difficulties associated with conducting research in prisons (Dolan, 2009; Lobmaier, et al.), this is perhaps not surprising. Furthermore, it could be argued that given the evidence supporting OST in community settings (Gowing, et al., 2008; Mattick, et al., 2009; Mattick, et al., 2008), RCTs of this treatment in prison settings are not required and indeed, may be unethical. Despite this, it remains important to evaluate prison OST programs and the design utilised by Heimer and colleagues (Heimer, et al., 2006) presents as a methodologically sound alternative to the RCT. In their study, Heimer and colleagues evaluated OST by comparing treated inmates to a control group assembled in two stages. First, inmates were randomly selected to serve as control participants. Of these, heroin users were identified by self-report and urinalysis (Heimer, et al., 2006). This design thus allows for a randomly selected group of heroin users for comparison to the treatment group, without the ethical concern of denying or delaying an effective treatment as when participants are assigned to a control group in a randomised controlled trial.

There were issues of bias in the included studies. In the two studies with follow-up data collection, follow-up rates were low, ranging from 52-68%. Previous

longitudinal studies of drug treatment have found that participants lost to follow-up have poorer outcomes than those retained at follow-up (Digiusto, et al., 2006a; Nemes, et al., 2002). Hence, low follow-up rates can have the effect of biasing results in favour of a treatment. Intention-to-treat analysis – wherein participants are analysed as randomised regardless of whether treatment is received or follow-up data are available – is one method for reducing this bias (Gravel, et al., 2007; Hollis & Campbell, 1999). Neither Bayanzadeh (2004) or Dolan (2003) utilised this method, potentially overestimating positive treatment effects.

HIV risk behaviors and incidence

Risk of heroin use was reduced by 62-91% across four studies reporting this outcome and risk of injecting drug use was reduced by 55-75% in two of three studies reporting this outcome. Most importantly for HIV transmission, risk of sharing needles and syringes was reduced by 47-73% in the three studies that reported this outcome.

No study has yet shown a direct effect of OST in correctional settings on HIV or HCV incidence; again, given ethical standards and the constraints of conducting research in prison, conducting a sero-incidence study of the effect of OST in prisons may be unfeasible. It is possible that reduced needle and syringe sharing associated with OST may translate to reduced blood-borne virus transmission in correctional settings, but there is no direct evidence to support this assertion. Indeed, it may be unrealistic to expect OST alone to affect HIV or HCV incidence, as it does not address the needs of inmates using non-opioid drugs, nor does it address non-drug related blood-borne virus risks such as tattooing and unprotected sex (Van Den Berg, et al., 2007).

Limitations

It is important to note that the review utilised data from only five studies and the results should be viewed with caution. However, this is not to say that these findings are without merit (Naylor, 1995). This analysis has highlighted that, in

comparison to the evidence on OST as HIV prevention in community settings (Gowing, et al., 2008), there is a need for studies designed specifically to assess the impact of OST in prison on HIV risk behaviors such as sharing of needles and syringes.

Conclusions

This systematic review provides limited support for OST as a method for reducing injecting-related HIV risk behaviors among opioid-using inmates. However, OST can only be effective at a population level if available to the majority of heroin dependent inmates. In many countries that offer OST in correctional settings, fewer than one percent of all inmates are in treatment, making population level benefits unlikely (Larney & Dolan, 2009b). Given the cost-effectiveness (Warren, et al., 2006) and increasing implementation of prison OST in low- and middle-income countries (Larney & Dolan, 2009b), it cannot be that cost is preventing more widespread treatment coverage. Rather, the reason for low levels of OST implementation in correctional settings appears to be philosophical opposition to pharmacologically assisted treatment (Gjersing, et al., 2007; Nunn, et al., 2009) and lack of awareness of the benefits of OST (Springer & Bruce, 2008).

Given the high proportion of heroin users who pass through prisons annually (Boutwell, et al., 2007), the lack of OST provision is not only short-sighted in terms of HIV prevention; it is also a lost opportunity to engage heroin users in effective drug treatment that potentially has additional benefits, such as reduced re-offending (Gordon, et al., 2008) and re-incarceration (Dolan, et al., 2005) on release. It is also theorised that prison OST may assist in reducing post-release deaths from opioid overdose by maintaining opioid tolerance (Christensen, et al., 2006). The impact of prison OST on post-release outcomes will be examined in greater detail in Chapter 4.

Unfortunately, no single intervention addresses all blood-borne virus risks in correctional settings. OST can reduce risk behaviors related to heroin and other

opioid injecting. However, unprotected sex, injection of non-opioid drugs and tattooing all pose a risk of HIV/HCV transmission. Hence, comprehensive HIV/HCV prevention in correctional settings requires provision of condoms, sterile injecting equipment and sterile tattooing equipment in addition to a high level of coverage of opioid substitution treatment.

4. Systematic review of prison opioid substitution treatment and post-release outcomes

Abstract

Aim: To assess if prison-based opioid substitution treatment reduces post-release re-offending, re-incarceration and mortality.

Method: Systematic review of the published and unpublished literature, following Cochrane Collaboration guidelines.

Results: Thirteen reports from eleven studies were included in the review. The majority of studies were of moderate methodological quality. The majority of studies showed no effect of prison OST on re-offending; however, results from the only study rated as methodologically strong suggest that retention in treatment may be a key, and to date unexplored, factor in risk of re-offending. It was not possible to conclude whether prison OST reduces risk of returning to custody, although it is clear that it does not increase re-incarceration. There may be a role for prison OST in reducing post-release mortality.

Conclusion: Research to date has produced conflicting findings with regards to the effect of prison OST on post-release offending and re-incarceration. The effect of retention in treatment on post-release outcomes requires further exploration, as does the potential for prison OST to reduce post-release mortality.

Introduction

The previous chapter identified that prison OST reduces injecting-related HIV risk behaviours and concluded that OST should be provided in prisons as part of comprehensive HIV prevention programming. However, treatment for drug dependence in prisons is not generally evaluated in terms of its public health

benefits; rather, the outcomes considered to be important in many evaluations of prison drug treatment programs are post-release offending and re-incarceration (e.g. Butzin, et al., 2006; Inciardi, et al., 2004; Welsh, 2007). Indeed, prison OST is promoted as having a positive impact on re-offending and re-incarceration (World Health Organization, 2007), and this reasoning has been used as a rationale for prison OST programs in Australia (Office of the Correctional Services Commissioner, 2002, p.4) and New Zealand (Ministry of Health, 2003, p.65).

These endorsements of prison OST have been in spite of conflicting findings regarding the efficacy of community-based OST in reducing criminality (Best, et al., 2001; Lind, et al., 2005; Mattick, et al., 2009) and incarceration (Milloy, et al., 2008; Werb, et al., 2008a). It appears that overall, relative to out-of-treatment heroin users, those in treatment have lower offending rates; however, there are sub-groups of persistent offenders for whom offending is unrelated to treatment (Best, et al., 2001; Lind, et al., 2005). For example, in a large Australian study, despite an overall significant reduction in criminal charges while participants were in OST, just under one-third of participants showed an increase in charges while in OST (Lind, et al., 2005). Despite this, the overall reduction in offending seen in treatment populations appears to affect imprisonment, with two large cohort studies finding significant reductions in risk of incarceration when in OST (Milloy, et al., 2008; Werb, et al., 2008a).

There is a third post-release outcome which it has been hypothesised may be affected by prison OST, namely, mortality. Excess mortality in the weeks following release from prison is a significant concern, with drug overdose being the most common cause of death (Farrell & Marsden, 2007; Kariminia, et al., 2007c; Rosen, et al., 2008). During the first two weeks post-release, men are nine times more likely, and women six times more likely, to die of a drug overdose compared to six-months post-release (Kariminia, et al., 2007c). This elevation in overdose risk is assumed to be a result of reduced opioid tolerance following a reduction or cessation in heroin

use while in prison (Wakeman, et al., 2009). It has been hypothesised that provision of OST in prisons will assist in maintaining opioid tolerance, thereby reducing risk of heroin overdose on release (Christensen, et al., 2006).

Aims

The aim of this chapter is to assess whether prison OST reduces:

a) Post-release offending, whether self-reported or officially recorded;
b) Return to full-time custody, whether pre-trial or sentenced, in a correctional institution; and
c) Post-release mortality.

Method

A systematic review was conducted in accordance with Cochrane Collaboration guidelines, with particular reference to guidelines on the inclusion of non-randomised studies in systematic reviews (Higgins & Green, 2008, Reeves, 2008).

The studies identified in Chapter 3 as relevant to prison OST (n=21) were supplemented by re-running the same search strategy to identify additional papers published between January 2009 and November 2009. There were no restrictions on language or year of publication.

Outcomes for assessment were post-release offending, re-incarceration and mortality. These outcomes can be assessed in randomised controlled trials but are more commonly measured using longitudinal, observational designs. Hence, both randomised and non-randomised studies (observational cohort studies) were eligible for inclusion (Petticrew & Roberts, 2006). To be included, a study had to compare treated and non-treated inmates with a history of heroin use or dependence on the outcomes of interest. Because *studies* rather than *reports* of studies were the unit of interest (Higgins & Deeks, 2009), multiple reports from a single study could be included. Due care was taken not to introduce bias by

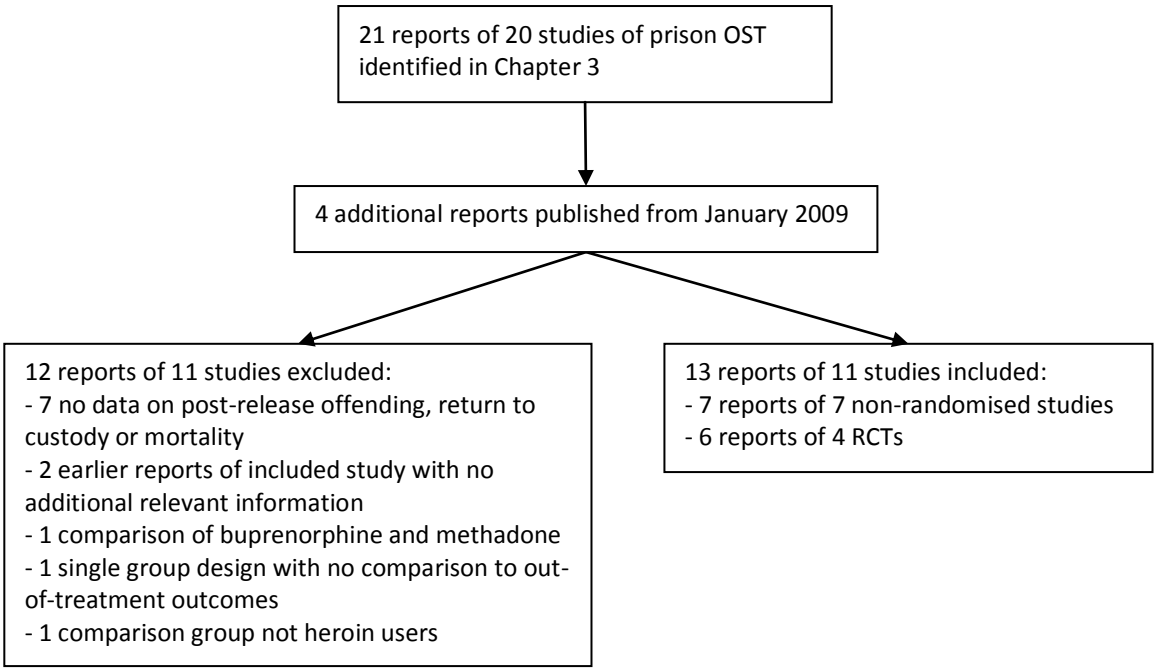
ensuring that multiple reports from a single study are clearly identified in the Results.

Study quality was assessed as in Chapter 3, using the Quality Assessment Tool for Quantitative Studies (Thomas, no year). Due to the variability in study design and means of outcome measurement, data were synthesised descriptively without derivation of a pooled quantitative effect estimate.

Results

Five reports from three randomised controlled trials and eight reports from eight non-randomised studies were included in the review (Figure 4.1). There were three reports from one randomised controlled trial, reporting results for three-month (Kinlock, et al., 2008), six-month (Gordon, et al., 2008) and 12-month follow-up (Kinlock, et al., 2009).

Figure 4.1: Identification of articles for inclusion in systematic review



Characteristics of included studies

Methadone was the substitution agent used in seven of the 11 studies. In two studies (Levasseur, et al., 2002; Marzo, et al., 2009), both methadone and buprenorphine were used and in one study (Kinlock, et al., 2005), the substitution agent was levo-alpha-acetylmethadol (LAAM). In randomised studies, control groups received no treatment (wait-list control), naltrexone implants or counselling and post-release treatment referrals.

The quality of included studies varied, with most studies rated as being of moderate methodological quality (Table 4.1, Table 4.2). Only one study, the randomised controlled trial with multiple follow-up occasions, was rated as methodologically strong. Although follow-up rates were good for three of four randomised studies, there were few participants per study. Non-randomised studies reported larger sample sizes, facilitated through the use of official records to ascertain treatment exposure and outcomes.

Table 4.1: Characteristics and quality of included randomised studies

Study no.	Author, Date	Method of randomisation	Groups comparable at baseline?	Comparison		Follow-up rate		N at follow-up		Quality
				Treatment	Control	Treatment	Control	Treatment	Control	
1	Dole, 1969	Lottery	Treatment group fewer prior convictions	Methadone maintenance	Wait list control	100%	94%	12	15	Weak
2	Kinlock, 2005	Not described	Treatment group less likely to report abstinence following prior treatment or incarceration	LAAM maintenance	Post-release treatment referral (TR) OR treatment drop-outs (DO)	85%	TR: 82% DO: 68%	22	TR: 31 DO: 13	Moderate
3a	Kinlock, 2008	Block randomisation	Yes	Counselling + methadone maintenance	Counselling only (CO) OR counselling + post-release OST referral (CR)	96%	CO: 90% CR:97%	68	CO: 63 CR: 66	Strong
3b	Gordon, 2008					99%	CO: 90% CR: 97%	70	CO:63 CR: 68	
3c	Kinlock, 2009					100%	CO: 91% CR: 99%	71	CO: 64 CR: 69	
4	Lobmaier, 2009	Not described	Not described	Methadone maintenance	Naltrexone implant	72%	81%	8	13	Weak

Table 4.2: Characteristics and quality of included non-randomised studies

Study no.	Author, date	N	Cohort selection	Comparability of cohorts	Ascertainment of treatment exposure	Ascertainment of outcomes	Quality
5	Bellin, 1999	9701	Treatment: all inmates receiving OST during study period Comparison: all inmates completing opiate detoxification during study period	Treatment cohort more extensive criminal history, less social supports	Official record	Official record	Moderate
6	Dolan, 2005	382	Follow-up of randomised controlled trial	Good	Official record	Official record	Moderate
7	Johnson, 2001	299	Treatment: all inmates receiving OST during study period Comparison: inmates identified as heroin users but not in OST	Treatment cohort older and less likely to be Canadian Aboriginal	Official record	Official record	Moderate
8	Levasseur, 2002	420	Treatment: all inmates receiving OST during study period Comparison: inmates identified as heroin users but not in OST	Uncertain	Official record	Official record	Moderate
9	Magura, 1993	446	Treatment: sample of inmates receiving OST during study period Comparison: sample of inmates completing opiate detoxification during study period	Treatment cohort more likely to be African-American and to be homeless before incarceration	Interview and official record	Interview	Weak
10	Marzo, 2009	507	Treatment: all inmates commenced on OST during study period Comparison: inmates identified as heroin users but not in OST	Treatment cohort poorer health, heavier opioid use	Interview and official record	Official record	Moderate

Study no.	Author, date	N	Cohort selection	Comparability of cohorts	Ascertainment of treatment exposure	Ascertainment of outcomes	Quality
11	McMillan, 2009	589	One group, consisting of all inmates with at least one episode of OST in prison during study period. Inmates could contribute multiple episodes, which were coded as treatment or non-treatment	Good	Official record	Official record	Moderate

Re-offending

Two randomised and two non-randomised studies reported on the effects of prison OST on re-offending (Table 4.3, Table 4.4). One randomised and both non-randomised studies reported no significant differences between groups. In the three- and six-month follow-up reports of the Kinlock randomised controlled trial, participants receiving OST or counselling plus referral to OST on release showed lower levels of self-reported re-offending than counselling only participants. However, by 12-month follow-up, there were no significant differences between groups on re-offending (Table 4.3).

Table 4.3: Effects of prison OST on re-offending – randomised studies

Study no.	Author, year	Results
2	Kinlock, 2005	No significant difference between groups in number of self reported days of criminal activity in the nine months post-release (treatment mean 40.4 crime days, control 114.6; treatment drop-outs 127.6)*
3a	Kinlock, 2008	Counselling + referral and counselling + OST participants were significantly less likely than counselling only participants to report criminal activity in the last 90 days (counselling only 56%; counselling + referral 29%; counselling + OST 29%; χ^2_2=16.7, *p*=.01)
3b	Gordon, 2008	Counselling + referral and counselling + OST participants reported significantly fewer days of criminal activity in the previous 180 days (counselling only mean 56.5 crime days; counselling + referral 35.6; counselling + OST 28.5; Wald χ^2=819.3, *p*=.00001)
3c	Kinlock, 2009	No significant differences between groups in number of self-reported days of criminal activity in 12 months post-release (counselling only mean 106.7 crime days; counselling + referral 65.2; counselling + OST 81.8)*

*Significance test results not reported and unable to be calculated from published data.

Table 4.4: Effects of prison OST on re-offending – non-randomised studies

Study no.	Author, year	Results
7	Johnson, 2001	No significant difference in proportion of each group with new convictions (treatment 31%; comparison 26%; χ^2_1=1.7, *p*=.19)^
9	Magura, 1993	No significant difference between groups in self-reported number of offences in the past 6.5 months (treatment mean 66 offences; comparison mean 49 offences)*

*Significance test results not reported and unable to be calculated from published data. ^Chi-square results calculated from published data

Re-incarceration

Four randomised and six non-randomised studies reported on the effects of prison OST on the likelihood of returning to custody (Table 4.5,Table 4.6). In two randomised studies, fewer treatment participants than controls were re-incarcerated; however, small sample sizes precluded significance testing. One randomised study reported no difference between groups in rate of re-incarceration. In the Kinlock trial, OST participants were less likely to have been re-incarcerated than counselling or counselling + referral participants at three-month follow-up, but this difference was no longer evident at six-month follow-up (Table 4.5).

Among the six non-randomised studies, two reported no effect of OST on re-incarceration. Two reported that OST was associated with reduced re-incarceration, while one study reported the opposite. Finally, one study reported that retention in treatment for at least 8 months was necessary to reduce the risk of re-incarceration significantly below that of those without treatment (Table 4.6).

Table 4.5: Effects of prison OST on re-incarceration – randomised studies

Study no.	Author, year	Results
1	Dole, 1969	3 of 12 (25%) treatment participants re-incarcerated, compared to 15 of 16 (94%) control participants[#]
2	Kinlock, 2005	No significant difference in proportion of groups re-incarcerated (treatment 29%; control 24%; treatment drop-outs 58%; χ^2_2=3.13, p=0.2)[^]
3a	Kinlock, 2008	Compared to counselling only and counselling + referral participants, significantly fewer counselling + OST participants were re-incarcerated within three months of release (counselling only 29% return to custody; counselling + referral 33%; counselling + OST 13%; χ^2_2=15.2, p=0.02
3b	Gordon, 2008	No significant difference between groups on number of days in custody (counselling only 21.4; counselling + referral 23.3; counselling + OST 21.4; χ^2=0.24, p=0.9
4	Lobmaier, 2009	2 of 11 (18%) OST participants re-incarcerated compared to 5 of 16 (31%) of naltrexone implant participants[#]

[#]No significance testing due to small cell sizes.

Table 4.6: Effects of prison OST on re-incarceration – non-randomised studies

Study no.	Author, year	Results
5	Bellin, 1999	Participants discharged on high-dose methadone (>70mg) were significantly less likely to be re-incarcerated than low-dose methadone (<30mg) participants (hazard ratio=0.87, 95% CI 0.79-0.96). However, comparison participants were significantly less likely to be re-incarcerated than high-dose participants (hazard ratio 0.76, 95% CI not reported).
6	Dolan, 2005	Risk of re-incarcerated decreased as retention in OST increased (for periods of OST of >8 months, hazard ratio=0.3, 95% CI 0.2-0.5)
7	Johnson, 2001	Treatment participants significantly less likely to have be re-incarcerated at 12-month follow-up (treatment 38%; comparison79%; χ^2_1=7.5, *p*=.006)^
8	Levasseur, 2002	Participants receiving OST in custody significantly less likely to be re-incarcerated (treatment 19% re-incarcerated, comparison 39%; χ^2_1=12.2, *p*<.001)^
10	Marzo, 2009	Receiving OST in custody did not significantly affect risk of re-incarceration (hazard ratio=1.3, 95% CI 0.89-1.85)
11	McMillan, 2009	Receiving OST in custody did not significantly affect risk of re-incarceration (hazard ratio=1.2, 95% CI 0.8-1.7)

^Chi-square results calculated from published data.

Mortality

One randomised and two non-randomised studies reported on post-release mortality among people receiving OST in prison, although no studies explicitly examined the relationship between these two variables. In Kinlock (2009), there were eight deaths among the 204 participants followed-up at 12 months post-release. Six of the deaths were of participants in the control group, including 4 opioid overdoses. One death occurred in the counselling + referral group and one death in the OST group. None of the deaths occurred while a participant was receiving OST.

In Dolan (2005), there were 17 deaths (8 drug overdoses) among 382 participants over four years of follow-up. As above, no deaths occurred while a participant was receiving OST. Finally, Marzo (2009) reported 10 deaths among 507 participants over three years of follow-up, but no information on OST status at time of death was reported.

Discussion

This systematic review has found mixed support for the contention that prison-based opioid substitution treatment contributes to reductions in post-release offending and re-incarceration. Although the studies included in the review were not designed to test the effect of prison OST on mortality, it is of note that of 25 deaths among 586 participants, none occurred while participants were in OST.

Study quality

The quality ratings of included studies ranged from weak to strong, with seven of 11 studies determined to be of moderate methodological quality. The majority of included studies were non-randomised; given the outcomes being analysed, this is perhaps to be expected. There was no evidence that randomised studies produced results that were consistently different from those of non-randomised studies; nor

does it appear that studies of lower methodological quality produced results that differed from those of higher quality studies.

Where baseline differences existed between groups, participants receiving OST were at higher risk of re-offending and/or return to custody than their non-treated peers, as measured by indicators such as pre-treatment level of social support (Bellin, et al., 1999), length of criminal history (Bellin, et al., 1999) and pre-treatment level of opioid use (Marzo, et al., 2009); however, there was no indication that the results of studies reporting baseline differences between groups differed from those with equivalent groups at baseline.

The non-randomised studies highlighted the utility of data linkage in conducting studies in this area. OST is generally a highly regulated treatment, and records of who is receiving treatment and when are often available. Similarly, offending and incarceration are typically recorded in administrative databases. Utilising these existing datasets to answer research questions is a cost-effective research strategy that does not rely on the willingness or ability of research participants to provide contact details to enable follow-up. Data linkage also enables analysis of outcomes at a population level; for example, McMillan and colleagues were able to access OST and re-incarceration data for all inmates entering a specific institution over a 12-month period (McMillan, et al., 2008). Such an undertaking would be expensive and time-consuming if participants were directly interviewed. Finally, data linkage provides a record of events as they occur, allowing for extraction of very specific variables, such as number of offences in a certain time period, or number of days in treatment. Individuals are unlikely to be able to provide these data with such precision.

Effect of prison OST on post-release offending

In the majority of studies reviewed, there was no effect of prison OST on post-release offending. In several studies of community OST, it has been noted that despite an overall reduction in offending associated with treatment, there are sub-

groups of participants for whom treatment does not moderate criminal activity (Lind, et al., 2005; Sidwell, et al., 1999). These studies follow from a classic paper by Nurco and colleagues that identified two types of heroin user: 'high-crime' and 'low-crime'. High-crime heroin users had histories of criminal involvement prior to heroin use, and their level of offending was consistently high, regardless of their level of drug use. In comparison, low-crime heroin users had little criminal justice involvement prior to heroin use, and reduced their offending during times of less frequent drug use (Nurco, et al., 1988). It is possible that heroin users recruited in prison are more likely than community-based populations of heroin users to be 'high-crime' individuals, for whom treatment does not affect criminal activity, thus explaining why prison OST does not appear to reduce post-release offending.

Although the majority of studies report no effect on re-offending, the results provided by the multiple follow-ups of the methodologically rigorous Kinlock trial (Gordon, et al., 2008; Kinlock, et al., 2009; Kinlock, et al., 2008) raise the possibility that treatment is effective in reducing offending only in the short-term, or only as long as individuals remain in treatment post-release. None of the reviewed studies controlled for or otherwise included treatment status at the time of offence in their statistical analyses. In studies of community OST, reductions in offending are only evident during periods when the individual is in treatment (e.g.Lind, et al., 2005). Treatment participation in the post-release period may be an important mediating factor in risk of re-offending, and further analyses controlling for this are required.

Effects of prison OST on re-incarceration

On the basis of the evidence reviewed, it is not possible to definitively conclude whether prison OST significantly reduces re-incarceration. As in studies of re-offending, it may be that return to custody is mediated by retention in OST following release. It is reasonable to conclude that prison OST does not increase risk of re-incarceration. It has been reported that prison staff opposition to OST includes the concern that prison OST will increase recidivism, as inmates will not be

concerned about experiencing opioid withdrawal if incarcerated (McMillan & Lapham, 2005). From the results presented here, it seems unlikely that this concern is justified.

Effects of prison OST on post-release mortality

There remains a need for studies analysing interactions between prison OST and post-release mortality. Cohort studies that link information about OST participation and prison releases to death registries would be a valid method for studying this relationship further.

Should prison OST prove protective against post-release mortality, this fact must be taken into account in the design and conduct of further research in this field. For example, randomisation of participants to a control group when treatment is known to reduce risk of death would breach international ethical standards for medical research (World Medical Association, 2008).

Limitations

The majority of included studies were non-randomised. Non-randomised studies are more prone to bias and confounding than randomised studies; however, care was taken to separate results from randomised and non-randomised studies, and to assess for systematic differences in results.

It was not possible to derive a pooled quantitative estimate of the effects of prison OST on offending, incarceration or mortality. This was because of variability in study designs (particularly the non-randomised studies) and different methods of data presentation in reviewed papers. Despite these limitations, this synthesis of the evidence has allowed for conclusions regarding the use of OST in prisons to address negative post-release outcomes.

Conclusion

The findings of this review on the effect of prison OST on post-release criminality and mortality are largely equivocal, although it is clear that prison OST does not

increase re-incarceration. Analysis of the effect of retention in treatment post-release is needed to assist in clarifying the role (if any) of OST in reducing re-offending and re-incarceration, while large-scale cohort studies are required to determine if prison OST reduces post-release mortality.

These results do not invalidate the use of OST in prisons. The primary goal of treatment for drug dependence is reduction in the use of illicit drugs. OST meets this aim, whether provided in the community (Mattick, et al., 2009; Mattick, et al., 2008), or, as shown in Chapter 3, in prisons. Chapter 3 also demonstrated that prison OST may have public health benefits in that it reduces injecting-related HIV risk behaviours; thus, prison OST can be recommended on clinical and public health grounds. Care should be taken not to overstate the level of evidence for the hypothesis that prison OST reduces post-release criminality. Further research examining the role of post-release treatment retention in mediating re-offending and re-incarceration is required.

5. Data linkage: Background and methods

Introduction

The preceding chapters have described some of the major harms associated with heroin dependence and the utility of opioid substitution as a treatment for heroin dependence, including in prison settings. In Chapter 3, it was found that opioid substitution treatment (OST) in prisons reduces heroin use, injecting drug use, and sharing of needles and syringes. This may produce benefits not only for the individual, but also for public health, as reduced injecting-related HIV risk behaviours may translate to reduced HIV transmission in prisons. The evidence relating to the effects of prison OST in the period after release from prison, as discussed in Chapter 4, is less clear. In light of this, the studies that follow will focus on questions relating to the role of OST in reducing negative post-release outcomes. These questions will be answered through analysis of a longitudinal dataset assembled by linking four administrative datasets to a cohort of heroin users originally recruited in prison. This chapter describes the use of administrative data to conduct research, followed by an overview of the data linkage process undertaken for the studies that are presented in Chapters 6-9.

Using administrative data to conduct longitudinal research

Longitudinal research has been crucial in establishing the chronic and relapsing nature of drug dependence and in quantifying the risks of long-term substance use (Hser, et al., 2007b). A common approach to longitudinal research has been to establish a cohort of participants who provide baseline data, and are then re-interviewed at set follow-up points. One of the longest running studies of this design comprises a cohort of heroin users originally recruited between 1962 and 1964, with follow-up interviews conducted 10, 24 and 33 years after recruitment (Hser, et al., 1993; Hser, et al., 2001; McGlothlin, et al., 1977). Findings from this cohort have included the identification of distinct trajectories of heroin dependence

(Hser, et al., 2007a) and quantification of the number of years of potential life lost due to heroin dependence (Smyth, et al., 2007), as well as theoretical (Hser, et al., 2007b) and statistical (Chou, et al., 2004) developments in longitudinal research methods.

Although this approach to longitudinal research has been popular, re-contacting and personally interviewing participants can be expensive and time-consuming. Furthermore, it may be difficult to follow-up sufficient numbers of participants to enable robust conclusions to be drawn about changes over time. This is a particular concern in research with illicit drug using or criminally involved populations, as participants often lack reliable contact details such as a stable address or telephone number. Finally, there can be issues of recall bias when participants are asked to report on past events. Day and colleagues asked heroin users to recall their drug use, drug treatment status and criminal activity over four discrete time periods during the previous two years. Participants were re-interviewed seven days later to assess the reliability of responses. They found that although recall of heroin use was generally reliable, recall of other activities was variable and worsened as participants were asked to recall more distant time periods (Day, et al., 2004).

An alternative, or complementary, data source that overcomes these issues is administrative data. These are existing data that are routinely collected for management or other non-research purposes (Evans, et al., 2008). Administrative data sources include hospital admissions, police arrest records and registries of births and deaths. One of the key advantages of administrative data over self-reported, retrospectively collected data is that administrative data provide an 'official' record of events as they happen; there is no reliance on participants to accurately recall past events. Although administrative databases may contain errors, these are likely to be random (e.g. transposing of numbers in a date field) rather than related to participant characteristics.

As with all methodologies, there are also disadvantages associated with using administrative data to answer research questions. Analyses are limited to the variables that have been collected. Furthermore, administrative records reflect experiences only of people who access, or come to the attention of, a particular system. Thus, people who experience a serious health condition but do not go to hospital, or who commit crime but are not arrested, are not recorded in administrative datasets (Evans, et al., 2008).

Data linkage

The utility of administrative data in answering research questions is greatly enhanced by linking data for individuals across different databases. Records from each source database are linked based on information common to each database, such as names and dates of birth, enabling analysis of events across services and systems. For example, Amin and colleagues linked viral hepatitis notifications from the NSW Notifiable Diseases Database to the NSW Central Cancer Registry and the Australian National Death Index, allowing examination of the incidence of liver cancer and causes of death among people with hepatitis B and C (Amin, et al., 2006a; Amin, et al., 2006b).

Data linkage methods

There are two distinct methods used for data linkage: deterministic and probabilistic. Deterministic linkage involves matching records based on exact agreement between key variables. Consider the example data in Table 5.1. In a deterministic linkage based on surname, given name, and date of birth, only record 1 from dataset A and record 3 from dataset B would be considered a matched pair.

Table 5.1: Example data

	Dataset A				Dataset B		
	Surname	**Given name**	**Date of birth**		**Surname**	**Given name**	**Date of birth**
1	Blakely	Toni	12/04/78	1	Johnstone	Anthony	03/11/76
2	Johnson	Anthony	03/11/76	2	Middleton	Bill	05/02/74
3	Middleton	William	02/05/74	3	Blakely	Toni	12/04/78

Deterministic linkage is precise; it links only those records that match exactly. In deterministic linkage, it is assumed that the data entered into each source dataset are wholly accurate. In reality, this assumption may not hold. Typing errors, variation in the spelling of names and transposing of numbers are just some sources of variation when data are entered. In the data in Table 5.1, despite minor variations in names and dates of birth, there is a high probability that record A2 is a match for record B1, and that record A3 is a match for record B2. In order to identify such likely, but not exact, matches between records, it is necessary to use probabilistic data linkage.

Probabilistic data linkage

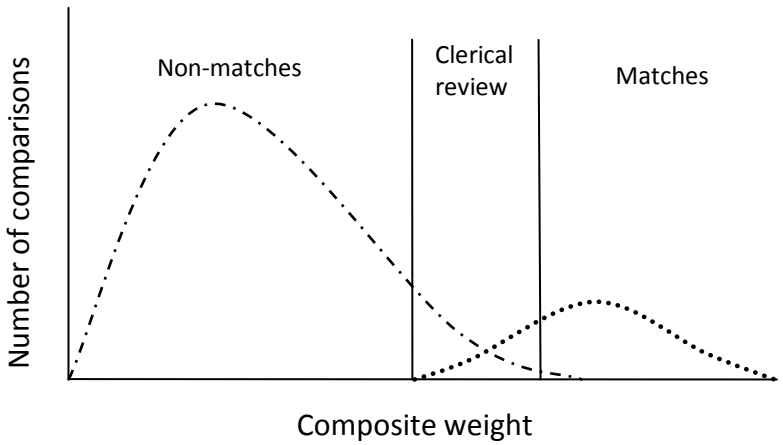
In probabilistic data linkage, each pair of records (consisting of one record from dataset A and one record from dataset B) is classified as belonging to one of two sets: matched pairs or non-matched pairs. To do this, record *x* from dataset A is compared to each record in dataset B, and each resulting pair (*x*-B1, *x*-B2, etc.) is classified as either a match or a non-match. In determining whether two records are a match, allowances are made for variations in spelling of names (e.g. Melissa and Mellissa), common variants of names (e.g. Bob and Robert), and other sources of variation that may obscure the fact that two records belong to one individual.

Each field (e.g. surname, date of birth) shared by datasets provides information to assist with determining which pairs are matches and which are non-matches. However, some fields provide more information than others. For example, a postcode field is less informative than a surname field for matching purposes. To

account for this, fields are weighted. To determine weights, each field is assigned two probabilities. The *m* probability is the probability that a field agrees, given that the pair being examined is a matched pair. The *u* probability is the probability that a field agrees, given that the pair being examined is an unmatched pair. That is, *u* is effectively the probability that the field agrees at random. The weight for a field is calculated as a ratio of *m* and *u*, with fields that provide more information in determining a match (i.e. fields in which *u* is low) receiving higher weights (Jaro, 1995).

For each pair, a composite weight, consisting of the sum of the field weights, is calculated. The distribution of weights is then used to determine an appropriate cut-off weight, above which pairs are accepted as matches, and below which pairs are taken to be non-matches. Often, a cut-off range is defined, with pairs that fall within the range subject to clerical review to determine whether the pair should be considered a match or non-match (Figure 5.1). Matched pairs are then used for analyses.

Figure 5.1: Typical distribution of weights and cut-off points for non-matched, matched and clerical review pairs



Data linkage for the present thesis

Ethical approvals

Ethical approval for the following studies was granted by the University of New South Wales Human Research Ethics Committee; the NSW Department of Health Population and Health Services Research Ethics Committee; the NSW Department of Corrective Services Research Approval Committee; and the Justice Health Human Research Ethics Committee.

Data sources

Baseline dataset

The individuals for whom data were linked were 375 men who were originally recruited to a prison-based randomised controlled trial (RCT) of opioid substitution treatment (Dolan, et al., 2003; Dolan, et al., 2002). Participants in the trial were recruited in New South Wales (NSW) prisons in 1996-97. NSW is the largest Australian state, with a population of seven million people (Australian Bureau of Statistics, 2009b). At the time of recruitment, around half of the estimated 74000 Australian heroin users were located in NSW (Hall, et al., 2000a). To participate in the trial, inmates were required to be male,[11] have a history of heroin injection,[12] be serving a sentence of at least four months and be willing to be randomly allocated to either opioid substitution treatment or wait-list control. Participants assigned to the treatment condition were prescribed and dispensed methadone as patients of the larger NSW prison OST program. Participants assigned to the control condition could enter OST after four months (the initial follow-up period). The findings of the

[11] Women were excluded from the trial as a pilot study showed that it would not be possible to recruit sufficient numbers of female prisoners with sentences of sufficient length (Dolan, et al., 2002).

[12] Determined via clinical interview and examination by a physician specialising in addiction medicine.

RCT and a four-year follow-up study appear elsewhere (Dolan, et al., 2003; Dolan, et al., 2005).

The data collected in initial recruitment interviews with trial participants provided the identifiers for use in linkage to administrative datasets, as well as demographic data and information regarding drug use, prior incarcerations and participation in OST during the trial period.

Incarceration data

Information regarding incarceration was obtained from the Offender Integrated Management System (OIMS).The OIMS is maintained by the NSW Department of Corrective Services. The OIMS monitors all prisoner movements - admissions, transfers and releases - in New South Wales. Variables requested from the OIMS were dates of prisoner movements, and reason for movement (e.g. received from court; sentence expired).

Opioid substitution treatment data

In New South Wales, prescribing of medications for opioid substitution treatment is monitored through the Health Department's Pharmaceutical Drugs of Addiction System (PHDAS). The PHDAS records basic clinical variables for all episodes of OST provided in NSW. Variables requested from the PHDAS were date of treatment entry and date of treatment exit.

Offending data

Data on offences committed by participants were obtained from the Re-offending Database (ROD), maintained by the NSW Bureau of Crime Statistics and Research (BOCSAR). ROD contains records of all finalised criminal court appearances in the Children's, Local, District and Supreme Courts of NSW (Hua & Fitzgerald, 2006). Variables requested from ROD were date and type of proved offences.

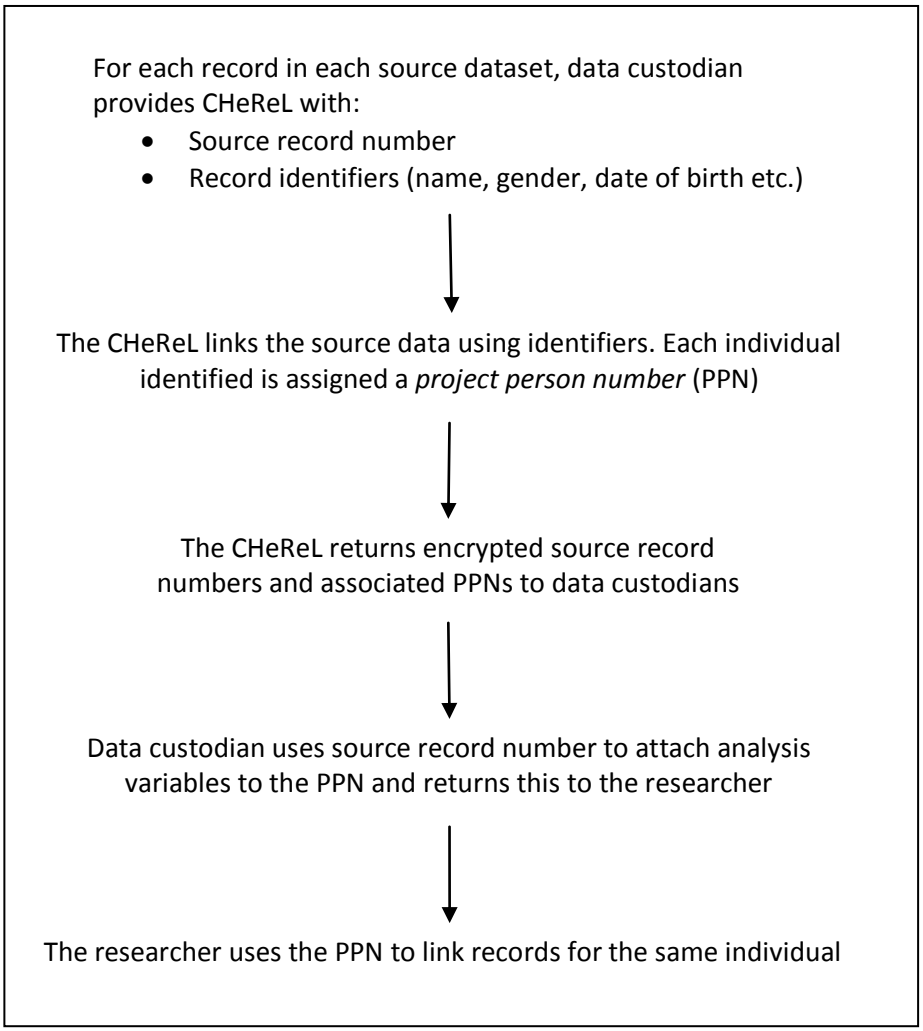
Mortality data

Data on mortality amongst the cohort were obtained from the Master Linkage Key (MLK), maintained by the Centre for Health Record Linkage. Mortality data recorded in the MLK includes death registrations from the NSW Registry of Births, Deaths and Marriages and causes of death as coded by the Australian Bureau of Statistics. Variables requested from the MLK were date and cause of death.

Extracting data for linkage

The extraction and linkage of data from multiple datasets raises significant ethical concerns in relation to privacy of health information and consent (McSherry, 2004; Paterson, 2004; Young, et al., 2001). In order to overcome these concerns, a staged linkage process was used that ensured separation of data that may identify an individual (e.g. names, dates of birth) from data that was of use in answering the research questions (e.g. dates of entry to or exit from prison). This process was handled by the Centre for Health Record Linkage (CHeReL). The CHeReL was established in 2006 specifically to support research using linked, administrative data (Lawrence, et al., 2008). As shown in Figure 5.2, the CHeReL acts as a third party intermediary between data custodians and researchers, separating the processes of data linkage and analysis and thereby maintaining the confidentiality of individuals whose data are accessed.

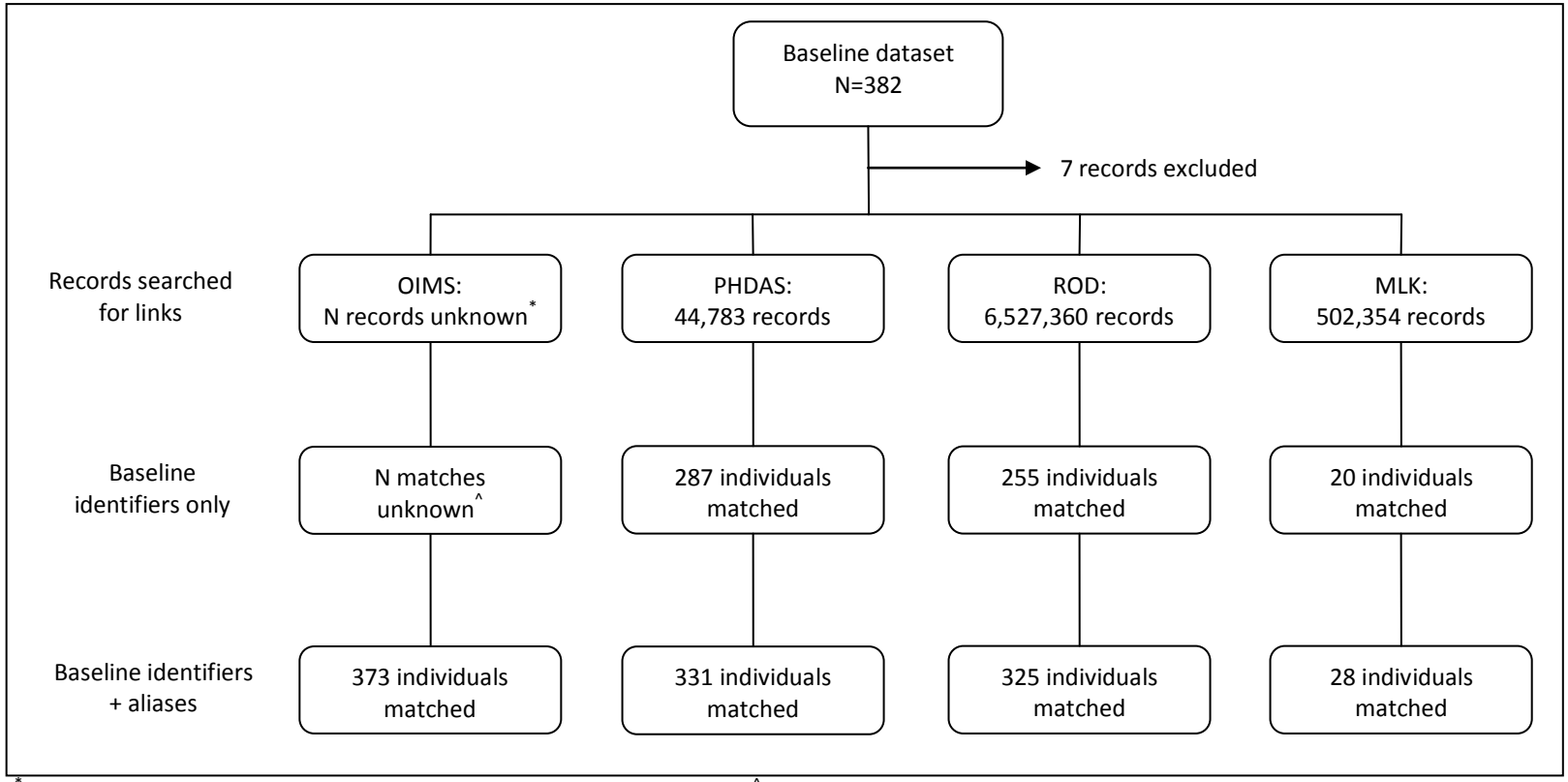
Figure 5.2: The Centre for Health Record Linkage (CHeReL) data linkage process



On receiving evidence of ethical approval of the project, the CHeReL requested identifiers for the members of the cohort so that linkage to other datasets could commence. The original cohort contained 382 individuals. Manual inspection of this cohort revealed that six records (2% of the cohort) contained no name details and hence were unsuitable for linkage. One record was found to be a duplicate and was not included in the cohort. Thus, full names, dates of birth and date of last contact for 375 individuals were supplied to the CHeReL for linkage using the procedure shown in Figure 5.2. These records were to be linked to records contained in the Offender Integrated Management System, the Pharmaceutical Drugs of Addiction System, the Re-offending Database, and the Master Linkage Key, for the period 1 June 1997 to 31 December 2006. It had originally been planned that records would be linked for the calendar years 1997-2006; however, the OIMS was only implemented in NSW prisons in May 1997 and information on prisoner movements prior to this time was not accessible.

An initial inspection of the records that were linked to the baseline dataset by the CHeReL revealed that there were fewer matches to the cohort than expected, particularly in relation to OST episodes and mortality. For example, there were 49 individuals who had been in OST during the RCT and who had not matched to a treatment record. Furthermore, there appeared to be too few matched deaths (n=20). A four-year follow-up study of the cohort had identified 17 deaths (Dolan, et al., 2005); it seemed unlikely that there would be only 3 additional deaths in the ensuing six years. In order to increase the number of baseline records linking to records in the other datasets, a request was made to the Department of Corrective Services to supply the CHeReL with all known aliases used by participants. These were added to the identifiers used for the first round of linkage, and the linkage procedure was undertaken for a second time. Figure 5.3 compares the number of records matched to the baseline dataset in the first linkage round (baseline identifiers only) to matches obtained in the second round of linkage (baseline identifiers + aliases).

Figure 5.3: Data linkage outcomes



*This figure was not released by the Deparment of Corrective Services.^ Significant delays were experienced in obtaining OIMS data; hence, the numbers of matched individuals for OIMS data are only available for the final linkage stage.

Clearly, the use of inmate aliases in the linkage process considerably increased the number of matches that were obtained between the baseline and other datasets. However, a greater number of matches does not necessarily indicate a superior linkage outcome; some linkage studies with prisoner populations have deliberately excluded aliases from the linkage process due to concerns that their use would increase the likelihood of false positive matches (Martin, et al., 2004). The matter of whether to use matches that were obtained using only the original baseline identifiers, or those obtained using the baseline identifiers plus aliases, was resolved through an analysis of the obtained sensitivities and specificities for each linkage strategy, the results of which are presented in Chapter 6.

Data cleaning and preparation for analysis

Prior to any data analysis, an extensive data cleaning and preparation phase was undertaken.

Baseline dataset

Data were extracted from the baseline dataset for the 375 participants whose identifiers had been supplied to the CHeReL for linkage. Data extracted were date of entry to the trial; demographic variables (e.g. age, Indigenous status); and self-reported age at first incarceration, number of prior custodial episodes, drug use history and use of drugs in prison. Dates of entry to OST during the trial were also extracted. Dates of treatment entry were available for participants who had been randomised to the treatment arm of the study and also for control participants who commenced OST after moving through the waiting list.

OST data, Pharmaceutical Drugs of Addiction System (PHDAS)

Start and end dates were obtained for all episodes of opioid substitution treatment undertaken by participants during the observation period (1 June 1997- 31 December 2006). Before the data could be used in analyses, it was necessary to identify continuous treatment episodes.

Treatment entry and exit dates are recorded in the PHDAS each time a patient changes prescribers or program type (switches from methadone to buprenorphine, or vice versa). For example, a patient may have arranged to move to a different prescribing doctor on a certain date. In the PHDAS, a treatment exit date will be recorded, followed by a treatment entry date the following day. Hence, although there is an administrative change, there is no interruption to treatment. Therefore, a continuous treatment episode was defined as one where there were six or fewer days between a treatment exit date and treatment entry date (Burns, et al., 2009). When there was a gap of seven or greater days between a treatment exit date and entry date, a new episode of treatment was considered to have begun. Episodes that commenced and ended on the same day, or in which the end date preceded the start date, were assumed to be errors and deleted from the PHDAS data.

Incarceration data, Offender Integrated Management System (OIMS)

Dates of prisoner movements and reason for movement were obtained for matched participants. It was necessary to undertake extensive data cleaning and manipulation to identify continuous custodial episodes for each member of the cohort. The phrase 'continuous custodial episode' is deliberately used here to remove some of the ambiguities that arise when considering incarceration. This term encompasses any time in custody, whether it be following arrest and awaiting a bail hearing, time in prison on remand, or serving a custodial sentence.

It was not the case that custodial episodes could be easily identified from admission and release dates recorded in OIMS. This is because an OIMS record is created for each prisoner movement between correctional institutions and/or the community, and these movements do not necessarily represent discrete episodes in custody. For example, an inmate may be temporarily released to police custody for a court appearance. In OIMS, this is recorded as a release, with reason for movement coded as 'police to court'. Such a release is typically followed within a day or two by an admission to a custodial institution, with the reason for movement coded as

'received from court'. Although there has been a release and admission, the individual has remained in custody for this time. Therefore, it was necessary to scrutinise the reason for each movement to identify the true beginning and end dates of continuous custodial episodes.

A person was taken to have exited custody if the reason for the release movement was coded as any of the following: acquitted, bail, escape, parole, sentence expired or deceased. The commencement of a period in custody was, by comparison, relatively easy to identify. A person was either already in custody at the commencement of the observation period, or an admission code directly followed one of the above release codes.

Offending data, Re-offending database (ROD)

Offending variables obtained for matched participants were date of proved offences and offence type as categorised using the Australian Standard Offence Classification (ASOC) system (Australian Bureau of Statistics, 2008). Note that proved offences, rather than charges, were utilised in data analyses. This provides the most conservative estimate of re-offending. Because ROD is maintained as a research dataset, no additional cleaning or preparation for analysis was required.

Mortality data, Master Linkage Key (MLK)

Date and cause of death data for participants were provided. One duplicate record was identified and deleted prior to use of the mortality data in analyses.

Thus prepared for analysis, each dataset was able to be linked to any other dataset by using the Project Person Numbers assigned by CHeReL.

Summary

This chapter has described the use of linked, administrative data in conducting longitudinal research, and summarised the datasets that were linked for the studies in this thesis. There were particular complications with the data linkage process due

to the use of aliases by the participant group. Given this, it was considered important to formally assess whether the accuracy of the data linkage was enhanced, or reduced, by the use of aliases in the linkage process. Thus, the following chapter presents the results of a study examining the sensitivity and specificity of the linkage between the baseline dataset and the Pharmaceutical Drugs of Addiction System.

6. Assessment of OST linkage sensitivity and specificity[13]

Abstract

Aim: The aim of this chapter was to estimate the sensitivity and specificity of the linkage between the baseline dataset and the Pharmaceutical Drugs of Addiction System using two sets of identifiers; first, only those identifiers as contained in the baseline dataset, and second, the identifiers contained in the baseline dataset, plus known aliases for each participant.

Method: For each linkage process, sensitivity was calculated as the proportion of participants with a treatment entry date in the baseline dataset who were also found to have entered treatment on that date in the PHDAS. Specificity was calculated as the proportion of participants without a treatment entry date in the baseline dataset who were also found to not have a treatment entry date in the PHDAS in the 20 days after entering the original trial of prison OST.

Results: Using only the baseline identifiers for linkage, sensitivity was 64.1% and specificity was 100%. Using baseline identifiers plus aliases, sensitivity was 86.1% and specificity was again 100%.

Conclusion: Sensitivity was increased when aliases were utilised in the linkage process. Using aliases did not decrease linkage specificity. The obtained sensitivity and specificity suggest that cohort participation in opioid substitution treatment has been adequately ascertained.

[13] A version of this chapter has been published as: Larney, S. & Burns, L. (in press). Evaluating health outcomes of criminal justice populations using data linkage: The importance of aliases. *Evaluation Review*, in press.

Introduction

The use of probabilistic methods to link datasets, as described in Chapter 5, introduces the potential for errors in the linkage process, thereby possibly reducing the accuracy of the linkage. There are two aspects to linkage accuracy: sensitivity, and specificity. Sensitivity refers to the extent to which a linkage correctly detects matches, while specificity is the extent to which a linkage correctly rejects non-matches (Blakely & Salmond, 2002).

Sensitivity and specificity of linkage processes varies between studies. In a systematic review of health-related data linkage studies, sensitivities ranged from 74-98%, while specificities were 99-100% (da Silveira & Artmann, 2009); however, what is considered an acceptable level of sensitivity and/or specificity in one study cannot be extrapolated to other studies. Rather, the sensitivity and specificity of a linkage are used to assist in evaluating the reliability of results that are obtained from analysis of the linked data.

Sensitivity and specificity are calculated by comparing linkage outcomes to known matches, with known matches assumed to be 100% accurate. For example, in a study of the sensitivity and specificity of a linkage between the New South Wales (NSW) prisoner population and a health dataset, true mortality status was able to be determined for inmates who were either currently alive and in prison, or had died in custody. The true mortality was compared to matches that had been obtained through linkage of the Department of Corrective Services' Offender Integrated Management System and the National Death Index, a national database recording all deaths in Australia. Sensitivity was 88.4% and specificity was 99.7% (Kariminia, et al., 2005); that is, the linkage correctly identified 88.4% of known deaths, and only 0.3% of individuals known to be alive were incorrectly linked to a mortality record.

Often, it is not possible to conduct a sensitivity and specificity analysis, as data that contain "known links" for at least some of the population under study cannot always be identified. Indeed, if such data existed, there may not be any need for linkage. Many data linkage studies have been published without any analysis of the accuracy of the linkage process (da Silveira & Artmann, 2009); however, in studies using general population samples and databases, it is unlikely that any significant proportion of the sample has deliberately obscured their identity by using an alias when, for example, presenting to hospital. The same cannot be said of individuals appearing in criminal justice databases. For example, in the prisoner mortality study cited above, each participant had an average of two aliases (Kariminia, et al., 2005), while in a study of female Canadian prisoners, half of participants had three or more names (Martin, et al., 2004).

The frequent use of aliases by criminally involved individuals complicates the process of data linkage. Using only one name per participant for linkage purposes may result in low sensitivity, as matches to databases where the individual is recorded under a different name will be missed. It has also been argued that using aliases in the linkage process may reduce specificity by increasing the number of false positive matches. This is particularly the case when linking to large, general population databases such as cancer registries (Martin, et al., 2004). To address this concern, Martin and colleagues (2004) excluded prisoners with five or more surnames, or four or more given names, from their data linkage study; however, this resulted in disproportionate exclusion of Canadian Aboriginal women and women with lower education levels (Martin, et al., 2005), potentially affecting the generalisability of their research findings.

As described in Chapter 5, the number of matches between the baseline dataset and the various administrative datasets increased substantially when participant aliases were included in the linkage process. Wary of the potential for decreased linkage specificity when using aliases for linkage, it was considered important to

formally assess the sensitivity and specificity of the linkage outcomes obtained with and without aliases, so as to determine which set of linkage outcomes to use in the analyses in subsequent chapters. The only linkage for which known true matches were available for comparison to linkage outcomes was that between the baseline dataset and the Pharmaceutical Drugs of Addiction System.

Aims

The aims of this chapter were to:

a) Estimate the sensitivity and specificity of the linkage between the cohort and the Pharmaceutical Drugs of Addiction System, when that linkage was conducted using only the identifying details contained in the baseline dataset.
b) Estimate the sensitivity and specificity of this linkage process when conducted using the identifying details contained in the baseline dataset, plus aliases.

Method

Data sources

The data sources used in this chapter were the baseline dataset and Pharmaceutical Drugs of Addiction System (PHDAS) data. The main variables of interest were the dates of OST entry as recorded in each dataset.

As described in Chapter 5, participants for which data were linked had originally been recruited to a randomised controlled trial (RCT) of prison opioid substitution treatment. In that study, participants assigned to the control group were placed on an OST waiting list and were eligible to commence treatment after four months on the list. For the duration of the RCT, the baseline dataset recorded the date on which any participant (including those in the control group) entered OST. Excepting treatment entry dates that were considered unfeasible (e.g. occurring before the

trial commenced), the dates in the baseline dataset were assumed to be completely accurate. These were the known matches for comparison to the linkage outcomes between the baseline dataset and the dates of OST entry recorded in the PHDAS.

Data analysis

The methods used to calculate sensitivity and specificity were informed by Amin (2006) and analyses were conducted in SAS 9.1. Sensitivity and specificity were calculated for the linkage using only the identifiers as contained in the baseline dataset (i.e. without aliases), and for the linkage using the baseline identifiers plus aliases.

Sensitivity was calculated as the proportion of participants with a treatment entry date in the baseline dataset who were also found to have entered treatment on that date in the PHDAS. This was a relatively simple process, requiring only the comparison of two dates.

Calculating specificity was a somewhat more complicated process, requiring the matching of two 'non-dates': the date the person did not enter treatment in the baseline dataset, and the date they did not enter treatment in the PHDAS. It was not possible to take the date of trial entry as the date on which the person did not enter treatment and then check that the person also did not enter treatment on that date in the PHDAS. This was because among those participants who did commence treatment, there was typically a delay between entering the trial and starting treatment. Although there were some participants who experienced delays of more than a month before commencing treatment, 90% of those who were assigned to receive treatment, and then commenced treatment, did so within 20 days of entering the trial. Therefore, it was assumed that if the person did not have a treatment entry date in the baseline dataset, they should also not have a treatment entry date in the PHDAS at any time between their date of trial entry and the subsequent 20 days. Hence, specificity was calculated as the proportion of participants without a treatment entry date in the baseline dataset who were also

found, in the PHDAS, to not have entered treatment on their day of entry to the trial or within the next 20 days. Precision of the sensitivity and specificity estimates was measured using exact binomial confidence intervals.

Results

The baseline dataset recorded treatment entry dates for 225 of 375 participants. Two treatment entry dates were considered to be data entry errors as they occurred before the start of the trial. These two records were excluded from the analysis, leaving 223 participants with, and 150 participants without, baseline treatment entry records (Table 6.1). Of those participants assigned to the treatment group, 170/187 (91%) commenced treatment; the remainder did not start treatment due to factors beyond the control of the original trial investigators (e.g. Correctional Services policies). Of 186 participants assigned to the control group, 53 (28%) commenced treatment after completing their four-month follow-up, but while recruitment was still ongoing (Table 6.1).

Table 6.1: Distribution of treatment entry records in baseline dataset

		Treatment entry recorded in baseline dataset		
		No	Yes	Total
Study group	Treatment	17	170	187
	Control	133	53	186
	Total	**150**	**223**	373

The known matches in the baseline dataset were compared to the linked matches obtained using baseline identifiers only. Of the 223 participants with trial treatment entry dates, 143 had a matching treatment entry record in the PHDAS, for a sensitivity of 64.1% (95% CI 57.5%-70.4%). Of the 150 participants without a trial treatment entry date, none were found in the PHDAS in the 20 days following trial recruitment, for a specificity of 100% (one-side lower 97.5% CI 97.5%).

The known matches in the baseline dataset were then compared to the linked matches obtained using baseline identifiers and aliases. Of the 223 participants who entered treatment, 192 had a matching treatment entry record in the PHDAS for a sensitivity of 86.1% (95% CI 80.8%-90.4%). Specificity was unchanged from the previous estimate.

Discussion

Assuming the baseline dataset to be accurate, linkage to the PHDAS opioid substitution treatment data using baseline identifiers without aliases correctly identified only 64% of OST episodes for the cohort, without any incorrect matches. In practice, this would mean a high number of missed treatment episodes, reducing the reliability of any analysis of the effect of OST on the chosen outcome measures.

When aliases were added to the linkage process, sensitivity increased to 86%, again without any incorrect matches; that is, aliases enabled better ascertainment of treatment entry among participants without increasing incorrect treatment linkages. As such, the linkage outcomes obtained when using aliases were used in the studies described in chapters 7-9.

It is generally accepted that data linkage is unlikely to be completely accurate (da Silveira & Artmann, 2009); however, the obtained sensitivity (86%) and specificity (100%) suggest that OST episodes for this cohort have been reasonably accurately ascertained, permitting confidence in conclusions relating to treatment participation by the cohort. Less than perfect sensitivity is likely attributable to errors in identifying details in either the baseline dataset or the PHDAS, or the possibility that participants were registered in the PHDAS under an alias that was not used for linkage (i.e. an alias that was not recorded in the baseline dataset or by the NSW Department of Corrective Services).

Limitations

Calculation of sensitivity and specificity requires a 'gold standard' dataset against which the administrative data can be compared. In this case, the baseline dataset was held to be the gold standard; however, there were some errors identified in this dataset, with two records dated prior to the commencement of the trial. It is not possible to know the extent of errors in the baseline dataset.

As in Kariminia (2005), it is assumed that the obtained sensitivity and specificity hold for the entire observation period, even though known matches were only available for the early stages of observation.

It was not possible to calculate sensitivity and specificity for the linkages between the baseline dataset and the other administrative datasets for which linkage was undertaken (e.g. the Re-Offending Database; the Master Linkage Key). It is assumed that, as for the linkage between the baseline dataset and the PHDAS, including aliases in these linkage processes would result in increased sensitivity without necessarily reducing specificity.

Conclusion

This chapter has shown that it is possible to obtain reliable data linkage results for prisoners, a population characterised by highly variable personal identifiers. Linkage sensitivity was maximised when aliases were included in the linkage process; including aliases in the linkage process did not compromise specificity. Assuming generalisability of these results to the entire observation period, the data extracted from the PHDAS are a reliable record of OST episodes for this cohort.

7. Opioid substitution treatment and re-incarceration[14]

Abstract

Aims: The aims of this chapter were to describe the study cohort, including patterns of incarceration and OST participation during the observation period (1 June 1997-31 December 2006); assess if being in OST at the time of release from prison is protective against re-incarceration; and assess if remaining in OST after release from prison is protective against re-incarceration.

Method: Data from the Offender Integrated Management System, the Pharmaceutical Drugs of Addiction System and the Master Linkage Key were linked to participants' baseline data. Patterns of incarceration and OST participation were extracted from the data. Two recurrent event survival models were developed to analyse the effect of OST on risk of re-incarceration. The first model analysed the effect of being in OST at the time of release from prison on subsequent re-incarceration. The second model analysed the effect of treatment retention in the post-release period on re-incarceration.

Results: The median age of participants at recruitment was 26 years. Participants had a median of five incarceration episodes, and two episodes of OST, over almost ten years of follow-up. Over half of OST episodes were commenced while in prison. Ninety per cent of participants were re-incarcerated following their first observed release. In Model 1, there was no significant association between being in OST at release from prison and risk of re-incarceration. In Model 2, there was a significant

[14] Although re-offending occurs before re-incarceration, analysis of the effect of OST on re-incarceration required linkage of four datasets (baseline, OIMS, PHDAS and MLK), while analysis of re-offending required linkage of five datasets (the above-name four, and the ROD). Hence, re-incarceration data are presented first, with re-offending data analysed in chapter 8.

effect of OST exposure on re-incarceration. As long as participants remained in OST post-release, their average risk of re-incarceration was 80% that of someone not in treatment.

Conclusion: These results highlight the role of prisons in engaging participants in OST, and the importance of ensuring that inmates who are released from prison while on OST are assisted to remain in treatment when they return to the community.

Introduction

Incarceration is a common experience among people who use heroin. In the United States, it is estimated that between one-third and one-quarter of all heroin users pass through a correctional facility annually (Boutwell, et al., 2007), while in the United Kingdom, around one-third of a cohort of treatment-seeking heroin users were incarcerated during a five-year period (Oliver, et al., 2010). Cross-sectional data show high levels of self-reported prior incarceration among Australian heroin users, with prevalence ranging from 41% (Ross, et al., 2005) to 52% (N. Sindicich, national co-ordinator, Illicit Drug Reporting System, personal communication, 2 April 2010). Unsurprisingly, longer duration of heroin use has been associated with increased likelihood of incarceration, with each additional year of use translating to an 11% increase in risk of having ever been in prison; however, risk of recent incarceration appears to decline with age (Darke, et al., 2009).

Once released from prison, heroin users are highly likely to experience further periods of incarceration. In an earlier follow-up of the cohort under study, 82% of participants who had been released from prison were re-incarcerated at least once during a four-year period (Dolan, et al., 2005). Re-incarceration is often rapid, with half of released heroin users returning to prison within six months in studies in the United States (McMillan, et al., 2008) and France (Marzo, et al., 2009).

Drug use after release from prison increases the risk of an individual returning to custody (Kinner, 2006; Kjelsberg & Friestad, 2008). Of particular relevance for the current study, among a sample of NSW and Victorian prisoners, risk of re-incarceration was significantly increased among participants reporting "worsening heroin use" in the post-release period (Baldry, et al., 2006).Given this, treatment for heroin dependence may contribute to reducing risk of re-incarceration. Participation in community-based OST reduces risk of imprisonment (Milloy, et al., 2008; Oliver, et al., 2010; Werb, et al., 2008a); however, the review in Chapter 4 found mixed results with regards to the effectiveness of prison OST in reducing re-incarceration. A limitation of the studies reviewed in Chapter 4 was lack of analysis of the post-release OST status of participants. In community studies, reduced incarceration risk is only seen while individuals remain in treatment (Oliver, et al., 2010). As such, it is crucial to control for post-release retention in OST when considering re-incarceration risk.

Aims

The aims of this chapter are to:

a) Describe the study cohort, including patterns of incarceration and OST participation over the observation period of 1 June 1997 - 31 December 2006;
b) Assess if being in OST on release from prison is protective against re-incarceration; and
c) Assess if retention in OST after release from prison is protective against re-incarceration.

Method

All analyses were conducted in SAS 9.1 (SAS Institute, 2003).

Data sources

The data sources used in this chapter were the baseline dataset (for demographic variables); the incarceration data from the Offender Integrated Management System (OIMS; for dates of entry to and exit from prison); the OST data from the Pharmaceutical Drugs of Addiction System (PHDAS; for dates of entry to and exit from treatment); and the mortality data from the Master Linkage Key (MLK; for correct censoring of observations in survival analysis).

Cohort characteristics

Demographic variables and variables describing participant drug use and incarceration histories were extracted from the baseline data. Continuous variables were highly skewed, so medians are presented. Patterns of incarceration and OST during the observation period were examined by extracting data from the OIMS and PHDAS. Re-incarceration within two years of release was calculated to allow for comparisons with the published re-incarceration rate of the general NSW prisoner population (Steering Committee for the Review of Government Service Provision, 2010).

Modelling re-incarceration risk

The research question at hand is concerned with modelling time to an event of interest. Survival analysis using the Cox proportional hazards model is the standard approach to modelling time-to-event data (Cox, 1972); however, this approach only permits analysis of time to a single event of interest per participant. In the data to be analysed here, participants could experience the event of interest – re-incarceration – multiple times over the observation period. Modelling recurrent event data such as these requires statistical models that account for correlations of event times within individuals. There are several possible models to choose from, and choice of model is guided by the research question that is to be answered (Guo, et al., 2008; Hosmer & Lemeshow, 1999; Lim, et al., 2007).

For the recurrent event analyses in this and the following chapter, the Prentice-Williams-Peterson gap-time (PWP-GT) model (Prentice, et al., 1981) was determined to be the most appropriate model. The PWP-GT model is an extension to the Cox model in which dependence of event times within individuals is accounted for by stratifying the analysis by event number (Ezell, et al., 2003; Guo, et al., 2008; Hosmer & Lemeshow, 1999; Lim, et al., 2007). In addition, the standard errors of the parameter estimates are adjusted using a robust sandwich variance estimator (Ezell, et al., 2003; Lin & Wei, 1989).

A key aspect of the model is the manner in which time is counted. Most models for recurrent event data count time continuously, from zero to the end of the observation period; however, in gap-time models, time is 're-set' when an event occurs. Thus, each time interval begins at zero, and continues until the event of interest (Hosmer & Lemeshow, 1999). This allows modelling of time between events, rather than time to each event from the beginning of the observation period (Box-Steffensmeier & Zorn, 2002). This is particularly useful for analysis of re-incarceration, as it allows modelling of multiple periods of time from release to re-incarceration, while excluding time spent in prison (i.e. time during which it is not possible to experience a re-incarceration event).

Data structure

The OIMS incarceration data were manipulated to create 'release intervals'. Each release interval began with a release date, and ended at either the date of re-incarceration, date of death or 31 December 2006 (the end of the observation period) (McMillan, et al., 2008). Release intervals ending on 31 December 2006 without a re-incarceration were censored, as were release intervals that ended because the participant died. Release intervals were linked to the OST data, and two variables describing OST exposure were defined. For the first variable, release intervals were categorised as 'treated' if the participant was in OST at the start of the release interval, and 'untreated' if not. This variable thus identified if a person

was in treatment when released from prison, in line with prior research (McMillan, et al., 2008). The second variable recorded the number of days a participant remained in OST from the beginning of the release interval; for untreated release intervals, this variable was defined as 0.

Model building

Two multivariate, recurrent event survival models were developed. Model 1 incorporated the OST variable indicating the treatment status of the release interval. Treated release intervals were coded as 1, and untreated release intervals as 0.

Model 2 used the information on retention in treatment after release from prison. The number of days that a participant remained in treatment after release was included in the model as a time-dependent variable. A time-dependent variable can change in value over time; in this case, participants with treated release intervals commenced the release interval with an OST value of 1, which changed to 0 at the time of ceasing treatment.

To identify covariates for inclusion in the models, a range of variables from the baseline dataset were tested for univariate associations with re-incarceration. Covariates tested were age at first drug injection; age at first incarceration; age at release; Indigenous status; number of prior incarcerations; use of heroin during baseline or prior incarceration; injecting drug use during baseline or prior incarceration; and number of drug classes used in the month prior to baseline incarceration. Variables with univariate $p \leq 0.25$ were included in the multivariate models, in line with the recommendation of Hosmer and Lemeshow (Hosmer & Lemeshow, 1999).

Model interpretation

Although often referred to as a conditional model (Box-Steffensmeier & Zorn, 2002; Ezell, et al., 2003; Guo, et al., 2008; Hosmer & Lemeshow, 1999), the PWP gap-time

model is a marginal model in the traditional statistical sense because the parameter estimates are calculated without participant-specific effects (Ezell, et al., 2003; Therneau & Grambsch, 2000). As such, results are interpreted as population average effects, rather than participant-specific effects (Ezell, et al., 2003).

Results

Cohort characteristics

All participants were male. The median age of participants at baseline was 26 (range 18-46), and 24% (91/375) of participants identified as Aboriginal or Torres Strait Islander. 63% (236/375) of participants reported that they were hepatitis C positive; no participants reported HIV infection. Drug use and imprisonment histories prior to the baseline incarceration are shown in Table 7.1.

Table 7.1: Baseline drug use and imprisonment histories

Drug use and incarceration history	**Median (range)**
Age first injected drugs	16 (7-40)
Age first incarcerated	18 (15-43)
Number of prior custodial episodes	4 (1-62)
Drug use in month prior to baseline incarceration	**N=375 n (%)**
Heroin	360 (96.0)
Cannabis	312 (83.2)
Benzodiazepines	261 (69.6)
Methamphetamine	163 (43.5)
Illicitly obtained methadone	162 (43.3)
Cocaine	143 (38.1)
Prescribed methadone	30 (8.0)
Number of above drug types used Median (range)	4 (1-6)
Drug use in baseline incarceration or prior incarceration	**N=375 n (%)**
Used heroin in prison	239 (63.7)
Injected heroin in prison	226 (60.3)
Any drug injection in prison	238 (68.4)
Shared needle/syringe in prison	*195 (81.9)**

*% of participants reporting any drug injection in prison

Patterns of incarceration and OST during the observation period

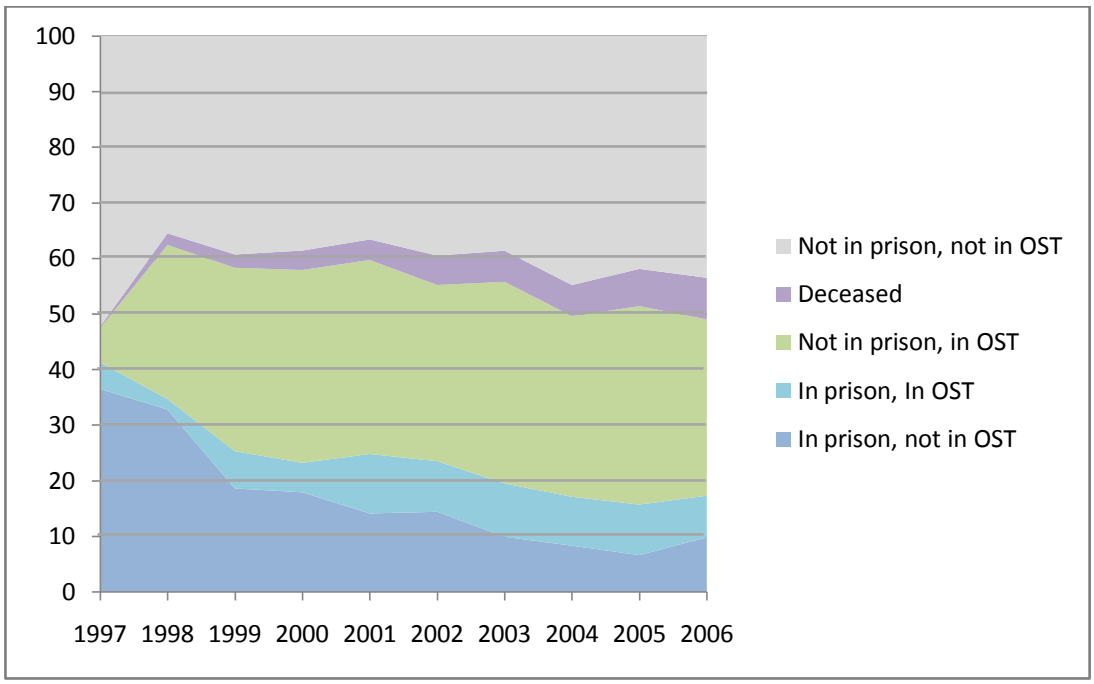
Figure 7.1 provides a graphical representation of incarceration, participation in OST, and deaths in the cohort at 30 June each year 1997-2006.[15] The figure shows that the proportion of participants in prison decreased over time, from 41% in 1997 to 17% in 2006.

Participation in OST increased rapidly between 1997 and 1999, before stabilising from 1999 onwards, with around 40-45% of participants in OST at any time point. From 2003, around half of those in prison were receiving OST. Twenty-eight participants, or 7.5% of the cohort, were deceased by 31 December 2006.[16]

[15] Note that recruitment to the original randomised controlled trial was completed in October 1998.

[16] Participant mortality is examined in greater detail in Chapter 9.

Figure 7.1: Natural history of incarceration, opioid substitution treatment and mortality, 1997-2006



Linkage between the baseline dataset and the OIMS identified that all but two of the 375 participants were incarcerated for at least one day between 1 June 1997 and 31 December 2006. Three participants were in custody for the entire observation period. Participants commenced 2036 custodial episodes, with a median of five (range 1-25) episodes per participant. The median length of each episode (based on 1946 completed episodes) was 99 days (range 1-3180 days). The median total length of time in prison over the observation period was 1337 days (range 0-3500 days), or 3.6 years.

From the linkage between the baseline dataset and the PHDAS, 88% (331/375) of participants were in opioid substitution treatment for at least one day between 1 June 1997 and 31 December 2006. Participants commenced a total of 1081 OST episodes, with a median of two (range 1-12) episodes per participant. Median episode length (based on 927 completed treatment episodes) was 156 days (range 1-2957), or approximately five and a half months. The median total length of time in treatment over the observation period was 592 days (range 3-3444), or 1.6 years.

Of the 1081 episodes of OST that were commenced during the observation period, 58% (632/1081) were commenced in prison. Eighty percent (300/375) of participants commenced an OST episode while in custody.

Risk of re-incarceration

370 participants were released from prison at least once between 1 June 1997 and 31 December 2006 and were therefore at risk of re-incarceration. Ninety percent (332/370) of released participants were re-incarcerated at some point following their first observed release. Eighty-four per cent (309/370) of released participants were re-incarcerated within two years; in contrast, only 43-45% of the total NSW prisoner population is re-incarcerated within two years of release (Steering Committee for the Review of Government Service Provision, 2010).

There were 2088 release intervals during the observation period; 40% (842/2088) were treated release intervals. The median number of release intervals was 4 (range 1-23). The median length of release intervals (i.e. time to re-incarceration or censoring) was 111 days (range 1-3391) and the median duration of post-release retention in OST was 63 days (range 1-3391); note that these latter two figures are not adjusted to take into account the correlation of release intervals within participants.

In univariate analyses, age at first incarceration and age at release were associated with re-offending at the $p \leq 0.25$ level (Table 7.2). These variables were entered into the multivariate models. Results are shown in Table 7.2.

Model 1: Dosing status of the release interval as the independent variable

In Model 1, controlling for age at first incarceration and age at release, there was no statistically significant association between OST status at release from prison and risk of re-incarceration. Age at release was significantly associated with re-incarceration, with each additional year of age associated with a 3% decrease in risk of re-incarceration (Table 7.2).

Model 2: Retention in OST post-release as the independent variable

In contrast to Model 1, there was a significant effect of OST exposure on re-incarceration in Model 2. As long as participants remained in OST, their risk of re-incarceration was reduced by an average of 20% (Table 7.2). As in Model 1, older age at release was associated with a small reduction in risk of re-incarceration.

Table 7.2: Recurrent event models of the effect of OST status at release from prison, and retention in OST post-release, on risk of re-incarceration

			Multivariate models*			
	Univariate*		Model 1 adjusted		Model 2 adjusted	
	hazard ratio (95% CI)	*p*	hazard ratio (95% CI)	*p*	hazard ratio (95% CI)	*p*
Opioid substitution treatment variables						
Treatment status of release interval	0.96 (0.86-1.06)	0.4	0.97 (0.87-1.08)	0.6		
OST status post-release#	0.79 (0.70-0.89)	<0.0001			0.80 (0.71-0.90)	0.0002
Covariates						
Age at first drug injection	1.00 (0.99-1.00)	0.7				
Age at first incarceration	0.98 (0.97-1.00)	0.01	1.00 (0.99-1.02)	0.9	1.00 (0.98-1.02)	0.9
Age at release	0.97 (0.96-0.98)	<0.0001	0.97 (0.96-0.98)	<0.0001	0.97 (0.96-0.98)	<0.0001
Indigenous status	1.05 (0.93-1.18)	0.5				
Number of prior incarcerations	1.00 (0.99-1.01)	0.8				
Used heroin in prison	1.00 (0.90-1.12)	0.9				
Injected any drug in prison	1.04 (0.93-1.17)	0.5				
Number of drug classes used month prior to baseline	1.02 (0.97-1.07)	0.4				

CI=confidence interval. *Models stratified by release episode. #Time-dependent covariate.

Discussion

Almost all participants were re-incarcerated, and re-incarceration was rapid. Simply being in treatment at the time of release did not affect re-incarceration risk; however, remaining in treatment post-release resulted in a significant reduction in the average risk of re-incarceration.

Cohort characteristics

This cohort of male, heroin-using prisoners had a median age of 26 at recruitment and one-quarter were of Aboriginal or Torres Strait Islander origin. As recruitment occurred in prisons and was restricted to men only, this cohort is not representative of all heroin users. In comparison to a group of Australian heroin users recruited to a treatment outcomes study, this cohort appears to be younger and to have initiated injecting earlier (Ross, et al., 2005). Earlier onset of injecting drug use is an indicator of socio-economic deprivation, traumatic experiences in childhood and adolescence, and poorer educational attainment (Fuller, et al., 2002; Kerr, et al., 2009; Seddon, 2008), suggesting that the cohort under study may be a particularly disadvantaged sub-group of heroin users.

Patterns of incarceration

Almost all participants experienced incarceration during the observation period. When total time in prison was considered, participants spent over one-third of the observation period in custody. Most commonly, incarceration was experienced as a series of episodes of 3-4 months duration. The proportion of participants in prison decreased over time, in line with a study of Australian heroin users that found that risk of recent incarceration decreased with age (Darke, et al., 2009).

A major concern raised by the observed pattern of incarceration is the heightened mortality risk that individuals are exposed to each time they are released from prison. In a study of NSW prisoners, Kariminia and colleagues found that as number of releases from prison increased, so too did risk of death (Kariminia, et al., 2007b).

Increased risk of death, particularly from drug overdose, in the weeks following release from prison has been frequently observed (Bird & Hutchinson, 2003; Kariminia, et al., 2007c; Odegard, et al., 2010). The frequent cycling in and out of prison seen in this cohort thus strongly suggests the need for pre-release overdose prevention strategies. It has been suggested that pre-release OST may reduce post-release overdose risk by maintaining opioid tolerance (Christensen, et al., 2006), and this issue will be considered in greater detail in Chapter 9. Providing take-away doses of naloxone, an overdose 'antidote', to heroin users on release from prison has also been suggested as a way to reduce mortality risk. Naloxone training and distribution programs have been successfully deployed in a number of locations (Doe-Simkins, et al., 2009; Strang, et al., 2008a; Wagner, et al., 2010), and an exploratory study of overdose prevention in the United States reported high acceptability of take-away naloxone among recently released prisoners (Wakeman, et al., 2009). At present, naloxone is only available in Australia on prescription (Lenton, et al., 2009a, 2009b), and there are no formal naloxone distribution programs for prisoners nearing release. The issue of post-release mortality, and how it can be addressed, is discussed in greater detail in Chapter 9.

Patterns of OST

The majority (88%) of participants engaged in OST at some stage during the observation period. Strikingly, 80% of participants commenced an OST episode while in custody, and these episodes made up over half of all treatment entries. This reflects the fact that OST is an attractive treatment option for incarcerated heroin users, because it allows inmates to avoid heroin withdrawal and alleviates opioid cravings. The appeal of OST in prison is also illustrated in a population-level study of the New South Wales OST program, which found that one-quarter of those starting OST for the first time did so while in a correctional facility (Burns, et al., 2009); that is, individuals who had not entered OST while at liberty did so when in custody. These results suggest that restrictions on commencing OST while in prison, as exist in some Australian jurisdictions and internationally (Larney & Dolan, 2009b),

are counter-productive, as they prevent treatment entry at a time when demand for treatment appears to be strong.

Effects of OST on re-incarceration

Re-incarceration following first observed release from prison was the norm and occurred rapidly, with median time to re-incarceration around 4.5 months. The proportion of released prisoners who had been re-incarcerated within two years of release was much greater than that seen among NSW prisoners in general (84% vs. 43-45%) (Steering Committee for the Review of Government Service Provision, 2010). Studies modelling prisoner population growth show that even minor reductions in re-incarceration of groups of offenders with high levels of re-incarceration produce significant benefits in terms of reducing the size of the prisoner population and the costs of correctional administration (Weatherburn, et al., 2009). Therefore, any intervention that reduces re-incarceration of heroin users would produce benefits for the correctional system as a whole.

In keeping with recent studies (Marzo, et al., 2009; McMillan, et al., 2008), being in OST at release from prison did not significantly affect re-incarceration. However, when retention in treatment was factored into the statistical model, it was found that while participants remained in OST after release, their risk of re-incarceration was reduced by an average of 20%. Thus, it appears that it is not OST exposure in prison *per se* that affects re-incarceration, but whether a person remains in treatment following release. This makes sense in light of research showing that the benefits of OST are maintained only while individuals remain in treatment; in community samples, rates of criminal offending and incarceration are reduced only while in OST, rising during periods out of treatment (Davstad, et al., 2009; Lind, et al., 2005; Werb, et al., 2008a).

Although risk of re-incarceration was reduced as long as participants were retained in treatment, the median retention time was only 63 days. That is, in half of treated release intervals, treatment had ceased within two months of release. The post-

release period is a highly stressful time, marked by difficulties in finding appropriate housing and income (Baldry, et al., 2006; Halsey, 2007). Released inmates typically return to a drug- and crime-involved peer group, and even among those who intend to avoid doing so, post-release illicit drug use and criminal activity is common (Halsey, 2007; Kinner, 2006). In the face of such pressures, the requirement to attend a clinic daily for pharmacotherapy may be a burden too difficult to maintain. Comprehensive pre-release planning and post-release support is needed to address not only treatment needs, but also the multitude of other difficulties that released inmates contend with.

During the observation period for this study (1997-2006), access to post-release OST for NSW inmates was conducted on either an ad hoc basis, or through pilot projects run by Justice Health (the government department providing health care services in NSW prisons) (Martire & Howard, 2009). In 2007, a state-wide program, the Connections Project, was established to link inmates not only to community OST providers, but also to housing and other health and welfare services. The Connections Project is currently being evaluated, but preliminary results suggest post-release retention in OST may be improved by participation in this program (Martire & Howard, 2009). Access to community OST is also facilitated by Department of Health policies giving released prisoners priority access to public (no-fee) OST clinics (Mental Health and Drug and Alcohol Office, 2005).

It could be argued that, because post-release retention is the key to reducing re-incarceration, there is no need to provide OST while in prison, and that resources should instead be directed to assisting inmates with a history of heroin use to enter OST on release. However, several studies have shown that post-release entry to OST is maximised when treatment is commenced while in prison (Kinlock, et al., 2007; Magura, et al., 1993; Tomasino, et al., 2001). For example, in a randomised trial of prison OST in the United States, those who had been in treatment while in prison were significantly more likely to enter post-release treatment than participants who

were simply given a post-release treatment referral (Kinlock, et al., 2007). As discussed in Chapter 3, there are also other benefits to OST in prison, such as reduced drug injecting and sharing of needles and syringes (Dolan, et al., 2003; Larney, 2010). Hence, the maximum benefits from OST may be obtained by commencing (or continuing) treatment while in prison, and providing assistance to ensure a smooth transition to a post-release treatment provider. Factors affecting post-release retention in treatment are not well understood and further research should consider the role of individual (e.g. motivation; social integration) and systemic (e.g. costs of treatment programs) factors in improving retention.

Limitations

There were some indications that, in comparison to a community-recruited cohort of Australian heroin users (Ross, et al., 2005), this cohort became entrenched in illicit drug use at an earlier age. Hence, these participants may not be representative of the broader population of heroin users. However, this does not invalidate the findings, as the more severe profile of this cohort would serve to produce conservative estimates of treatment effects.

It is also important to keep in mind that all members of the cohort under study, by definition, have a history of incarceration. Prior incarceration is a strong predictor of future incarceration (Department of Justice, 2007); therefore, patterns of incarceration seen in this cohort may be more extreme than those seen in a community-recruited cohort of heroin users, among whom only a proportion would have a history of incarceration.

A limitation to all data linkage studies is the potential for poor linkage accuracy. The sensitivity and specificity analysis in Chapter 6 suggested that the linkage to the PHDAS was relatively accurate, and the linkage to the OIMS was conducted using a unique identifier, promoting high sensitivity and specificity of linkage. However, it is possible that some participants may have had periods of incarceration or treatment outside of NSW. In a recent survey of NSW inmates, around 10% had been living

interstate in the year prior to their current incarceration (Indig, et al., 2010). Incarceration or treatment episodes occurring interstate would not have been identified in the linkage, potentially leading to underestimation of re-incarceration.

Conclusion

This chapter has identified a pattern of repeated incarceration of heroin users, with participants spending more than twice as much time in prison as in opioid substitution treatment. It was common for participants to commence OST while in prison, demonstrating the importance of prisons as sites for engaging heroin users in treatment.

Heroin users who remained in OST after release from prison had a reduced risk of re-incarceration. Thus, in terms of reducing re-incarceration, the maximum benefits of prison-based OST can be obtained by providing treatment in prison, and support to remain in treatment after release. In addition to the benefit to the individual, reduced re-incarceration of heroin users would benefit the correctional system as a whole, through reducing the size of the prisoner population and the costs of correctional administration.

8. Opioid substitution treatment and post-release criminal convictions

Abstract

Aims: The aims of this chapter were to describe the number and type of criminal convictions received by participants; compare conviction rates in and out of OST; assess if being in OST at time of release from prison reduced risk of receiving a new criminal conviction; and assess if remaining in OST after release from prison reduced risk of receiving a new criminal conviction.

Method: Criminal convictions from the Re-Offending Database were examined and the number and type of offences committed by participants were described. Conviction rates were calculated per person, per year at liberty, for time in OST and out of OST. To examine associations between OST and offending, convictions data were added to the linked data used in Chapter 7. As in Chapter 7, two recurrent event survival models were developed; one considering the effect of OST status at release on subsequent convictions, and one considering the effect of retention in post-release OST on convictions. Because of concerns related to potentially informative censoring, the recurrent event models were subjected to a sensitivity test.

Results: 88% of participants were convicted of an offence between 1 June 1997 and 31 December 2006. Theft and related offences were the most common type of offences for which participants were convicted. The overall conviction rate was 4 convictions per person, per year; there was no statistically significant difference between the in-treatment and out-of-treatment conviction rates. There was no statistically significant association between either OST status at release, or retention in OST post-release, on risk of criminal conviction. However, results of sensitivity testing suggested that the second recurrent event model may have been biased as a result of informative censoring.

Conclusions: There was no evidence of an association between either OST release status, or post-release OST retention, and subsequent criminal convictions; however, sensitivity testing suggested that the use of convictions, rather than arrests or criminal charges, may have introduced bias to the analysis.

Introduction

The relationship between heroin use (and illicit drug use more generally) and criminal activity has been widely studied. Although there is no objective 'true' record of how much crime an individual commits (see Box 8.1), self-reported and officially recorded offending data generally show high levels of criminal offending among people who use heroin (Bennett, et al., 2008; Oliver, et al., 2010; Oviedo-Joekes, et al., 2008; Sheerin, et al., 2004; Stewart, et al., 2000).

Multiple studies have examined offending among Australian heroin users. In a national study of treatment entrants, 39% reported committing any crime in the past month, most commonly property offences (e.g. theft; 22%) and drug dealing (21%) (Digiusto, et al., 2006b). In a separate treatment-seeking cohort, 55% reported criminal activity in the previous year, with property crimes (38%) and dealing (27%) again being the most common offences (Ross, et al., 2005). More recently, just over half (52%) of heroin users interviewed nationally for the 2009 Illicit Drug Reporting System (IDRS) reported committing at least one crime in the last month. Thirty percent reported drug dealing, and 23% had committed property offences (N. Sindicich, national co-ordinator, Illicit Drug Reporting System, personal communication, 3 May 2010).

Box 8.1: Data sources for studying offending

There is no objective, 'true' source of data about criminal offending. Data for studying offending are of two main types: self-report, and official records maintained by criminal justice agencies. Both of these types of data have weaknesses. In the case of self-report, it is difficult to know the extent to which a participant is honestly recounting their offending history. Depending on their motivation, it may be expected that participants might minimise or exaggerate their criminality. However, several studies have examined the validity of self-reported criminal activity, concluding that, generally, individuals do not deliberately under-report or exaggerate their offending, and self-reports are an acceptably reliable method for assessing such behaviour (Bonito, et al., 1976; Junger-Tas & Marshall, 1999; Langenbucher & Merrill, 2001; Webb, et al., 2006).

Criminal justice records of offending may document arrests, criminal charges or convictions. Although criminal justice records are a more objective data source than participant self-reports, these also have limitations. Not all crime is reported to police (Australian Bureau of Statistics, 2010), and of crimes that are reported, only a minority result in an arrest or conviction (Goh & Moffatt, 2010). As such, officially recorded offending will always provide conservative estimates of true offending.

There is evidence that at least some, if not most, offending by heroin users is driven by the need to generate funds for drug purchases. As noted above, the crimes most commonly committed by this group are those that provide income: drug dealing, and property crimes such as shoplifting and theft from individuals (Best, et al., 2001; Digiusto, et al., 2006b; Maher, et al., 2002; Manzoni, et al., 2010; Ross, et al., 2005). Several studies have demonstrated that as the intensity or frequency of heroin use increases, so too does the frequency of offending, and that during periods of relatively less drug use, offending is reduced (Ball, et al., 1983; Manzoni, et al., 2010).

Although the economic imperative drives much offending by heroin users, there is also evidence that for some individuals, offences are committed for reasons unrelated to drugs. For example, in one study, half of injecting drug users who engaged in criminal activity said they would continue to commit crimes even if they did not need money to buy drugs (DeBeck, et al., 2007). Multiple studies have noted

that within samples of heroin users, there are individuals who are particularly prolific offenders (Hall, et al., 1993; Nurco, et al., 1988; Stewart, et al., 2000).For example, among treatment entrants in one study, three-quarters of property crimes were committed by just 10% of the sample (Stewart, et al., 2000). These individuals with higher levels of criminal activity tend to have commenced their offending careers at an earlier age, often preceding illicit drug use (Nurco, 1998; Nurco, et al., 1988). Nurco classified heroin users such as these as 'high-crime' users, as compared with 'low-crime' users, and showed that it was only low-crime users who reduced their offending behaviour during periods of reduced drug use; in contrast, high-crime individuals maintained a high level of offending behaviour irrespective of changes in drug use patterns (Nurco, 1998; Nurco, et al., 1988).

Does opioid substitution treatment reduce offending?

It is generally argued that reducing heroin use through treatment should have the flow-on effect of reducing criminal activity (Hall, 1996). However, offending is most effectively reduced by treatment approaches that address a suite of 'criminogenic' risks and needs (Andrews & Bonta, 2006, 2010). Drug use is one of these risks; others include antisocial/pro-criminal cognitions, behaviours and associates and limited involvement in pro-social leisure activities and employment (Andrews, et al., 2006). In the risk/needs model of offending, addressing drug use through OST will only reduce offending in those individuals for whom drug use is the primary reason for offending. The fact that many heroin users have motivations other than purchasing drugs when committing crimes (DeBeck, et al., 2007; Nurco, 1998; Nurco, et al., 1988; Stewart, et al., 2000) suggests that OST alone may not always be effective in reducing offending.

This limitation of OST – that it addresses only one risk factor for offending - has been borne out by research evidence suggesting that participation in OST substantially reduces criminal activity overall, but that a minority of individuals continue to commit crime while in treatment. For example, in a national evaluation

of OST in Australia, the proportion of participants reporting past-month criminal activity was significantly reduced from 39% to 20% (Digiusto, et al., 2006b). Similarly, half of participants entering OST as part of a UK treatment evaluation study reported recent acquisitive crime at baseline; at one-year follow-up, one-quarter reported committing an acquisitive crime in the three months prior (Gossop, et al., 2000). This pattern of findings – that overall offending is decreased while in treatment, but a minority continue to commit crimes – has been reported many times over (Bell, et al., 1997; Hser, et al., 1988; Lawrinson, et al., 2008; Sheerin, et al., 2004).

Other factors besides individual propensities for offending also affect the extent to which OST reduces offending behaviour. Retention in treatment has been shown to be critical in reducing offending, with offending rates increasing after leaving treatment (Deck, et al., 2009; Lind, et al., 2005), although perhaps not to the same level as pre-treatment (Hser, et al., 1988). Indeed, there is evidence from recent studies that shorter episodes of OST (e.g. 3-4 months duration) may have zero effect on offending (Deck, et al., 2009; Oliver, et al., 2010). For example, a study of OST patients in a primary care clinic found that there was no difference in number of criminal convictions over a five-year period between those who left treatment early in the follow-up, and those who engaged in multiple treatment episodes of limited duration. In contrast, those who were in treatment continuously over the five-year period had significantly fewer convictions than either of these groups (Oliver, et al., 2010).

Prison-based OST and post-release offending

One rationale for OST in prisons is that treatment in prison will reduce criminal offending after release (Hall, et al., 1994). As the review in Chapter 4 showed, there is currently limited evidence to support this hypothesis. The strongest evidence, from a series of follow-ups of a randomised controlled trial of prison OST, suggests that for the first six months post-release, inmates treated with OST commit fewer

offences than untreated inmates (Gordon, et al., 2008; Kinlock, et al., 2008); however, by 12 months post-release, this difference is no longer evident (Kinlock, et al., 2009). Potentially, this pattern of results is related to retention in treatment after release, but an analysis incorporating post-release treatment retention was not conducted on this sample. No other studies reviewed in Chapter 4 found any significant effect of prison-based OST on re-offending, and none considered the role of retention in treatment after release on whether a person re-offended.

Aims

The aims of this chapter are to:

a) Describe the number and types of criminal convictions received by participants
b) Compare conviction rates in and out of treatment
c) Assess if being in OST on release from prison reduces re-offending, as measured by criminal convictions
d) Assess if retention in OST after release from prison reduces re-offending, as measured by criminal convictions.

Method

Data sources and preparation

The analyses in this chapter used all of the administrative datasets used in Chapter 7, with the addition of data from the Re-Offending Database (ROD) on the types and dates of offences committed by participants. Data from the ROD contained proved

offences only.[17] Proved offences were selected for analysis because they are the most conservative indicator of re-offending.

Criminal convictions and conviction rates

Participants were grouped by whether they had a proved conviction during the observation period, and differences between participants with and without proved offences were tested using *t*-tests and chi-square tests as appropriate. For those participants with proved offences, the number and types of offences were tabulated.

Conviction rates and 95% confidence intervals were calculated per person, per year, based on person years at liberty (i.e. not in prison). The conviction rate in treatment was compared to that out of treatment to give a rate ratio.

Re-offending analyses

Data structure

The dataset used to assess re-incarceration in Chapter 7 was linked to the offending data from the Re-offending Database. In the data used in Chapter 7, release intervals ended with a date of re-incarceration, date of death, or 31 December 2006 (the end of the study period). For analysis of re-offending, release intervals ended at either the date of first offence after release from prison, date of re-incarceration, date of death, or 31 December 2006. Release intervals ending in re-incarceration, death or on 31 December 2006 without an offence were censored.

The use of re-incarceration as a censoring event requires some explanation. It had been assumed prior to conducting these analyses that all re-incarcerations would be preceded by an offence date, and therefore that all release intervals that did not

[17] That is, offences for which the individual was convicted.

end in death or at the end of the study period would end with an offence. Once the data were linked, it became apparent that this was not the case. Only data on *proved* offences were obtained for the study. Thus, it was possible for individuals to appear in the prison data following an arrest for an offence, but if the offence was not proved, it would not appear in the offending data. Participants could also be re-incarcerated as a result of a breach of parole conditions; this would not necessarily require a new conviction to be recorded. As a result, there were a number of release episodes which ended with re-incarceration, but the participant had not experienced an offending event as defined for this study. In order to avoid treating time in prison the same as time at liberty in terms of risk of new conviction, these release intervals were censored on the day of re-incarceration.

The use of re-incarceration as a censoring variable potentially introduces the problem of 'informative censoring' to the analysis. Informative censoring occurs when the time to censoring is related to the outcome of interest, potentially biasing results (Clark, et al., 2003). In this case, it is possible that re-incarceration was related to offending behaviour that resulted in arrest, but not conviction.

It is difficult to identify and assess the impact of informative censoring. The standard approach is to conduct a sensitivity analysis in which two models are generated, each under a different extreme assumption (Allison, 1995; Clark, et al., 2003; Collett, 2003). If the model results under each of these assumptions are broadly similar to those of the original model, it can be assumed that the results are not sensitive to the presence of informative censoring (Collett, 2003).

The first sensitivity analysis assumption is that censored observations actually experienced an event at their censoring time. This assumption is based on the hypothesis that those who are censored were actually at high risk of experiencing the event of interest. The second assumption is that censored observations, although still censored, were observed as long as the longest time to event in the sample. This assumption is based on the hypothesis that those who were censored

were at low risk of the event of interest (Allison, 1995; Collett, 2003). Allison (1995) notes that in many cases, one of these assumptions may be more plausible than the other, in which case greater attention may be given to the assumption that is more likely to affect the data at hand. In this case, the first assumption – that people censored because of re-incarceration had actually committed an offence – is more likely than the second.

Model building

Time to re-offending was analysed using the same modelling strategy as in Chapter 7. Two Prentice-Williams-Peterson gap-time models were developed to test factors affecting time to first proved offence following release from prison: Model 1, with the treatment status of the release interval as the independent variable, and Model 2, with retention in OST after release from prison as the independent variable. Covariates in the models were identified by testing for associations between a range of variables and time to first proved offence, with variables reaching $p \leq 0.25$ included in the multivariate models (Hosmer & Lemeshow, 1999).

Because of the potential for informative censoring introduced by the use of re-incarceration as a censoring variable, sensitivity analyses were undertaken. Each model was re-fit under the assumption that in all release intervals that ended with re-incarceration, the participant had committed an offence that day (Allison, 1995). The second sensitivity assumption (which was highly unlikely to represent the true situation) could not be implemented without interfering with the recurrent event structure of the data, so this analysis was not conducted.

Results

Criminal convictions

According to the linkage with the Re-offending Database, 325/375 (88%) of participants were convicted of a new offence between 1 June 1997 and 31 December 2006. Comparisons between participants with new convictions and those

without showed that the former were significantly younger than the latter at recruitment (Table 8.1). No other variables tested showed a significant difference between groups.

Table 8.1: Participant characteristics, by conviction status

	New criminal conviction?			
	Yes	No		
	Mean (SD)		Student's *t*	*p*
Age	26.6 (6.0)	28.4 (6.6)	1.94	0.05
Age at first injection	17.3 (7.5)	17.8 (4.0)	0.72	0.5
Age at first incarceration	19.7 (3.6)	20.4 (4.5)	0.99	0.3
Prior incarcerations	4.9 (5.3)	4.4 (3.2)	-1.02	0.3
Drug classes used in month prior to baseline incarceration^	3.7 (1.1)	3.7 (1.4)	-0.41	0.7
	n (%)		χ^2	*p*
Indigenous status				
Indigenous	79 (87)	12 (13)		
non-Indigenous	246 (87)	38 (13)	0.002	0.9
Used heroin in prison				
Yes	203 (85)	36 (15)		
No	122 (90)	14 (10)	1.7	0.2
Injected drugs in prison^				
Yes	201 (85)	36 (15)		
No	123 (90)	14 (10)	1.9	0.2

^ Data missing for one participant

Participants were convicted of 5975 offences during the observation period. The median number of proved offences per participant was 15 (range 1-79). As shown in Table 8.2, theft and related offences were the charges most frequently bought against participants, making up almost one-third of offences. Theft was also the most widespread offence, with 83% of participants being found guilty of theft or a related offence at least once (Table 8.2).

Table 8.2: Criminal convictions of participants, 1 June 1997- 31 December 2006

Offence type	Convictions (N=5975) n (%)	Participants (N=325) n (%)
Theft and related offences	1736 (29.0)	268 (82.5)
Traffic and vehicle regulatory offences	826 (13.8)	184 (56.6)
Public order offences	646 (10.8)	225 (69.2)
Unlawful entry/burglary, break and enter	628 (10.5)	159 (48.9)
Offences against justice procedures	520 (8.7)	187 (57.5)
Illicit drug offences	456 (7.6)	196 (60.3)
Acts intended to cause injury	435 (7.3)	171 (52.6)
Fraud, deception and related offences	205 (3.4)	98 (30.2)
Dangerous or negligent acts endangering persons	175 (2.9)	104 (32.0)
Property damage and environmental pollution	120 (2.0)	80 (24.4)
Miscellaneous offences	84 (1.4)	59 (18.2)
Prohibited and regulated weapons offences	75 (1.3)	52 (16.0)
Robbery, extortion and related offences	61 (1.0)	41 (12.6)
Other*	8 (<1)	8 (<1)

*Includes abduction and other offences against the person; homicide and related offences; and sexual assault and related offences.

Conviction rates

The overall conviction rate was 4 convictions per person, per year. Although the in-treatment conviction rate was lower than that out of treatment, the difference was not statistically significant (Table 8.3).

Table 8.3: Conviction rates in and out of treatment

	N proved offences	Person years	Conviction rate (95% CI)*	Rate ratio (95% CI)^
Total convictions	5975	1461.35	4.09 (3.99-4.19)	
Convictions in OST	1961	495.27	3.96 (3.79-4.14)	
Convictions out of OST	4014	966.08	4.16 (4.03-4.29)	0.95 (0.90-1.01)

*Proved offences per person per year; ^Ratio of conviction rate in OST to conviction rate not in OST

Risk of new conviction post-release

The median length of time between release from prison and a proved offence was 155 days (range 1-3391 days) and the median duration of post-release retention in OST was 63 days (range 1-3391 days); note that these two figures are not adjusted to take into account the correlation of release intervals within participants.

In univariate analyses, age at first incarceration, age at release, number of prior incarcerations, having injected drugs in prison and number of drug classes used prior to baseline incarceration were all associated with a new conviction at the $p \leq 0.25$ level (Table 8.4). These variables were entered into multivariate models that were stratified by release number. Results are shown in Table 8.4.

Model 1: Treatment status of the release interval as the independent variable

Adjusted for all other variables in the model, there was no association between OST status at release from prison and time to first proved offence (Table 8.4). There was a significant association with age at release, with each additional year of age associated with a 3% reduction in risk of new conviction post-release. Incarceration history was also significantly associated with risk of new conviction, with each additional prior incarceration contributing a 2% increase in risk.

In the sensitivity analysis, treating release intervals that ended with re-incarceration as though they were offending events had minimal effect on the hazard ratio of the OST variable (adjusted hazard ratio for OST status 0.99, 95% CI 0.89-1.10, *p*=0.8), suggesting that the results were robust to the effects of potentially informative censoring.

Model 2: Retention in OST post-release as the independent variable

Adjusted for all other variables in the model, there was no association between retention in OST after release from prison and time to first proved offence (Table 8.4). As in Model 1, age at release and number of prior incarcerations were significantly associated with small changes in risk of new conviction.

In the sensitivity analysis, treating release intervals that ended with re-incarceration as though they were offending events led to a statistically significant finding (adjusted hazard ratio 0.90, 95% CI 0.80-1.00, *p*=0.05), suggesting that the results of the model may have been biased by informative censoring.

Table 8.4: Recurrent event models of the effect of OST status at release from prison, and OST status post-release, on criminal convictions

			Multivariate models*			
	Univariate* hazard ratio (95% CI)	*p*	Model 1 adjusted hazard ratio (95% CI)	*p*	Model 2 adjusted hazard ratio (95% CI)	*p*
Opioid substitution treatment variables						
Treatment status of release interval	1.03 (0.91-1.18)	0.6	0.99 (0.87-1.13)	0.9		
Treatment status post-release#	0.97 (0.85-1.12)	0.7			0.88 (0.77-1.01)	0.07
Covariates						
Age at first injection	0.99 (0.99-1.00)	0.49				
Age at first incarceration	0.98 (0.96-1.00)	0.01	1.00 (0.98-1.02)	0.3	1.00 (0.98-1.02)	0.9
Age at release	0.97 (0.96-098)	<0.0001	0.97 (0.96-0.98)	<0.0001	0.97 (0.96-0.98)	<0.0001
Heroin use in prison	1.03 (0.88-1.19)	0.7				
Indigenous status	1.06 (0.88-1.26)	0.5				
Number of prior incarcerations	1.01 (1.00-1.02)	0.01	1.02 (1.01-1.03)	0.0007	1.02 (1.01-1.03)	0.001
Injected any drug in prison	1.10 (0.95-1.28)	0.2	1.12 (0.97-1.30)	0.1	1.13 (0.98-1.32)	0.1
Number of drug classes used in month prior to baseline incarceration	1.05 (0.98-1.21)	0.1	1.04 (0.98-1.10)	0.2	1.04 (0.97-1.10)	0.3

CI=confidence interval. *Models stratified by release episode. #Time-dependent covariate.

Discussion

The key finding of this chapter is that neither being in OST at release from prison, nor remaining in OST after release, were associated with reduced risk of a new criminal conviction. This somewhat contradicts the finding in Chapter 7 that remaining in OST post-release reduces risk of re-incarceration, as it would be logical to assume that reductions in re-incarceration are a result of reducing offending. Potential explanations for this inconsistency, and the impact of using convictions as an outcome measure, are examined below.

Criminal convictions

The majority of participants (88%) were convicted of a new offence during the observation period, with only age differentiating those who were not convicted from those who were. As expected, convictions were most commonly for theft offences. There was no significant difference in conviction rates when participants were in OST versus out of OST. Although a number of studies have found OST to be associated with reductions in offending (Digiusto, et al., 2006b; Gossop, et al., 2000; Lawrinson, et al., 2008; Lind, et al., 2005), there have also been studies demonstrating that the relationship between treatment and criminal activity is mediated by other factors. Variables such as ongoing illicit drug use during treatment (Bell, et al., 1997; van der Zanden, et al., 2007) and shorter treatment episodes (Deck, et al., 2009; Oliver, et al., 2010) both play a role in reducing the likelihood that OST will reduce an individual's offending behaviour. Although no information was available on participants' drug use during the observation period, data on OST episodes presented in Chapter 7 showed that the median length of treatment episodes was only five months. Therefore, it is perhaps not surprising that OST did not significantly affect conviction rates among this cohort.

Risk of new conviction post-release

Neither being in OST at release from prison, nor remaining in OST post-release, protected against new criminal convictions. However, results of the sensitivity

analysis for Model 2 suggest that if arrests or criminal charges had been used as the outcome measure, rather than convictions, there may have been a statistically significant effect of retention in treatment. In this study, convictions were selected for analysis as they are the most conservative proxy measure of re-offending; however, as Lind notes, offences can be resolved informally, without a criminal conviction (Lind, et al., 2005). As such, convictions may be too conservative a measure of re-offending, and arrests or criminal charges may be a more appropriate outcome measure.

As they stand, these results accord with those of other studies that defined re-offending in terms of convictions (Hume & Gorta, 1989; Johnson, et al., 2001). They contrast with the self-reported criminal activity data that Kinlock and colleagues analysed at three- and six-months post-release in their randomised trial of prison OST. Those studies found that treated inmates reported significantly less criminal activity than untreated inmates (Gordon, et al., 2008; Kinlock, et al., 2008); however, when officially recorded arrests were analysed for this cohort at 12-month follow-up, treated inmates had the same risk of arrest as untreated inmates (Kinlock, et al., 2009).

Setting aside the possibility that the obtained results are overly conservative, a potential explanation for the lack of a treatment effect on post-release offending is the limited effect that OST has on criminogenic risks and needs other than drug use. Having been recruited in prison, and, as shown in the previous chapter, potentially having a more severe clinical profile than other samples of Australian heroin users, it is likely that a proportion of the individuals in this cohort have motivations for offending that extend beyond acquiring funds for drug purchases. As such, OST alone will not necessarily reduce their offending. This highlights the importance of therapeutic programs in prison that address the range of criminogenic risks and needs (Andrews & Bonta, 2006, 2010). To date, there have been no evaluations of

prison OST in conjunction with such programs; this is an area worthy of further exploration.

The finding in Chapter 7, that remaining in OST after release from prison reduced risk of re-incarceration, is somewhat contradicted by the findings of this chapter. It is possible that although OST did not reduce participants' criminal convictions, being enrolled in OST made it less likely that a participant, once convicted, would receive a custodial sentence. That is, sentencing magistrates may have taken into account that an individual was in treatment, and applied a non-custodial sentence in order to avoid interrupting this treatment program. It is also possible that although participants continued to offend, the seriousness of the offences was reduced while in treatment, and hence custodial sentences were not applied for this reason. The role of OST in moderating offence seriousness or sentencing outcomes requires further research.

It is of note that both here and in the previous chapter, there was no association between being Indigenous and recidivism. This is at odds with the wider literature on recidivism in Australia (Department of Justice, 2007). However, limited studies of sub-populations of offenders with substance use disorders have found that Indigenous status is unrelated to recidivism risk when these disorders are taken into account (Martire & Larney, 2011; Larney & Martire, 2010). It is possible that heroin use is associated with such high rates of re-offending and re-incarceration that it overrides socio-demographic characteristics usually associated with increased risk of recidivism, such as Indigenous status.

Limitations

As noted above, criminal convictions was not the best choice of outcome measure for this study. The use of convictions complicated the data linkage and analysis as, contrary to initial expectations, a number of incarceration episodes were not preceded by a conviction. These may be explained by imprisonment following arrests for offences which did not proceed to court (Lind, et al., 2005), or for which

the participant was acquitted by the court; in NSW, as great a proportion as 60% of people received to prison are subsequently released without a conviction (Grant, 2010). It is also possible that the data linkage with the Re-Offending Database may not have been as sensitive as that with the custodial data from the Offender Integrated Management System (OIMS). A unique identifier (the Master Index Number, or MIN) was used to match the baseline data to the OIMS, while matches between the baseline data and the ROD were made using names, aliases and dates of birth. The use of the MIN may have assisted in identifying more matches between the baseline and custodial data than the combination of identifiers used for matching the baseline data with the Re-Offending Database.

Conclusion

This chapter has reported results suggesting that neither OST in prison, nor post-release, assists in reducing criminal convictions. However, results of the sensitivity analysis for Model 2 suggest that convictions may be an overly conservative indicator of re-offending. Further examination of the effects of post-release retention in OST on re-offending, measured by arrests or even self-reported offences, is warranted. In particular, evaluations of OST combined with therapeutic programs designed to address non-drug criminogenic risks and needs may provide insights into how best to reduce offending.

9. Opioid substitution treatment, incarceration and mortality

Abstract

Aim: The aim of this chapter was to examine mortality among the cohort, with reference to participation in OST and periods of incarceration.

Method: Mortality data from the Master Linkage Key were linked to the OST data from the Pharmaceutical Drugs of Addiction System and incarceration data from the Offender Integrated Management System. Causes of death were described using ICD-10 codes as applied by the Australian Bureau of Statistics. The standardised mortality ratio was calculated by comparing observed deaths to the age-, sex- and period-adjusted number of expected deaths in New South Wales for the years 1997-2006. Crude mortality rates (CMR) and rate ratios were calculated for time in treatment vs. out of treatment, time in prison vs. at liberty, and the first 28 days post-release vs. all other time at liberty.

Results: There were 28 deaths (7.5% of participants), half of which were drug-related. Participants died at six times the rate of male New South Wales residents of the same age; risk of death was significantly reduced while in OST and while incarcerated. There were four deaths in the 28 days post-release; three of these were opioid overdoses and none were in OST prior to death. Although the CMR for the first 28 days post-release was higher than that for all other time at liberty, this difference did not reach statistical significance.

Conclusions: The high prevalence of drug-related deaths in the cohort indicates that there is a need for education for prisoners on risk factors for, and appropriate responses to, overdose. Training inmates nearing release, and their partners or families, to administer cardiopulmonary resuscitation and naloxone may assist in reducing overdose deaths. This study was not able to directly assess the effect of prison OST on post-release risk of death; however, given the effectiveness of OST in

reducing mortality among heroin users in general, prison-based OST is likely to be of benefit in addressing post-release mortality.

Introduction

Heroin use is associated with a significantly increased risk of death (Darke, et al., 2007a). In Australian cohort studies, heroin users die at around six times the rate seen in the general population, with overdose, accidental injury and suicide the leading causes of death (Degenhardt, et al., 2009c; Gibson, et al., 2008; Stoove, et al., 2008). Low HIV prevalence in Australian heroin users (National Centre in HIV Epidemiology and Clinical Research, 2009a) means that AIDS is not a significant contributor to excess mortality, accounting for only 5% of deaths in a cohort of OST patients observed between 1985 and 2005 (Degenhardt, et al., 2009c). This is in sharp contrast to European and North American cohorts, where AIDS accounted for up to half of all injecting drug user deaths in the 1980s and 1990s (Bargagli, et al., 2001; Sanchez-Carbonell & Seus, 2000; Tyndall, et al., 2001). Deaths due to AIDS are declining among heroin users in developed countries due to improved effectiveness of, and access to, antiretroviral therapies for HIV infection (Manfredi, et al., 2006; Pavarin, 2008), but AIDS remains a significant source of mortality among drug users in developing countries (Solomon, et al., 2009).

Mortality and imprisonment

As a group, prisoners and ex-prisoners experience substantially increased mortality in comparison to the general population (Farrell & Marsden, 2005; Kariminia, et al., 2007a; Rosen, et al., 2008). In Australia, male prisoners and ex-prisoners die at 3.7 times, and females at 7.8 times, the rate of their age-matched, never-incarcerated peers (Kariminia, et al., 2007a; Kariminia, et al., 2007b). The most common causes of death among people with a history of incarceration are drug overdose and suicide, but mortality rates for all causes of death are elevated compared to non-

incarcerated persons. For example, people with a history of incarceration are two to three times as likely as their non-incarceration peers to die of cardiovascular disease (Kariminia, et al., 2007a). Factors associated with increased risk of death include having been hospitalised for psychiatric illness, and multiple episodes of imprisonment (Kariminia, et al., 2007b).

The increased risk of death experienced by prisoners and ex-prisoners fluctuates across time. Multiple studies have demonstrated that the immediate post-release period is a time of particularly extreme mortality risk (Binswanger, et al., 2007; Farrell & Marsden, 2007; Hobbs, et al., 2006; Kariminia, et al., 2007c; Krinsky, et al., 2009; Merrall, et al., 2010). In a study of US inmates, the risk of death in the two weeks after leaving prison was 13 times that of the general population (Binswanger, et al., 2007). In the UK, excess mortality was even greater, with the first week post-release associated with a 29-fold increase in risk of death among men, and a 69-fold increase among women (Farrell & Marsden, 2007).

Although rates vary between countries, the most frequent cause of death in the initial post-release period is drug overdose, largely heroin or other opioid overdose (Binswanger, et al., 2007; Bird & Hutchinson, 2003; Farrell & Marsden, 2005, 2007). In a recent meta-analysis, 76% of 411 deaths in the two weeks following release from prison were overdoses (Merrall, et al., 2010). Risk of overdose is thought to be increased at this time because of reduced opioid tolerance following abstinence from, or significantly lowered use of, heroin while in prison (Wakeman, et al., 2009). In a large study of NSW inmates, the risk of overdose in the first two weeks post-release was 9 times that at six months post-release (Kariminia, et al., 2007c). Similarly, a study of Norwegian prisoners found that the risk of overdose death was 10 times higher in the two weeks post-release than at all other time at liberty, with risk of death remaining elevated for four weeks (Odegard, et al., 2010).

Interventions to reduce post-release overdose-related mortality

Several interventions have been suggested to counteract the increased risk of overdose death after release from prison; however, there have been limited evaluations of their effectiveness. It has been argued that prisoners with a history of heroin use would benefit from being provided with training in cardiopulmonary resuscitation (CPR) and provision of several doses of naloxone, a drug that counteracts the effects of opioid overdose, at the time of release (Ochoa, et al., 2005; Wakeman, et al., 2009). Evaluations of community-based CPR training and naloxone distribution programs have shown that this approach can be effective (Doe-Simkins, et al., 2009; Strang, et al., 2008a; Wagner, et al., 2010), but no evaluations of these in relation to prisoners could be identified in the literature.

As described above, post-release overdoses occur largely because of reduced opioid tolerance following abstinence or reduced use of heroin while in prison. Accordingly, it has been suggested that maintaining opioid tolerance through the use of OST in prison may help to reduce overdose risk in the event of post-release heroin use (Christensen, et al., 2006). OST is undoubtedly effective in reducing mortality risk in community settings; in an examination of deaths among OST clients in NSW over a twenty year period, the relative risk of death while in treatment was half that while out of treatment (Degenhardt, et al., 2009c). Significant reductions in mortality associated with OST have also been reported internationally (Brugal, et al., 2005; Clausen, et al., 2008; Kimber, et al., 2010; Peles, et al., 2010). It is highly plausible that being in OST prior to release from prison is protective against post-release death. As described in Chapter 4, there have been two studies of prison OST that have reported on participant mortality in relation to OST status. In Kinlock (2009), there were eight deaths among 204 participants (3.9%) who were followed for 12 months post-release, while in Dolan (2005), 17 of 382 participants (4.5%) were deceased after four years of follow-up. None of these deaths occurred while participants were in treatment, supporting the assertion that prison OST may reduce post-release mortality. However, meaningful analysis of prison OST as a

moderator of post-release mortality risk has been hampered by the need for a sample size in the tens of thousands (Bird, 2009). In the absence of such a large sample, this study examines causes of death and mortality rates for the cohort, with particular attention to mortality rates in relation to treatment and incarceration status.

Aims

The aims of this chapter are to:

a) Describe the causes of death in the cohort;
b) Assess the mortality rate of the cohort and compare to the general population; and
c) Compare mortality rates for the following states:
    i. in and out of treatment
    ii. in and out of prison
    iii. in the first 28 days post-release and all other time at liberty.

Method

Data sources

The datasets used in this chapter were the incarceration data from the Offender Integrated Management System, the OST data from the Pharmaceutical Drugs of Addiction System and the mortality data from the Master Linkage Key.

Data analysis

All analyses were conducted in SAS 9.1 (SAS Institute, 2003) and Microsoft Excel.

Causes of death

All deaths in Australia are coded by expert clinical coders at the Australian Bureau of Statistics (ABS) on the basis of information contained in the death certificate. For the period 1997-2006, deaths were coded using the International Classification of Diseases, tenth edition (ICD-10) (World Health Organization, 1993).

The supplied cause of death data included both underlying and contributing causes of death. An underlying cause of death is defined as the 'disease or injury which initiated the train of morbid events leading directly to death, or the circumstances of the accident or violence which produced the fatal injury' (Pink, 2008). Contributing causes of death are morbid conditions, diseases or injuries that are entered on a death certificate but are not the underlying cause of death (Pink, 2008). In the case of deaths due to external events, the event leading to death (e.g. a car accident) is considered to be the underlying cause of death, while the consequences of the event (e.g. multiple injuries) are coded as contributing causes of death (Australian Bureau of Statistics, 2009a).

Based on the literature (Degenhardt, et al., 2009c; Gibson, et al., 2008; Stoove, et al., 2008) and the mortality findings of the four-year follow-up of this cohort (Dolan, et al., 2005), it was expected that drug-related events (e.g. accidental overdose), violence, accidents and suicide would account for most deaths. The ICD-10 codes for each of these cause-of-death categories are taken from previously published work (Randall, et al., 2009) and shown in Table 9.1. Drug-related deaths were further classified into those in which opioids were specifically mentioned as the underlying or contributing cause of death. Drug-related deaths that were classified as intentional were to have been counted under suicide deaths, but there were no such deaths in the cohort.

Table 9.1: ICD-10 codes for drug-related, violent, accidental and suicide deaths

Cause of death	ICD-10 codes	Definition
Accidental drug-related	F10-F19	Mental and behavioural disorders due to psychoactive substance use
	X40-X45	Accidental poisoning by and exposure to noxious substances
	Y10-Y14	Poisoning by and exposure to noxious substance, undetermined intent
Accidental drug-related: opioids specified	F11	Mental and behavioural disorders due to use of opioids
	F19 **AND** F11	Mental and behavioural disorders due to multiple drug use and use of other psychoactive substances **AND** mental and behavioural disorders due to use of opioids
	X42 **AND** T40.0-T40.4 or T40.6	Accidental poisoning by and exposure to narcotics and psychodysleptics, not elsewhere classified **AND** poisoning by narcotics and psychodysleptics
	X44 **AND** T40.0-T40.4 or T40.6	Accidental poisoning by and exposure to other and unspecified substances **AND** poisoning by narcotics and psychodysleptics
	F19 **AND** T40.0-T40.6 or T40.6	Mental and behavioural disorders due to multiple drug use and use of other psychoactive substances **AND** poisoning by narcotics and psychodysleptics
Violence	X85-Y09	Assault
	Y87.1	Sequelae of assault
Accidents	V01-V99	Transport accidents
	W00-X39, X50-X59	Other external causes of accidental injury
Suicide	X60-X84	Intentional self-harm
	Y87.0	Sequelae of intentional self-harm

Adapted from: Randall, D. *et al.* (2009). *Mortality among people who use illicit drugs: A toolkit for classifying major causes of death*. Sydney: National Drug and Alcohol Research Centre.

Mortality rates and standardised mortality ratio

Crude mortality rates (CMR) were calculated by dividing the number of deaths by the number of person-years contributed by participants, and multiplying by 1000 to obtain results in terms of deaths per 1000 person-years of follow-up. The all-cause CMR and the opioid-related CMR were calculated.

For comparison with the general population, an indirectly standardised mortality ratio (SMR) was calculated. An SMR is the ratio of observed deaths to expected deaths, with an SMR of greater than one reflecting elevated mortality in the observed group. Data on expected deaths were calculated from age, sex and calendar-specific mortality rates in New South Wales for the years 1997-2006, available from the Australian Bureau of Statistics.[18]

Mortality in relation to custodial episodes and opioid substitution treatment

To assess how risk of death may vary in relation to imprisonment and OST, crude mortality rates and rate ratios (Degenhardt, et al., 2009c) were calculated for:

- In treatment vs. out of treatment. In keeping with previous work addressing mortality in relation to OST, when calculating CMRs for periods in and out of treatment, the six days following the end of a treatment episode were classed as time in treatment (Degenhardt, et al., 2009c).
- Periods in custody vs. at liberty. Deaths in custody were defined as those participants with a final OIMS release code of 'deceased'.
- The first 28 days post-release vs. all other time at liberty. Twenty-eight days was chosen as the expected period of elevated mortality risk in line with the findings of Odegard *et al*. (2010) and Merrall *et al*. (2010). For deaths in the

[18] http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3302.02007

first 28 days post-release, causes of death and OST status at time of death were noted.

Results

There were 28 deaths among the 375 participants (7.5%). The median age at death was 31 (range 25-47).

Causes of death

Half (14/28; 50%) of the recorded deaths were drug-related; of these, 10 were opioid-related. There were three suicide deaths, all by hanging. Additionally, one death was coded as an accidental hanging. Other accidents (e.g., motor vehicle accidents, accidental drowning) accounted for four further deaths. Two deaths were due to cancer and one death each was due to alcoholic cirrhosis of the liver, epilepsy and homicide. Finally, there was one death in which the participant died after being hit by a moving vehicle, but intent (i.e. whether accidental or intentional self-harm) could not be determined. Causes of death are summarised in Table 9.2.

Table 9.2: Causes of death

Cause of death	N
Accidental drug related	14
Opioid-related	*10*
Violence	1
Accidents	5
Suicide	3
Other	5
Total	**28**

Crude mortality rate and standardised mortality ratio

Participants were observed for 3607.6 person-years, making for an all-cause CMR of 7.8 per 1000 person-years (py) (95% CI 5.3-11.1). Considering only opioid-related deaths (n=10), the CMR was 2.8 per 1000 py (95% CI 1.4-4.9).

Compared to the New South Wales population, all-cause mortality was significantly elevated in the cohort over the length of the observation period, with participants dying at 6.1 times the rate of men of the same age (95% CI 4.1-8.6; χ^2 = 118.3, *p*<.001) (Table 9.3).

Table 9.3: Annual and total standardised mortality ratio, 1997-2006

	Observed deaths	Expected deaths	SMR	95% CI
1997	1	0.51	2.0	0.1-9.7
1998	7	0.53	13.3	5.8-26.3
1999	1	0.52	1.9	0.1-9.6
2000	4	0.48	8.4	2.7-20.3
2001	1	0.48	2.2	0.1-10.8
2002	6	0.44	13.7	5.6-28.5
2003	1	0.40	2.5	0.1-12.3
2004	0	0.41	0	-
2005	4	0.44	9.1	2.9-22.0
2006	3	0.46	6.6	1.7-17.9
Total	**28**	**4.62**	**6.1**	**4.1-8.6**

SMR= Standardised mortality ratio. CI= Confidence interval

Deaths in opioid substitution treatment

Six participants died while in OST. Cause of death in three cases was opioid overdose; the remaining deaths were due to cancer, a motor vehicle accident and suicide. The ratio of the out-of-treatment CMR over the in-treatment CMR showed that the risk of death while out of treatment was 2.4 times that while in treatment (*p*=0.04) (Table 9.4).

Deaths in prison

There were three deaths in prison, as identified by release codes of 'deceased' in the OIMS data. Cause of death in two cases was hanging; the third death was a homicide. Participants were six times more likely to die while at liberty than while in prison (*p*<0.001) (Table 9.4).

Deaths after release from prison

There were four deaths within 28 days of release from prison. Causes of death were accidental opioid overdose (6, 22 and 27 days post-release) and cancer (three days post-release). The post-release overdose deaths all occurred while participants were not in treatment. Although the CMR in the first 28 days post-release was elevated compared to that during all other time at liberty, the difference was not statistically significant (Table 9.4).

Table 9.4: Crude mortality rates and rate ratios

	Deaths	Person-years	CMR per 1000 py	95% CI	Rate ratio	95% CI	*p*
Treatment							
Out of treatment	22	2163.2	10.2	6.5-15.2			
In treatment	6	1444.4	4.2	1.7-8.6	2.4	1.0-6.6	0.04
Imprisonment							
At liberty	25	2114.5	11.8	7.8-17.2			
In prison	3	1493.1	2.0	0.5-5.5	5.9	2.0-24.5	<0.001
Post-release[^]							
First 28 days post-release	4	146.2	27.4	7.4-70.0			
Remainder of time at liberty	21	1968.3	10.7	6.7-16.3	2.6	0.8-7.0	0.1

[^]Deaths post-release sum to 25 as 3 participants died in custody

Discussion

The crude mortality rate and standardised mortality ratio for this cohort were similar to those seen in other cohorts of Australian heroin users (Degenhardt, et al., 2009c; Stoove, et al., 2008). Causes of death were also similar, with half of the 28 deaths attributed to accidental drug overdose. 'Natural' deaths (i.e. not a result of substance use, accident or violence) were rare, reflecting the relative youth of the cohort and high-risk lifestyle of participants. As in previous studies, deaths were significantly reduced while in OST (Clausen, et al., 2008; Degenhardt, et al., 2009c) or in prison (Bobrik, et al., 2005; Kariminia, et al., 2007b). Of the four deaths during

the four weeks post-release, three were opioid overdoses and none had been in OST prior to death.

Reducing overdose mortality

With half the deaths in the cohort a result of drug overdose, there is clearly a need for interventions aimed at reducing overdose risk behaviours and improving peer responses when an overdose is witnessed. It has been demonstrated that awareness of risk factors for overdose (e.g. combining heroin with other central nervous system depressants; recent periods of abstinence) can be raised through educational campaigns (McGregor, et al., 2001); however, awareness of risk factors does not necessarily result in reduced overdose risk behaviours (Dietze, et al., 2006). Training heroin users in cardiopulmonary resuscitation (CPR) and administration of naloxone has been shown to improve peer responses in the event of witnessing an overdose, potentially saving lives (Doe-Simkins, et al., 2009; Seal, et al., 2005; Strang, et al., 2008a).

It has been argued that the strong association between release from prison and fatal overdose makes prison an ideal location for overdose prevention interventions (Ochoa, et al., 2005), and it has been recommended that inmates with a history of heroin use be provided with doses of take-home naloxone on release from prison (Wakeman, et al., 2009). However, overdose prevention programs such as CPR training and naloxone distribution are based on training individuals to respond in the event of an overdose; training those at highest risk of overdose (i.e. inmates nearing release) in how to respond will not necessarily reduce their personal overdose risk. For CPR training or take-away naloxone to be effective interventions for released inmates, people around the inmate, rather than the inmate him/herself, need to be familiar with CPR and naloxone. Thus, it may be useful to provide overdose training to not only the inmate, but also individuals they expect to associate with after release, such as a partner and/or family members. A study of family members of heroin users found that the majority wanted to learn how to

manage an overdose (Strang, et al., 2008b); the feasibility of training partners or family members of released prisoners to respond to overdoses is worth exploring.

Factors moderating mortality risk

As in previous studies (Clausen, et al., 2008; Degenhardt, et al., 2009c), the risk of death while out of treatment was over twice that while in treatment. Studies have reported that mortality risk decreases as time in treatment increases (Kimber, et al., 2010), highlighting the importance of retention in treatment in gaining the greatest benefits from OST. In this regard, the discontinuous patterns of OST exhibited by most participants (as described in Chapter 7) are less than ideal; efforts to increase the length of treatment episodes would likely work to reduce mortality risk even further than seen here.

A greatly reduced risk of death was seen while participants were in prison. This is in line with other research on prisoners both in Australia (Kariminia, et al., 2007b) and internationally (Bobrik, et al., 2005). It appears that while in prison, heroin users are protected against some of the common causes of death in this group, such as overdose and accidents.

Although the crude mortality rate was higher in the first 28 days post-release than at all other time at liberty, this difference was not statistically significant. It is of note that three of the four post-release deaths were opioid overdoses; studies with larger sample sizes have found that 71-92% of post-release deaths are due to drug overdose (Binswanger, et al., 2007; Bird & Hutchinson, 2003; Christensen, et al., 2006), and a meta-analysis reported that 76% of deaths in the first two weeks post-release are drug-related (Merrall, et al., 2010). Inmates may benefit from education on their increased risk of overdose following reduced use or abstinence, and safer approaches to using after release (e.g. smoking rather than injecting; utilising Safer Injecting Facilities where these exist); however, as noted above, awareness of overdose risk factors does not necessarily translate to safer using behaviours (Dietze, et al., 2006).

None of the participants who died in the post-release period had been in OST prior to death. In previous studies of prison OST, it has been noted that no deaths occurred while participants were in treatment (Dolan, et al., 2005; Kinlock, et al., 2009), highlighting the potential protective effects of treatment for prisoners. Given the small sample size, it was not possible to conduct a meaningful analysis of the role of prison OST in moderating risk of death in the post-release period. Larger studies with sufficient statistical power to detect a change in post-release mortality rates associated with prison OST may be desirable; however, it has been calculated that a study with 80% power to detect an effect would require a sample size of 80,000 inmates on OST (Bird, 2009). It is highly unlikely that a single study could achieve a sample size this large. Despite the lack of unequivocal answer, it is known that OST reduces mortality (Clausen, et al., 2008; Degenhardt, et al., 2009c; Kimber, et al., 2010), and there is no apparent reason why this effect would not hold for inmates being released from prison. The safety and risks of OST in general are established, and there is no reason to assume that prison OST would have hitherto unknown mortality risks. Thus, it is reasonable to assume that prison OST would reduce post-release mortality risk, either by reducing risk of heroin use, or, in the event of heroin use, reducing the risk of overdose (Christensen, et al., 2006).

Limitations

As alluded to above, the sample size was too small to conduct an analysis of predictors of mortality, including the role of prison OST in moderating risk of post-release death. A further limitation of the study was the inability to formally assess the accuracy of the linkage with the mortality data contained in the Master Linkage Key; however, a visual inspection of matched deaths revealed that none had episodes of treatment or incarceration after their recorded date of death, suggesting high linkage specificity (i.e. low false positives). Deaths occurring interstate, or recorded under a name or alias unknown to the Department of Corrective Services, would not have been identified in the linkage. The concordance between the mortality rates seen in this study and those in other Australian studies

(Degenhardt, et al., 2009c; Gibson, et al., 2008; Stoove, et al., 2008) suggests that mortality was reasonably well ascertained.

The potential for misclassification of cause of death, although not a significant concern, should be noted. All deaths in Australia are coded, based on information in the deceased's death certificate, using the International Classification of Diseases (ICD) coding system; for the period under study, coding was as in the tenth edition of the ICD (Australian Bureau of Statistics, 2009a; World Health Organization, 1993). It is possible that intentional opioid overdose deaths may have been misclassified as accidental overdoses; however, this is unlikely as there are factors that differentiate intentional and accidental overdoses, and it is generally considered that intentional overdoses comprise only a small proportion of opioid overdoses (Darke, et al., 2007a; Darke, et al., 2010). It should also be mentioned that one death was classified as an accidental hanging. This individual was in prison at the time of death and given the frequent use of hanging as a method of suicide in prison (O'Driscoll, et al., 2007), it is possible that this death was a misclassified suicide.

The calculated standardised mortality ratio adjusted for participant age, sex and calendar year. The calculation did not adjust for Indigenous status. As a population, Australian Indigenous peoples have poorer health than non-Indigenous people and die at a greater rate than the non-Indigenous population (Vos, et al., 2007). Despite this, within the sub-population of people who have experienced incarceration, there are limited health differentials between Indigenous and non-Indigenous persons (Kariminia, et al., 2007d), and Indigenous inmates do not die at a greater rate than non-Indigenous inmates (Kariminia, et al., 2007b). Thus, it is not considered that adjusting for Indigenous status would affect the reported SMR.

Conclusions

The results of this study accord with the findings of other cohort studies in terms of overall mortality risk of heroin users (Degenhardt, et al., 2009c; Gibson, et al., 2008; Stoove, et al., 2008). The high proportion of overdose deaths highlights the need for

interventions to address this source of preventable deaths. As in other studies, being in treatment (Clausen, et al., 2008; Degenhardt, et al., 2009c) or in prison (Bobrik, et al., 2005; Kariminia, et al., 2007b) reduced the risk of death. There were some indications that the post-release period was a time of elevated risk of death, particularly from drug overdose, but the difference between mortality rates in the post-release period and all other time at liberty did not reach statistical significance. Research to date has not definitively shown that OST in prison reduces the risk of post-release overdose; however, there is sufficient evidence of the benefits of OST in relation to mortality to make this a reasonable assumption.

10. General discussion

The aim of this thesis was to examine the influence of prison-based opioid substitution treatment (OST), and OST in the post-release period, on re-incarceration, offending and mortality of heroin users. Following two systematic reviews of the literature (see also Larney & Dolan, 2009; Larney, 2010), it was determined that there were significant limitations to current research examining the effects of prison-based OST on post-release outcomes. The majority of research into post-release offending and re-incarceration has not taken into account whether an individual released from prison while on OST had remained in treatment in the community, despite retention in treatment being crucial to achieving positive criminal justice outcomes in this population (Deck, et al., 2009; Oliver, et al., 2010). There also remained significant questions as to how OST and incarceration interact to influence risk of death in the post-release period.

In order to address these gaps in the literature, administrative records summarising OST participation, incarceration, criminal convictions and mortality were examined for a cohort of 375 Australian male heroin users. Records were for the almost ten-year period of 1 June 1997 – 31 December 2006. A strength of using administrative records to assess these outcomes is that they provide an accurate record of events (e.g. treatment entry, incarceration) as they occur. Data can also be linked across databases to examine the interplay between different services and systems that an individual accesses (Evans, et al., 2008). Administrative data allow for very high levels of follow-up, even among populations that may lack reliable contact details. Furthermore, administrative data are not subject to recall bias or other biases as self-reported data may be (Day, et al., 2004; Del Boca & Noll, 2000).

Key findings

Use of aliases increases sensitivity of data linkage

A sensitivity and specificity analysis of the linkage between the baseline data and OST data showed that cohort participation in OST was ascertained with 86% sensitivity and 100% specificity. This study also demonstrated that the 'best' linkage results were obtained when participant aliases were incorporated into the linkage process. This is a useful methodological contribution to the literature, as no previous studies have reported on how the sensitivity and specificity of a linkage process has been altered by the inclusion or exclusion of participant aliases.

Natural history of incarceration in heroin users

Analysis of the natural history of incarceration showed that almost all participants experienced incarceration during the observation period. Indeed, when total time in prison was considered, participants spent a median of one-third of the observation period in custody (3.6 years), most commonly as a series of custodial episodes of 3-4 months duration. Following release from prison, re-incarceration was the norm and occurred within a median of 4.5 months. This is the first time the natural history of incarceration has been described for a cohort of Australian heroin users; however, it is important to note that because the cohort was originally recruited in prison, and prior incarcerations are a strong predictor of future incarceration, the patterns observed for this cohort may overestimate incarceration among heroin users in general.

Effect of OST on criminal justice outcomes

As in previous studies (Marzo, et al., 2009; McMillan, et al., 2008), OST status (in treatment vs. out of treatment) at the time of release from prison did not significantly affect participants' risk of re-incarceration. When post-release retention in treatment was taken into account, a significant treatment effect was observed; while participants remained in treatment post-release, their risk of re-incarceration was, on average, 80% that of their out-of-treatment peers.

The majority (88%) of participants were convicted of a new offence during the observation period. The conviction rate during periods of OST did not differ significantly from that when participants were not in treatment. Running somewhat counter to the re-incarceration findings, neither OST status at time of release from prison, nor post-release participation in OST, significantly affected risk of being convicted of an offence. However, these results should be interpreted with caution. There were indications that the use of incarceration as a censoring event, as necessitated by the use of convictions as an outcome measure, may have led to informative censoring, which can in turn lead to biased survival models. A sensitivity test suggested that a treatment effect may have been observed in the second survival model had a different measure of offending, such as arrests or criminal charges, been used in the analysis.

Mortality

During the almost ten-year observation period, 28 participants died, half from drug-related causes. The crude mortality rate (7.8 per 1000 person years) and standardised mortality ratio (6.1) were similar to those reported in other Australian heroin-using cohorts (Degenhardt, et al., 2009c; Gibson, et al., 2008; Stoove, et al., 2008). As in Australian and international studies, death rates were reduced while in OST (Clausen, et al., 2008; Degenhardt, et al., 2009c) and while in prison (Bobrik, et al., 2005; Kariminia, et al., 2007b). The crude mortality rate for the 28 days post-release was higher than that for all other time at liberty, but this difference was not statistically significant. With few deaths in the cohort, further exploration of interactions between OST, incarceration and mortality was not feasible, and it was not possible to conduct a meaningful analysis of the role of prison OST in reducing post-release deaths.

Limitations

Limitations specific to particular chapters have been addressed in those chapters. Below are two general limitations affecting the studies presented in this thesis.

Limitations related to the participant sample

All study participants were male, but around one-third of Australian heroin users are female (Burns, et al., 2009; Digiusto, et al., 2005; Ross, et al., 2005). Although women tend to begin using heroin at a later age than men, women's heroin use tends to escalate and become problematic more rapidly than men's (Anglin, et al., 1987; Hernandez-Avila, et al., 2004). Women heroin users in treatment tend to have a more severe clinical profile than their male counterparts, being more likely to report suicidal ideation and suicide attempts (Darke, et al., 2004), and more likely to suffer major depressive disorder (Teesson, et al., 2005) and post-traumatic stress disorder (Mills, et al., 2005). Despite these differences, gender is not in itself a predictor of OST outcomes (Kreek, et al., 2010), lending weight to the notion that the relationships between OST and incarceration, offending and mortality reported in this thesis may also hold for women. Research specifically incorporating incarcerated female heroin users should be conducted to determine if this is the case.

As acknowledged throughout the thesis, an important limitation to these studies is the sample size. Although data linkage studies usually make use of the entire population of records in a database, for the present studies a smaller samples was chosen, consisting of individuals for whom baseline data were available. Although this allowed for greater covariate adjustment in statistical analyses, using a larger sample of all people appearing in the source datasets would have increased statistical power. This is particularly relevant to the mortality data reported in Chapter 9.

Limitations related to the use of administrative data

Like all data, administrative data have strengths and limitations. Strengths include the ability to precisely date events, rather than relying on participant recall; the ability to observe how events recorded in different databases influence each other; and the objective nature of records in comparison to self-reported data (Day, et al.,

2004; Del Boca & Noll, 2000; Hser & Evans, 2008). One limitation of administrative data that has been noted throughout the thesis is that it is often not possible to determine if the outcome of interest has been ascertained with adequate accuracy; that is, it is not possible to test the sensitivity and specificity of the linkage. For the data linkages in this thesis, it was possible to calculate sensitivity and specificity only for the linkage between the baseline data and the Pharmaceutical Drugs of Addiction System; sensitivity was adequate (86%) and specificity was complete (100%). Although they could not be calculated in relation to incarceration data, the use of a unique identifier in the linkage to the Offender Integrated Management System promoted high sensitivity and specificity. Ad hoc analysis of mortality data suggested that, at the very least, linkage specificity was high. The only data for which no assessment of linkage accuracy could be made was the convictions data from the Re-Offending Database; potentially, the linked data may have underestimated the true conviction rate of participants. However, the high proportion of participants found to have a conviction suggests that this was not a major concern. Hence, it is not considered that the reliability or validity of the results presented herein were compromised by low sensitivity or specificity.

Other limitations of the administrative data used in this thesis include the limited nature of some data; for example, as noted in Chapter 8, information on participants' drug use during follow-up would have constituted a useful covariate in the various outcome analyses. It is also acknowledged that officially recorded offending data underestimate actual offending rates.

Implications for policy and practice

The analysis of the natural history of incarceration showed that heroin users, or at least a sub-group of heroin users, experience frequent periods of incarceration. This rapid cycling between prison and the community is destabilising for people in terms of housing, employment, healthcare and relationships. While in prison, heroin users are exposed to a high-risk environment for transmission of blood borne viral

infections (Dolan, et al., 1994; Dolan, et al., 2010; Gore, et al., 1995; Jahani, et al., 2009), and each post-release period is a time of increased mortality risk (Binswanger, et al., 2007; Bird & Hutchinson, 2003; Farrell & Marsden, 2007; Kariminia, et al., 2007c). Furthermore, as a group with high rates of re-incarceration, heroin users impose a significant financial burden on the criminal justice system.

Even modest reductions in incarceration of this group would likely produce substantial individual and public health benefits, as well as economic benefits. Therefore, the finding that remaining in OST after release from prison significantly reduces the average risk of re-incarceration is of great importance in terms of prison – and community – OST policy. This result is strong evidence in support of programs and services that enable continuity of care as inmates transition from prison to the community. Currently, it is the policy of the NSW Health Department to provide released prisoners with priority access to public (no-fee) OST programs (Mental Health and Drug and Alcohol Office, 2005). Furthermore, the state-wide Connections Project, run by the correctional arm of the NSW Health Department, Justice Health, was established in 2007 and aims to link inmates with not only OST providers, but also housing and welfare services (Martire & Howard, 2009). Availability of such programs and/or assistance to remain in treatment varies between Australian jurisdictions. For example, in the state of Victoria, where all OST clients, including those at public clinics, must pay a dispensing fee, the Department of Corrections funds four weeks of post-release OST for inmates released while in treatment; however, after this time, responsibility for meeting treatment costs falls to the client (Ritter & Chalmers, 2009). There has been no Australian research directly examining the ability of released inmates to pay for treatment after the withdrawal of fee relief; however, preliminary findings of a post-release OST program in the United States suggest that inability to pay treatment costs is a major reason for treatment drop-out (McKenzie, et al., 2005). No other programs specifically targeting post-release OST could be identified in Australia, although a

general health intervention, the Passports to Advantage study, is underway in Queensland (Kinner, et al., 2007). In the Passports study, inmates undertake a detailed health needs assessment, the results of which are used to generate targeted health-related referrals for the post-release period, which may include referrals to OST.

Barriers to continuous OST can arise at various stages of incarceration. This thesis has focused on the transition from prison to the community, but care can also be interrupted when entering prison. In terms of interruptions when returning to the community, prison-based OST prescribers in NSW have reported that, due to a lack of treatment places, it is becoming increasingly difficult to link inmates with community OST providers prior to release (D. Zador, Clinical Director Drug and Alcohol, Justice Health, personal communication, 10 August 2010). New South Wales, and Australia in general, lacks a system for determining if OST coverage is adequate or if a shortfall of treatment places exists; however, it is likely that there is considerable unmet treatment demand (Chalmers, et al., 2009; Ritter & Chalmers, 2009). This limits access to treatment not only for released inmates, but heroin users in general. Ensuring adequate OST places are available in community settings is therefore critical for enabling continuous OST for prisoners.

In terms of interruptions to OST when an individual enters prison, in Australia and internationally there are jurisdictions that require inmates who enter prison on OST to cease treatment (Larney & Dolan, 2009b; Nunn, et al., 2009). This breaches the right of incarcerated persons to receive healthcare of the same standard as that they would receive if at liberty (United Nations Committee on Economic Social and Cultural Rights, 2000; United Nations General Assembly, 1990). Many jurisdictions also prevent treatment entry while in prison (Larney & Dolan, 2009b; Nunn, et al., 2009), yet the finding that 80% of all participants commenced an episode of OST in prison, and that 58% of all OST episodes were commenced in prison, demonstrates that prisons can play a significant role in engaging heroin users in treatment that

they may continue with on release. There is strong evidence that participation in post-release OST is maximised when inmates begin treatment in prison (Kinlock, et al., 2007; Magura, et al., 1993; Tomasino, et al., 2001). Permitting both continuation of OST commenced prior to incarceration, and initiation of OST while incarcerated, is therefore an important aspect of enabling continuous care.

The likelihood that an individual will receive continuous care when moving between prison and the community can be affected by the administrative arrangements under which healthcare is provided in prison. In New South Wales, healthcare is provided to inmates by a dedicated unit within the Department of Health that is independent of the Department of Corrective Services. This model of service delivery recognises that prisoners are drawn from the community, and in all likelihood, will return to the community. An integrated service delivery model such as this is unusual and seen in only a few jurisdictions globally; in the majority of prison systems, healthcare provision is the responsibility of correctional authorities and is provided with little or no reference to the broader community-based health system (Hayton, Gatherer & Fraser, 2010). The use of dual healthcare systems hinders continuity of care both on entry to prison and on release. For example, in the various Baltic States it has been reported that, although legislation allows inmates to continue OST that was started before incarceration, treatment is frequently discontinued in police cells and prisons. A major reason for this is differences in philosophies and drug treatment approaches of the prison health system, operating under the Ministry of Justice, and the community health system, administered by the Ministry of Health (Petrauskas, 2010; Rotberga, 2010). In the United States, where OST availability in correctional settings is very low, only a minority of state correctional systems offer post-release referrals to OST. Reasons given for not offering referrals reflect the disconnect between prison and community health systems, such as ‘facility prefers drug-free detoxification’ and ‘facility focuses on inmate health during incarceration’ (Nunn, et al., 2009).

Transferring responsibility for prisoner healthcare from prison authorities to the relevant state or national health service may assist in addressing issues of continuity of care, as well as broader issues around the quality of healthcare in prisons (International Centre for Prison Studies, 2004). For example, beginning in 2003, responsibility for healthcare in prisons in England was shifted from the Home Office to the Department of Health (PwC, 2008). Prior to this, the standard of care in prisons had been noted as less than that in community settings, despite the endorsement of the principle of equivalence of care in Home Office policy documents (Harty, et al., 2001). Following the transfer of responsibility to the Department of Health, there have been significant increases in funding of general prison health services (International Centre for Prison Studies, 2004). Access to OST has increased considerably under a program known as the Integrated Drug Treatment System (IDTS) (Marteau & Stover, in press), with the number of OST episodes commenced in prison increasing from 700 in 2003 to 19,450 in 2008 (Marteau & Stover, in press; Stevens, et al., 2010).

Implications for research

This thesis has demonstrated that data linkage is a feasible and useful approach for examining OST among incarcerated populations. A key factor differentiating this research from previous studies was the use of post-release OST records in addition to OST records pertaining to time in custody. This was possible as all OST episodes in NSW are recorded in the Pharmaceutical Drugs of Addiction System of the NSW Health Department, regardless of the location of treatment. In contrast, studies elsewhere have reported being unable to consider post-release treatment participation specifically because OST records during incarceration could not be linked with OST records from community treatment settings (Marzo, et al., 2009). Given the importance of post-release OST retention in determining post-release outcomes, future research in this area should attempt to include indicators of post-release treatment retention in analyses. If a centralised database containing all OST

episodes is not available, efforts should be made to link prison-based and community-based systems for recording OST episodes. If linkage is not possible, it may be necessary to follow-up participants in person.

An aspect of OST provision in prisons that has not been addressed by this thesis is duration of OST prior to release from prison. It may be that longer duration of treatment while in prison is associated with increased likelihood of remaining in treatment post-release. Research examining this issue is of particular relevance for pre-release prison OST programs (i.e. programs accessible only to inmates within several months of release). Results from such studies would be of use in identifying if outcomes of pre-release OST programs differ from those of programs that permit treatment initiation at any point during incarceration, and if there is a minimum duration of pre-release OST exposure required before post-release treatment benefits are observed.

There was some evidence that the cohort under study was a particularly entrenched group of heroin users, and being in OST did not appear to reduce criminal behaviour. Drawing on notions of criminogenic risks and needs (Andrews & Bonta, 2006, 2010), it can be seen that OST alone may not affect offending because treatment addresses one criminogenic need (i.e. drug use), but overlooks other factors affecting offending risk, such as antisocial personality traits and pro-criminal attitudes and associates. In terms of reducing criminal recidivism, the most effective therapeutic programs in prison are those that address a suite of criminogenic needs (Andrews & Bonta, 2006). Thus, combining OST programs with programs that attend to other, non-drug criminogenic needs may be more effective in reducing re-offending than prison OST alone. A randomised controlled trial comparing OST alone to OST with a criminogenic needs-focused therapeutic program would be necessary for evaluating this hypothesis.

If an adequate sample size can be obtained, studies examining the relationship between OST, release from prison and mortality would be highly influential in policy

debates around OST in prisons. A case-control study examining this relationship is in the planning stages in the United Kingdom. The anticipated sample size is 20,000 (M. Farrell, Professor, Institute of Psychiatry, personal communication, 14 September 2010). Results from this study will likely prove highly informative.

Finally, further follow-ups of the cohort in question, at five- to ten-year intervals, would be beneficial. Although there have been some very long-term studies of heroin users (Hser, et al., 2001; Oppenheimer, et al., 1994), these were conducted overseas (e.g. the United States and United Kingdom) and participants were recruited in the 1960s and 70s, prior to the advent of the HIV epidemic and the widespread application of OST or harm reduction measures such as needle and syringe programs. The individuals in the current cohort were recruited at a time of high heroin availability in New South Wales (Darke, et al., 2002), in an environment of low HIV prevalence (MacDonald, et al., 1997), and have been followed-up over a period of reduced heroin availability (Day, et al., 2003), relatively high treatment coverage (Champion & Gray, 2003; Cook, et al., 2004) and access to harm reduction measures such as needle and syringe programs (NSW Health Department, 2006a) and a supervised injecting facility (Van Beek, et al., 2004). As such, the course and consequences of their heroin use are likely to differ substantially from cohorts recruited in other geographical areas and points in time. Future follow-ups could examine how participation in OST and patterns of criminal behaviour change as individuals age, and if there are changes in causes of death over time. Data linkage could also be extended to other outcomes, such as blood borne viral infections (through notifiable diseases registers) and morbidity (through ambulance and hospital data collections). The statistical power of the follow-up studies could be enhanced by combining the cohort with that of the New South Wales arm of the Australian Treatment Outcome Study, consisting of 615 heroin users recruited in 2001-02 (Teesson, et al., 2003). Follow-up studies such as these would assist in developing a detailed picture of the life course of heroin use and dependence in an environment of low HIV prevalence and a strong harm reduction focus.

Conclusion

Heroin dependence is a chronic condition requiring ongoing treatment and management to reduce negative outcomes. This thesis has demonstrated that continuous access to OST when moving from prison to the community is an important aspect of treatment effectiveness. Policies around OST should reflect this by ensuring ease of access to OST during and after incarceration. Further research should be conducted to establish whether longer duration of prison OST results in improved post-release outcomes, and to determine the extent to which prison OST may reduce post-release mortality.

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Appendix A: Countries and territories with opioid substitution treatment in community and/or prison settings.

All listed countries provide OST from at least one site. Countries in bold type also provide OST in at least one prison. Sixty-six countries offer OST; 37 offer OST in prisons.

Albania	Hungary	Nepal
Australia	Iceland	**Netherlands**
Austria	**India**	**New Zealand**
Azerbaijan	**Indonesia**	**Norway**
Belarus	**Iran**	**Poland**
Belgium	**Ireland**	**Portugal**
Bosnia and Herzegovina	Israel	**Puerto Rico**
Bulgaria	**Italy**	**Romania**
Cambodia	Kazakhstan	**Serbia**
Canada	Kyrgyzstan	Slovakia
China	Latvia	**Slovenia**
Croatia	Lebanon	South Africa
Cyprus	Lithuania	**Spain**
Czech Republic	**Luxembourg**	**Sweden**
Denmark	**Macedonia FYR**	**Switzerland**
Estonia	**Malaysia**	Taiwan
Finland	Maldives	Thailand
France	**Malta**	Ukraine
Georgia	**Mauritius**	**United Kingdom**
Germany	Mexico	**United States**
Greece	**Moldova**	Uzbekistan
Hong Kong SAR	Myanmar	Vietnam

Source: International Harm Reduction Association (2010). *Global State of Harm Reduction 2010.*

Appendix B: References for Table 2.1

Country	Reference
Albania	Mucollari, G. (2007). Albania: Methadone program now available in prisons. http://www.ceehrn.org/index.php?ItemId=17069
Australia	Australian Institute of Health and Welfare. (2010). *National Opioid Pharmacotherapy Statistics Annual Data Collection: 2009 Report*. Canberra: Australian Institute of Health and Welfare.
Austria	BISDRO. (2008). *Reduction of drug-related crime in prison: The impact of opioid substitution treatment on the manageability of opioid dependent prisoners*. Bremen: University of Bremen.
Denmark	European Monitoring Centre for Drugs and Drug Addiction. (2009). *Annual Report 2009: Denmark*. EMCDDA.
France	European Monitoring Centre for Drugs and Drug Addiction. (2008). *National Report 2008: France*. EMCDDA.
India	UNODC (2009). Oral substitution treatment for drug users in Tihar Prisons. http://www.unodc.org/india/en/india_-tihar-jail-looking-beyond-the-bars.html
Iran	Farnia, M., Ebrahimi, B., Shams, A., & Zamani, S. (2010). Scaling up methadone maintenance treatment for opioid dependent prisoners in Iran. *International Journal of Drug Policy, 21*, 422-424.
Ireland	European Monitoring Centre for Drugs and Drug Addiction. (2009). *Annual Report 2009: Ireland*. EMCDDA.
Italy	BISDRO. (2008). *Reduction of drug-related crime in prison: The impact of opioid substitution treatment on the manageability of opioid dependent prisoners*. Bremen: University of Bremen.
Moldova	Cook, C., & Kanaef, N. (2008). *Global State of Harm Reduction 2008*. London: International Harm Reduction Association.
Montenegro	Cook, C., & Kanaef, N. (2008). *Global State of Harm Reduction 2008*. London: International Harm Reduction Association.
New Zealand	New Zealand Department of Corrections. (2007). Change to methadone treatment in prisons. *Corrections News* (February), 3.
Scotland	Eurasian Harm Reduction Network. (2010). *Hepatitis C transmission and injecting drug use: Harm reduction responses*. Vilnius: Eurasian Harm Reduction Network.
Serbia	Cook, C., & Kanaef, N. (2008). *Global State of Harm Reduction 2008*. London: International Harm Reduction Association.
Spain	European Monitoring Centre for Drugs and Drug Addiction. (2009). *Annual Report 2009: Spain*. EMCDDA.
United States	Nunn, A., Zaller, N., Dickman, S., Trimbur, C., Nijhawan, A., & Rich, J. D. (2009). Methadone and buprenorphine prescribing and referral practices in US prison systems: Results from a Nationwide Survey. *Drug and Alcohol Dependence, 105*, 83-88.

Appendix C: Publications and conference presentations from this thesis

Peer-reviewed publications

1. **Larney, S.**, Dolan, K. (2009). A literature review of international implementation of opioid substitution treatment in prisons: Equivalence of care? *European Addiction Research*, *15,* 107-112.

2. **Larney, S.** (2010). Does opioid substitution treatment in prisons reduce injecting-related HIV risk behaviours? A systematic review. *Addiction*, *105*, 216-223.

3. **Larney, S**., Burns, L. (in press). Evaluating health outcomes of criminal justice populations using record linkage: the importance of aliases. *Evaluation Review*, in press.

Non-peer reviewed publications

1. **Larney, S.,** Dolan, K. (2008). Increased access to opioid substitution treatment in prisons is needed to ensure equivalence of care. *Australian and New Zealand Journal of Public Health*, *32*, 86-87.

2. **Larney, S.**, Toson, B., Burns, L., & Dolan, K. (in press). *Opioid substitution treatment in prison and post-release: Effects on criminal recidivism and mortality.* Adelaide: National Drug Law Enforcement Research Fund.

Conference presentations

1. **Larney, S.**, Wodak, A., & Dolan, K. *An international review of prison methadone maintenance treatment*. Paper presented at the 2nd International Prisoner Health Conference, Varna, Bulgaria, September 2007.

2. **Larney, S**., & Dolan, K. *An international review of prison methadone maintenance treatment*. Poster presented at the combined Cutting Edge/Australasian Professional Society on Alcohol and Other Drugs Conference, Auckland, New Zealand, November 2007.

3. **Larney, S.**, Dolan, K., & Wodak, A. *Prison methadone maintenance treatment: Implementation and meta-analytic review.* Paper presented at the International Harm Reduction Conference, Barcelona, Spain, May 2008.

4. **Larney, S.**, Dolan, K., Wodak, A. *Meta-analysis of opioid substitution treatment in prisons*. Presentation to the UNSW School of Public Health and Community Medicine Student Conference, Sydney, November 2008.

5. **Larney, S.,** & Dolan, K. *Ten-year natural history of incarceration and opioid substitution treatment in heroin users.* Poster presented at the National Drug and Alcohol Research Centre Annual Symposium, Sydney, August 2010.

6. **Larney, S.,** & Dolan, K. *Opioid substitution treatment in correctional facilities: Treatment entry, retention and re-incarceration.* Poster presented at Addictions 2010 Conference, Washington D.C., USA, October 2010.

Appendix D: Additional peer-reviewed publications during candidature

1. Silins, E., Sannibale, C., **Larney, S.,** Wodak, A., & Mattick, R.P. (2008). Residential detoxification: Essential for marginalized, severely alcohol- and drug-dependent individuals. *Drug and Alcohol Review*, *27*, 414-419.

2. **Larney, S.,** & Dolan, K. (2008). An exploratory study of needlestick injuries among Australian prison officers. *International Journal of Prisoner Health*, *4*, 164-168.

3. **Larney, S.,** Conroy, E., Mills, K., Burns, L., Teesson, M (2009). Factors associated with violent victimisation among homeless adults in Sydney, Australia. *Australian and New Zealand Journal of Public Health*, *33*, 347-351.

4. Dolan, K., **Larney, S.,** Jacka, B., & Rawlinson, W. (2009). Presence of hepatitis C virus in syringes confiscated in prisons in Australia. *Journal of Gastroenterology and Hepatology, 24*, 1655-1657.

5. Martire, K.A., & **Larney, S.** (2009). Inadequate data collection prevents health planning for released prisoners [peer-reviewed letter to the Editor]. *Medical Journal of Australia*, *191*, 408-409.

6. Dolan, K., & **Larney, S.** (2009). A review of HIV in prisons in Nepal. *Kathmandu University Medical Journal, 7*, 351-354.

7. **Larney, S.,** & Dolan, K. (2009). Compulsory detoxification is a major challenge to harm reduction in China. *International Journal of Drug Policy*, *21*, 165-166.

8. Martire, K.A., & **Larney, S.** (2010). An estimate of the number of inmate separations from Australian prisons 2000/01 and 2005/06. *Australian and New Zealand Journal of Public Health, 34*, 255-257.

9. Martire, K. & **Larney, S.** (in press). Health outcomes, program completion and criminal recidivism among participants in the Rural Alcohol Diversion program, Australia. Accepted to *Journal of Substance Use.* Date of acceptance 9 February 2010.

10. **Larney, S.,** & Martire, K. (in press). Factors affecting criminal recidivism among participants in the Magistrates Early Referral Into Treatment (MERIT) program in New South Wales, Australia. Accepted to *Drug and Alcohol Review*. Date of acceptance 24 February 2010.

11. Dolan, K., & **Larney, S.** (in press). A review of HIV risk, prevalence, prevention and treatment in prison in India. Accepted to *The Indian Journal of Medical Research*. Date of acceptance 25 March 2010.