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Determining the impact of opioid substitution therapy upon mortality and recidivism among prisoners: A 22 year data linkage study

Natasa Gisev, Sarah Larney, Jo Kimber, Lucy Burns, Don Weatherburn, Amy Gibson, Tim Dobbins, Richard Mattick, Tony Butler, Louisa Degenhardt

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**DETERMINING THE IMPACT OF
OPIOID SUBSTITUTION THERAPY
UPON MORTALITY AND
RECIDIVISM AMONG PRISONERS:
A 22 YEAR DATA LINKAGE STUDY**

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ABBREVIATIONS

| | |
|--------|--|
| AHR | Adjusted Hazards Ratio |
| AIHW | Australian Institute of Health and Welfare |
| BOCSAR | Bureau of Crime Statistics and Research |
| CCR | Crude Crime Rate |
| CEA | Cost Effectiveness Analysis |
| CI | Confidence Interval |
| CMR | Crude Mortality Rate |
| IDU | Injecting Drug User |
| NDI | National Death Index |
| NSW | New South Wales |
| OIMS | Offender Integrated Management System |
| OST | Opioid Substitution Therapy |
| PHDAS | Pharmaceutical Drugs of Addiction System |
| PY | Person-years |
| ROD | Reoffending Database |
| WHO | World Health Organization |

EXECUTIVE SUMMARY

Prisoners experience very high rates of drug dependence, health problems and premature mortality. Without intervention they are highly likely to come into further contact with the criminal justice system, creating further health risk. Opioid dependence is a common problem among prisoners, and opioid substitution therapy (with methadone and buprenorphine) for opioid dependence may be an effective intervention in preventing morbidity, mortality and offending. Using retrospective data linkage, this study evaluated engagement with treatment, patterns of offending, incarceration and mortality among opioid-dependent people who received OST in New South Wales, Australia, at some time between 1985-2010. We linked all OST records with data on all court appearances 1993-2011, custody episodes 2000-2012, and mortality 1985-2012.

A total of 638,545 charges were laid against cohort members between 1993-2011. Eight in ten males (79.7%) and 67.9 percent of females had at least one charge; rates were 94.15 per 100 PY (95% CI 93.89-94.41) among males, and 53.19 per 100 PY (95% CI 52.91-53.46) among females, and highest at 15-19 years (175.74 per 100 PY males (95% CI 174.45-177.03), 75.60 per 100 PY females (95% CI 74.46-76.76)) and 20-24 years (144.61 per 100 PY males (95% CI 143.70-145.53), 84.50 per 100 PY females (95% CI 83.53-85.48)). The most frequent charges were theft (24.5% of all charges), traffic/vehicle offences (16.3%), offences against justice procedures (10.5%), illicit drug offences (10.0%), intentional injury offences (9.9%) and public order offences (8.9%).

Almost four in ten of the cohort (37%; 43% of men and 24% of women) had at least one episode of incarceration between 2000-2012. Men had a median of 3 (ranging between 1-47) incarcerations, and women, 2 (ranging between 1-35). Costs of incarceration of this cohort between 2000 and 2012 totalled nearly AUD\$3 billion. Our findings suggest that a substantial

minority of opioid dependent people experience incarceration, usually on multiple occasions and at significant cost.

Of the 34,962 people in the cohort, 6,830 were Indigenous and 28,132 were non-Indigenous. Among the 6,830 Indigenous people, 4,615 (67.6%) were male and 2,215 (32.4%) female. The median number of charges against Indigenous people (25, IQR 31) was significantly greater than non-Indigenous people (9, IQR 16) ($p < 0.001$). The median proportion of follow-up time that Indigenous males and females spent in custody was twice that of non-Indigenous males (21.6% vs. 10.1%, $p < 0.001$) and females (6.1% vs. 2.9%, $p < 0.001$). The proportion of Indigenous people who first commenced OST in prison (30.2%) was three times that of non-Indigenous people (11.2%) ($p < 0.001$).

Following on from our study of patterns of offending among opioid-dependent people, we also examined the effect of OST treatment and retention on crime rates among 10,744 opioid-dependent people who first entered OST on or after 1 January 2004. This allowed a comparison of crime rates in the four years immediately prior to treatment entry (the average time before an individual enters treatment after becoming opioid dependent), as well as periods in and out of OST after initiating treatment. We adjusted for time spent in custody over this period.

The crude crime rate (CCR) per 100 person-years for all offences that individuals were charged with prior to treatment entry was 130.78 (95% CI 129.65-131.91). A 32% reduction was observed while individuals were in OST [CCR per 100PY 88.29, 95% CI 86.96-89.63] and a 20 percent reduction was observed while individuals were out of OST [CCR per 100PY 101.67, 95% CI 100.35-102.99]. When comparing the crime rates after treatment entry only, being out of treatment was associated with a 15% increase, compared to the rate during time spent in treatment.

We found that cohort members were in prison for 30,998 person-years (PY), during which time there were 51 deaths. The all-cause crude mortality rate (CMR) in prison was 1.6 per 1,000 PY

(95% CI: 1.2, 2.2 per 1,000 PY), and the unnatural death CMR was 1.1 per 1,000 PY (95% CI: 0.8, 1.6 per 1,000 PY). Compared to prison time spent out of OST, the hazard of all-cause death was 74 percent lower while in OST in prison (adjusted hazard ratio (AHR): 0.26; 95% CI: 0.13 to 0.50), and the hazard of unnatural death was 87 percent lower while in OST (AHR: 0.13; 95% CI: 0.05 to 0.35). Compared to periods not in OST, the hazard of all-cause death during the first four weeks of incarceration was 94% lower while in OST (AHR: 0.06; 95% CI: 0.01 to 0.48).

There were 100,978 person-years of follow-up post-release, during which time 1,050 deaths occurred, for a CMR of 10.4 per 1000 person-years (95% CI: 9.8-11.0). Accidental drug-induced deaths were the most common cause of death. OST exposure in the four weeks post-release reduced the hazard of death by 75% (adjusted hazard ratio 0.25; 95%CI: 0.15, 0.52); OST receipt in prison had a short-term protective effect that decayed quickly across time.

Through the use of a population-wide linkage we were able to avoid the limitations of small, selected and possible unrepresentative samples. Our study provides persuasive evidence that OST provision in prison and post-release reduces mortality risk in the immediate post-release period. We concluded that OST in prison and post-release reduces mortality risk in the immediate post-release period. OST in prison should be scaled up, and post-release OST continuation maximised.

1. INTRODUCTION

Prisoners are one of the most vulnerable groups in the community, experiencing extremely high rates of mental illness, drug and alcohol dependence, chronic health conditions, exposure to violence, stigmatisation, social isolation and mortality (Kariminia et al. 2007a). Parental incarceration is also associated with negative health and social outcomes for children and families (Quilty et al. 2004). The World Health Organization (WHO) states that “Prisoners are members of the general population: they come from and usually return to the community. The relation between the health of prisoners, their families and the wider community is thus an acute concern. Limiting the spread of communicable diseases in prison benefits both prisoners and the wider community. Health promotion in prisons – which contributes to the health of prisoners and staff by, for example reducing smoking, improving diet and increasing exercise – reduces the burdens on a country's health system as a whole.” (World Health Organization 2010). Crime also carries costs to the wider community: impacts upon public amenity, financial loss, personal/property damage, and the public health burden associated with premature morbidity and mortality of prisoners.

Prisoners have extremely elevated rates of heroin dependence relative to the general population (Butler et al. 2004). Heroin dependence causes significant impacts upon public health and public order (Hall et al. 1999), and is thought to have the greatest impact of all illicit drugs, in Australia and globally (Begg et al. 2007; Degenhardt et al. 2013b; Nutt et al. 2007). The post-release period has been identified as a high risk period for mortality among prisoners (Coffey et al. 2003; Merrall et al. 2010; Seaman et al. 1998; Harding-Pink 1990; Christensen et al. 2006; Bird & Hutchinson 2003; Binswanger et al. 2007), most of it directly drug-related, with high rates of death from drug overdose in the early weeks post-release noted in a number of studies. For the first time our study will allow us to quantify the impact and model the cost effectiveness of

opioid substitution therapy (OST) in reducing mortality and recidivism among this extremely disadvantaged group.

1.1 The association between opioid dependence and crime

There is a strong association between heroin dependence and criminal activity. Surveys of injecting drug users (IDUs) find that more than 50 percent report imprisonment, predominantly for property and drug offences (Black et al. 2008). Early studies of heroin users entering treatment services found even higher rates of offending: one early study showed 90 percent had one or more convictions, 76 percent for drug offences, and 78 percent for property offences (Hall et al. 1993). There is evidence that this high conviction rate is directly related to heroin use. Daily heroin users report committing robberies at nearly twice the rate of irregular users (i.e. heroin use of less than three times/week) (Stevenson & Forsythe 1998); and among those convicted of burglary, those who are heroin dependent report committing burglaries at 50 percent higher rates than those without such drug problems (Stevenson & Forsythe 1998).

1.2 Opioid substitution therapy (OST)

The mainstay of treatment for opioid dependence is opioid substitution therapy (OST). Both methadone and buprenorphine (the two most commonly used medicines) have been listed on the WHO's *List of Essential Medicines* as core medicines for the treatment of people who are opioid dependent (World Health Organization 2005), given strong evidence of their effectiveness. Methadone is an orally administered opioid agonist with a half-life of 24–36 hours, dosed daily. Buprenorphine is a sublingually administered partial opioid agonist, with a longer period of action, allowing less frequent dosing, publically subsidised as a form of OST in Australia since 2001 (Burns et al. 2009).

Differences in clinical outcomes exist between these two medicines (Mattick et al. 2014). Our previous research has demonstrated that buprenorphine clients in NSW are retained for shorter periods in treatment; are more likely to cycle in and out of treatment; and are more likely to make repeated switches in medicines (Burns et al. 2009). These findings are consistent with evidence from randomised controlled trials (RCTs) (Mattick et al. 2014) .

1.3 The impact of OST upon crime

There is limited direct evidence of the impact of OST on crime. The Cochrane reviews which we have contributed to have concluded that further evidence is needed to understand the nature and extent of impacts of OST generally, and buprenorphine specifically; no studies have examined its impact upon actual criminal activity (charges or convictions), nor compared it to methadone (Mattick et al. 2008). Few, if any, RCTs would have sufficient power or follow-up to examine these issues with certainty, and certainly not for subgroups who may be at differing risk for recidivism or treatment failure. Given the differences in treatment retention mentioned above, it is possible that any potential impacts on incidence and rate of re-offending may be attenuated for buprenorphine compared to methadone. The current study will have sufficient power to examine links between retention in buprenorphine and methadone specifically, levels of offending, imprisonment and reoffending, and examine potential variations in the strength of this link across different patient groups.

1.4 Provision of OST in prison

OST is an effective treatment for opioid-dependent prisoners; post-release it is associated with reduced heroin use, reduced injecting and injecting risk and higher treatment engagement

compared to controls (Stallwitz & Stover 2007; Kinlock et al. 2009; Jürgens et al. 2009). Nonetheless, there remains considerable controversy surrounding the implementation and expansion of OST in prisons, with inequities in provision of care for opioid dependent people in prisons compared to those in the community. Although international agencies have emphasised the effectiveness and importance of OST provision within the prison setting (Jürgens et al. 2009; Stallwitz & Stover 2007; Larney 2010), policymakers in many countries are resistant to calls for the introduction of OST in prison settings (McKenzie et al. 2009).

Reviews of evidence on OST provision in prison have further highlighted a need for careful study of the impact of OST in prison (and transfer post-release) upon mortality and recidivism post-release, arguing that evidence has not yet been sufficiently powerful or rigorous to examine either outcome (Stallwitz & Stover 2007). Comparisons of buprenorphine and methadone have never been undertaken before. The current study will conduct the following: a) examine mortality risk of opioid dependent prisoners upon release, comparing those successfully transferred to community OST with those who are not and b) analyse outcomes across minority subgroups.

1.5 The impact of OST in selected priority subgroups

Some subgroups of opioid dependent people are at elevated risk, but research to date has been limited due to low power. Subgroup analysis is important if there are potentially large differences between groups in the risk of a poor outcome (Rothwell 2005), and we believe this may be the case with some groups in our research. Subgroup analyses need to be predefined, carefully justified and limited to clinically important questions (Rothwell 2005), so are rarely undertaken in RCTs. Here, we describe such a rationale for two groups: Indigenous (Aboriginal and/or Torres Strait Islander) Australians, and women.

Indigenous Australians are highly overrepresented among samples of primary heroin IDUs (Phillips & Burns 2009) and are 12 times more likely to be incarcerated than non-Indigenous Australians (Snowball & Weatherburn 2006). The overrepresentation is strongly associated with drug and alcohol use, even after controlling for other correlates of Indigenous imprisonment (Weatherburn 2008). Despite this, no specific analyses of mortality risk among Indigenous opioid dependent prisoners have ever been undertaken; an intervention such as OST could serve to significantly decrease both mortality and recidivism among this group.

Health outcomes for drug dependent women are worse than those of men, particularly with respect to mental health, exposure to violence, engagement in sex work, and drug-related physical problems. Physiological differences mean that women advance more rapidly from drug use to dependence than men, developing harms more quickly (Hernandez-Avila et al. 2004). The mortality elevation for women compared to their age peers is greater than that for men (Degenhardt et al. 2009). Although women are less likely to be incarcerated than males, the number being incarcerated in Australia is increasing at a faster rate than for men: a 57 percent increase from 1999-2009, compared to a 35 percent increase for males (Australian Bureau of Statistics 2009). Drug offences are among the most common offences for which women are incarcerated, reflecting a high levels of drug dependence (Butler et al. 2004).

It is therefore timely that an analysis is undertaken of the impact of OST on in-prison and post-release mortality and crime among female prisoners. Research in this area is lacking: RCT trials of OST are largely based on male samples; if women are included, they are generally minorities with gender included (if at all) as a covariate (Kinlock et al. 2009). Our study will provide first studies of OST impacts upon mortality post-release among women.

1.6 The association between OST and mortality

Opioid dependent people have significantly elevated mortality compared to the general population (Darke et al. 2006). OST reduces this mortality risk (Gibson et al. 2008; Degenhardt et al. 2009; Davoli et al. 1994; Brugal et al. 2005; Caplehorn & Drummer 1999). Previously we have found that the NSW OST program produced a 29 percent reduction in mortality across the entire cohort (Degenhardt et al. 2009). Mortality was particularly elevated in the first weeks upon leaving treatment, and during induction onto methadone (but not buprenorphine) treatment (Degenhardt et al. 2009).

Heroin dependent prisoners are at particular mortality risk: the post-release period has been identified as a high risk period for mortality; with high rates of death from drug overdose in the early weeks post-release noted in a number of studies (Coffey et al. 2003; Seaman et al. 1998; Harding-Pink 1990; Christensen et al. 2006; Bird & Hutchinson 2003; Binswanger et al. 2007). The extent of this elevated mortality rate has been quantified in the United Kingdom: deaths in the first 45 days were four times higher than in the first year post-release (Harding-Pink 1990); the relative risk of death in the first two weeks post-release was 4.4 (Christensen et al. 2006) or seven times higher than in the following 10 weeks (Seaman et al. 1998). One Australian study found increased mortality risk for deaths due to suicide and overdose in the period immediately after release from prison (Kariminia et al. 2007b). There is evidence that this heightened risk is attributable to low opioid tolerance, residual psychological problems and a lack of social support (Harding-Pink 1990). No study has examined the impact of treatment with OST in prison, and following release, among opioid dependent prisoners compared to those who do not receive such treatment, and those without opioid dependence, during an extended period.

1.7 The importance of data linkage

The benefits of using linked population data are that the entire sample is included (ascertainment is unbiased), large sample sizes allow the investigation of rare outcomes, the results are highly generalisable and the costs are much lower than gathering the same information in a prospective cohort study. Data linkage is increasingly recognised as having unique potential as a means of monitoring and evaluating health care services (Brook et al. 2008), with important public health benefits (Hulse et al. 2005).

We have previously successfully linked the Pharmaceutical Drugs of Addiction System (PHDAS) to the Admitted Patients Data Collection to examine neonatal outcomes among drug dependent pregnant women in NSW (Burns & Mattick 2007), and examined mortality rates among prisoners in NSW (Kariminia et al. 2005). More recently, we successfully linked the PHDAS data with the National Death Index (NDI). We demonstrated that changes have occurred over time in mortality rates and causes (Randall et al. 2011; Degenhardt et al. 2014c); that mortality differed during treatment versus out of treatment, and that the impact of OST differed across patient subgroups (Degenhardt et al. 2009). Because the relevant treatment information is not captured within the PHDAS dataset and treatment administration points are not updated in a timely way (personal communication, Pia Salmalinen, NSW Health), we were unable to determine when those receiving OST in prison were released from prison or which prisoners were successfully transferred to community OST. Linkage of the PHDAS dataset with prison records is essential if we are to ascertain the incidence of contacts with the criminal justice system, the effect of treatment on time spent in prison, the coverage of OST among prisoners and effect of treatment on mortality post-release. This study will allow us to estimate the extent of mortality risk among opioid dependent prisoners and the mortality reductions achieved through provision of OST.

1.8 The contribution of health economic analyses

It is important to demonstrate the cost effectiveness of interventions and evidence of cost-effectiveness is critical when dealing with interventions that are unpopular for political or bureaucratic reasons. Incarceration is expensive; net recurrent expenditure on corrective services was \$2.4 billion in 2007-08 (Steering Committee for the Review of Government Service Provision 2009). National expenditure per person in the population, based on net recurrent expenditure on corrective services including depreciation, increased in real terms over the last five years, from \$100 in 2003-04 to \$115 in 2007-08 (Steering Committee for the Review of Government Service Provision 2009). We know that methadone and buprenorphine maintenance therapies have been demonstrated to be cost effective in reducing heroin use and have been estimated to be a far cheaper intervention to reduce heroin use than is prison alone (Moore et al. 2007). However, conducting a cost-effectiveness analysis showing the costs offset by treatment can provide important additional evidence that could provide justification for widespread provision of this treatment within prison settings, nationally and internationally. This is the first study which has estimated the cost effectiveness of OST in reducing mortality after release from prison.

1.9 Aims

In this report, we summarise a range of analyses that have been undertaken during the course of this study. Many of these have already been published (Degenhardt et al. 2013a; Larney et al. 2014; Degenhardt et al. 2014b; Gisev et al. 2014; Degenhardt et al. 2014a), or are currently in the process of being peer-reviewed or submitted for publication (Burns et al. under review; Gisev et al. in preparation; Gisev et al. under review; Kimber et al. in preparation). For that reason, we summarise the key findings from each piece of work here and direct interested readers to full details in the published works.

These papers largely each reflected one of the original aims, although we undertook additional work compared to the original proposal (see Aims 1, 2, 7), and some of the papers contained information that addressed more than one aim (for example, the papers on mortality in prison and post release (Aims 7, 8 and 9) also examined potential gender differences in mortality risk, and differences in mortality risk for Indigenous Australians). The publications arising from this work included examination of:

1. The natural history of criminal justice system involvement among opioid dependent people, 1993-2011;
2. The extent of imprisonment of opioid dependent people, 2000-2012;
3. Potential differences in the impacts of buprenorphine and methadone upon treatment retention and mortality;
4. Differences in OST engagement and crime among Aboriginal and Torres Strait Islanders;
5. Gender differences in OST engagement;
6. The association between retention in OST and crime among opioid dependent people;
7. The impact of opioid substitution therapy (OST) provision in prison upon in-prison mortality;

8. The impact of OST on mortality following release from prison;
9. The nature of deaths occurring in prison or immediately post-release;
10. Cost effectiveness of OST in reducing mortality post-release among this group.

2. METHODS

2.1 Ethical approval

Ethical approval was obtained from the NSW Aboriginal Health and Medical Research Council (AHMRC), University of New South Wales, NSW Health's Population & Health Services Research Ethics Committee, the Australian Institute of Health and Welfare, the Alfred Hospital (Victoria), Corrective Services NSW, Justice Health and Forensic Mental Health Network, and the Department of Justice (Victoria).

2.2 Datasets

This study involved the linkage of four datasets:

- a. Pharmaceutical Drugs of Addiction System (PHDAS) at NSW Department of Health
- b. National Death Index (NDI) at the Australian Institute of Health and Welfare (AIHW)
- c. Offender Integrated Management System (OIMS) at NSW Department of Corrective Services
- d. Reoffending Database (ROD) at the Bureau of Crime Statistics and Research (BOCSAR)

The data linkage was undertaken by two agencies: AIHW (linking PHDAS and NDI) and the Bureau of Crime Statistics and Research (linking PHDAS, OIMS and ROD). The data linkage process for the study is summarised in Figure 1.

Pharmaceutical Drugs of Addiction System (PHDAS)

The PHDAS is a database containing records of authorisations by the NSW Department of Health for medical practitioners to prescribe drugs of addiction. It is a fully identified database of all methadone and buprenorphine (i.e. OST) recipients in NSW, as notified to the NSW Pharmaceutical Services Branch since 1985. As proof of identity is required to be shown to the prescribing doctor, the name variables are of high quality in this dataset. The database also records patient admissions and exits from the treatment program, and the type of pharmacotherapy treatment (methadone or buprenorphine) and the reason for exiting treatment.

National Death Index (NDI)

The NDI is a fully identified database held by the Australian Institute of Health and Welfare (AIHW) and contains mortality data collected from each of the State and Territory Births, Deaths and Marriage Registers. It collects information including date, state, and causes of death (primary causes for all records, secondary causes for deaths occurring 1997 and later). We have previously linked the PHDAS data (1985-2006) with the National Death Index (NDI) through the Australian Institute of Health and Welfare (AIHW).

Offender Integrated Management System (OIMS)

Offender Integrated Management System (OIMS) is a fully identified administrative database of the NSW Department of Corrective Services. An extract from this system known as the 'Prisoner database' containing demographic and criminographic information on all adults in full-time custody in NSW has been successfully used previously (Kariminia et al. 2005) and BOCSAR has institutional access to that dataset. We requested a similar extract from OIMS.

Reoffending Database (ROD)

ROD was developed by BOCSAR to investigate reoffending. It is an identified, internally linked dataset of court records, and contains records of all finalised court appearances in the Local, District and Supreme Courts of NSW. The internal matching process of the ROD database has

been previously validated and has a specificity of 99.9 percent and a sensitivity of 93.8 percent (Hua & Fitzgerald 2006).

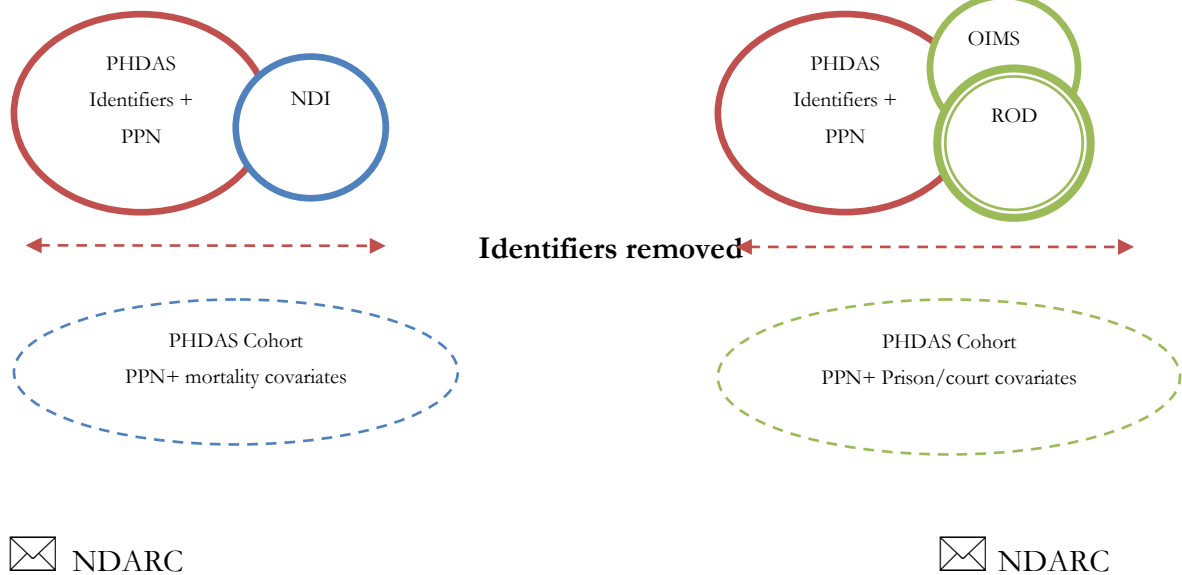
Figure 1: Flow chart of linkage process

STEP 1. NSW Health creates and sends PHDAS cohort files

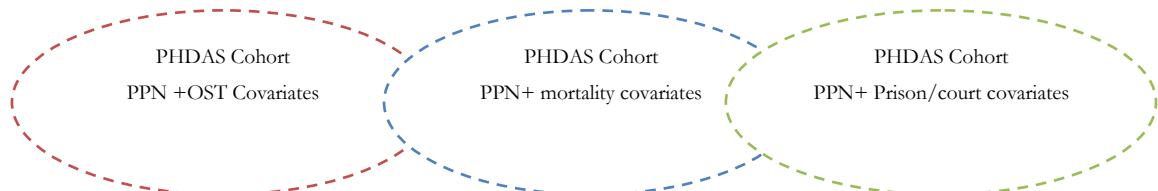


**STEP 2. Linkage to NDI by AIHW
OIMS & ROD by BOCSAR**

STEP 3. Linkage to



STEP 4. PPN files merged for analysis by NDARC



3. RESULTS

3.1 The natural history of criminal justice system involvement among opioid dependent people, 1993-2011

Studies of offending among people who use drugs typically focus upon small and potentially unrepresentative samples. We examined NSW opioid dependent clients' contact with the criminal justice system to develop population-wide measures of offending among opioid-dependent people. Full details have been published elsewhere (Degenhardt et al. 2013a).

We examined all entrants (n=48,069) to opioid substitution therapy (OST) for opioid dependence in New South Wales, Australia, between 1985 and 2010, with data on court appearances from 1 December 1993 to 31 March 2011. We calculated person years (PY) of observation and charge rates for major crime categories estimated by sex, age, and time.

A total of 638,545 charges were laid against cohort members during the follow-up period. Eight in ten males (79.7%) and 67.9% of females had at least one charge; rates were 94.15 per 100 PY (95% CI 93.89-94.41) among males, and 53.19 per 100 PY (95% CI 52.91-53.46) among females, and highest at 15-19 years (175.74 per 100 PY males (95% CI 174.45-177.03), 75.60 per 100 PY females (95% CI 74.46-76.76)) and 20-24 years (144.61 per 100 PY males (95% CI 143.70-145.53), 84.50 per 100 PY females (95% CI 83.53-85.48)).

The most frequent charges were theft (24.5% of all charges), traffic/vehicle offences (16.3%), offences against justice procedures (10.5%), illicit drug offences (10.0%), intentional injury offences (9.9%) and public order offences (8.9%).

Overall, 20.8 percent of the cohort accounted for 67.4 percent of charges. The top most frequently appearing 5.6 percent of the cohort accounted for 24.3 percent of costs (\$75.5M). Among opioid dependent people in Australia, a minority account for the majority of the criminal justice contact and levels of offending are not consistent over time, sex or age.

3.2 The extent of imprisonment of opioid dependent people, 2000-2012

There are few data about the incarceration of opioid dependent people involving large representative cohorts. We aimed to determine the prevalence and duration of incarceration in a large cohort of opioid dependent people in Australia using data linkage methods, and estimate the costs associated with their incarceration. Full details of this work have been published elsewhere (Degenhardt et al. 2014a).

We conducted a retrospective linkage study of all entrants to OST in NSW, 1985-2010, with data on incarceration, 2000-2012 (n=47,196). The number and duration of incarcerations were calculated. The average daily cost of incarceration was applied to days of incarceration in the cohort to examine the costs associated with incarceration of this cohort across the observation period.

Almost four in ten of the cohort (37%; 43% of men and 24% of women) had at least one episode of incarceration lasting one or more days. Men had a median of 3 (ranging between 1-47) incarcerations, and women, 2 (ranging between 1-35). Indigenous men spent 23 percent of their follow-up time incarcerated, compared with 8 percent for non-Indigenous men. Similarly, Indigenous women spent a substantially greater proportion of time incarcerated than non-Indigenous women (8% vs. 2%).

Costs of incarceration of this cohort between 2000 and 2012 totalled nearly AUD\$3 billion. Our findings suggest that a substantial minority of opioid dependent people experience incarceration, usually on multiple occasions and at significant cost. Treatment for opioid dependence, inside and outside prisons, may help reduce incarceration of this cohort.

3.3 Potential differences in the impacts of buprenorphine and methadone upon treatment retention and mortality

As noted earlier, research suggests methadone and buprenorphine may be differentially suited to particular groups of people and particular settings. The aims of this study were to compare the characteristics of first-time methadone and buprenorphine treatment entrants; track treatment discontinuation and re-entry with methadone and buprenorphine; and examine the factors associated with an individual's risk of leaving their first OST treatment episode. Full details of this study are presented elsewhere (Burns et al. under review).

We conducted a retrospective data linkage study of OST entrants (N=32,033) in New South Wales (NSW) (August 2001-December 2010) to records of custody episodes (January 2000- March 2012). Characteristics of methadone and buprenorphine users were compared descriptively and time-dependent Cox proportional hazard models were used to examine factors associated with an individual's risk of leaving their first treatment episode.

There were 15,600 first time OST entrants between 2001 and 2010 - 7,183 (46%) commenced buprenorphine and 8,417 (54%) methadone. Fifty-six percent of those who commenced buprenorphine spent fewer than 3 months in treatment, compared to 30

percent who commenced methadone. Retention in treatment at 12 months was higher among those commencing methadone (44%) compared to buprenorphine (25%). However, 12-month buprenorphine retention increased by 10 percent from 2001-2010, whereas methadone retention at this point decreased by 3 percent. Receiving buprenorphine in the community was associated with the greatest risk of leaving a first treatment episode (Adjusted Hazards Ratio 1.68, 95% CI 1.61-1.75), compared to receiving methadone, and prison OST receipt.

We concluded that individuals commencing methadone are retained longer in treatment than those commencing on buprenorphine although buprenorphine retention has improved over time.

3.4 Differences in engagement with OST and crime among Aboriginal and Torres Strait Islanders

Although Indigenous Australians are over-represented among heroin users, there has been no study examining offending, time in custody, and OST treatment utilisation among Indigenous opioid-dependent people at the population level, nor comparing these to non-Indigenous opioid-dependent people. The aims of this study were to compare the nature and types of offences, time in custody and OST treatment utilisation between opioid-dependent Indigenous and non-Indigenous Australians in contact with the criminal justice system. Full details can be found elsewhere (Gisev et al. under review).

We used linked records of OST entrants in New South Wales, Australia (1985-2010), court appearances (1993-2011) and custody episodes (2000-2012). Rates of criminal charges per 100 person-years were compared between Indigenous and non-Indigenous

Australians. Comparisons were made between Indigenous and non-Indigenous Australians for time spent in custody, as well as characteristics of OST utilisation.

Of the 34,962 people in the cohort, 6,830 were Indigenous and 28,132 were non-Indigenous. Among the 6,830 Indigenous people, 4,615 (67.6%) were male and 2,215 (32.4%) female. The median number of charges against Indigenous people (25, IQR 31) was significantly greater than non-Indigenous people (9, IQR 16) ($p < 0.001$). Overall, Indigenous people were charged with 33.2 percent of the total number of offences against the cohort and 44.0 percent of all violent offences. The median proportion of follow-up time that Indigenous males and females spent in custody was twice that of non-Indigenous males (21.6% vs. 10.1%, $p < 0.001$) and females (6.1% vs. 2.9%, $p < 0.001$). The proportion of Indigenous people who first commenced OST in prison (30.2%) was three times that of non-Indigenous people (11.2%) ($p < 0.001$). Indigenous males spent less time in OST compared to non-Indigenous males (median proportion of follow-up time in treatment: 40.5% vs. 43.1%, $p < 0.001$).

Indigenous opioid-dependent people in contact with the criminal justice system are charged with a greater number of offences, spend longer in custody and commonly initiate OST in prison. Criminal justice system contact is an important opportunity to engage Indigenous people in OST.

3.5 Gender differences in OST engagement

Few population-based studies have examined differences in OST treatment utilisation between men and women. Using a population of opioid-dependent people in NSW, first-episode and long-term OST treatment utilisation profiles between men and women were compared, differentiating between treatment initiation in the community and in custody.

This was a retrospective data linkage study using records of new OST entrants (2001-2010), and custody episodes (2000-2012). First OST treatment episode and overall treatment utilisation characteristics were compared between men and women initiating treatment in the community or in custody. Treatment retention was evaluated at three, six, nine and 12 months after first commencing OST, and overall, as the median proportion of follow-up time spent in treatment.

There were 15,600 first-time OST entrants in the cohort during the follow-up period. This included 10,930 men (70.1%) and 4,670 women (29.9%). A substantial minority initiated treatment in custody (n=3,016, 19.3%). More men than women began OST in custody (24.0% vs. 8.3%, $p<0.001$) and only ever received OST in custody (57.5% vs. 41.8%, $p<0.001$). Women were retained longer in their first OST treatment episode at three, six, nine and 12 months post-entry into treatment. They also spent more of their overall follow-up time in treatment. The median proportion of follow-up time spent in treatment was higher among women than men initiating treatment in both the community (46.6% (IQR 74.9) vs. 39.1% (IQR 72.4)) and custody (41.3% (IQR 61.4) vs. 30.8% (IQR 55.1)).

We concluded that there are a number of key differences in OST treatment utilisation profiles between men and women. Whereas men commonly initiate, and only receive, OST in custody, treatment retention is higher among women, independent of the setting in which treatment is initiated.

3.6 The association between retention in OST and crime among opioid dependent people

Following on from our study of patterns of offending among opioid-dependent people, we also examined the effect of OST treatment and retention on crime rates among 10,744 opioid-dependent people who started OST for the first time on or after 1 January 2004. This allowed a comparison of crime rates in the four years immediately prior to treatment entry (the average time lag before an individual enters treatment after becoming opioid dependent), as well as periods in and out of OST after initial contact with treatment services. Follow-up commenced on the date exactly four years prior to entering treatment, and ended on 31 December 2011 or the date of death, whichever was earlier. We also accounted for the time spent in custody over this period, including only the days that individuals were in the community.

The crude crime rate (CCR) per 100 person-years for the total number of offences that individuals were charged for during the four years prior to treatment entry was 130.78 (95% CI 129.65-131.91). A 32 percent reduction was observed in the CCR while individuals were in OST [CCR 88.29, 95% CI 86.96-89.63] and a 20 percent reduction was observed while individuals were out of OST [CCR 101.67, 95% CI 100.35-102.99]. When comparing the crime rates after treatment entry only, a 15% increase in the CCR was observed over the period in which individuals were not receiving OST.

The effect of retention in treatment for individuals was evaluated for individuals who were in treatment for at least three months (n=7,546), six months (n=6,685), nine months (n=6,072) and 12 months (n=5,586). There was a clear reduction in the total CCR the longer individuals were in treatment: 85.72 (95% CI 84.40-87.05) at three months, 82.78 (95% CI 81.48-84.10) at six months, 79.20 (95% CI 77.91-80.50) at nine months and 76.50 (95% CI 75.22-77.80) at 12 months.

In summary, entry into OST had a positive effect on reducing crime rates among people with established opioid dependence. Lower crime rates were observed during periods in OST and greatest reductions were observed among people who were retained longer in treatment.

3.7 The impact of opioid substitution therapy (OST) provision in prison upon in-prison mortality

Deaths in prison are a significant concern, and correctional authorities have a responsibility to ensure that such deaths are kept to a minimum. Opioid dependent people commonly experience imprisonment (as we documented earlier in this cohort), and may be at particular risk of death in prison. OST reduces mortality among opioid-dependent people residing in the community, but it is unclear if this is also the case in prison. This paper aimed to describe deaths in prison among opioid-dependent people, and examine associations between receipt of opioid substitution therapy and risk of death in prison. Full details of this work have been published elsewhere (Larney et al. 2014).

The cohort in this analysis included all opioid dependent people who had been received to adult prison at least once (n=16,715) in NSW between 2000 and 2012. We examined rates of mortality during different periods in prison, and examined both natural and unnatural (suicide, drug-induced, violent and other injury) deaths in prison.

We found that cohort members were in prison for 30,998 person-years (PY), during which time there were 51 deaths. The all-cause crude mortality rate (CMR) in prison was 1.6 per 1,000 PY (95% CI: 1.2, 2.2 per 1,000 PY), and the unnatural death CMR was 1.1 per 1,000 PY (95% CI: 0.8, 1.6 per 1,000 PY).

Compared to time out of OST, the hazard of all-cause death was 74 percent lower while in OST (adjusted hazard ratio (AHR): 0.26; 95% CI: 0.13 to 0.50), and the hazard of unnatural death was 87% lower while in OST (AHR: 0.13; 95% CI: 0.05 to 0.35). The all-cause and unnatural death CMRs during the first four weeks of incarceration were 6.6 per 1,000 PY (95% CI: 3.8, 10.6 per 1,000 PY) and 5.5 per 1,000 PY (95% CI: 2.9, 9.4 per 1,000 PY), respectively. Compared to periods not in OST, the hazard of all-cause death during the first four weeks of incarceration was 94 percent lower while in OST (AHR: 0.06; 95% CI: 0.01 to 0.48), and the hazard of unnatural death was 93 percent lower while in OST (AHR: 0.07; 95% CI: 0.01 to 0.53).

Mortality of opioid-dependent prisoners was significantly lower while in receipt of OST. In addition to other known benefits of OST in prison (e.g. reduced opioid use and injecting drug use), to-scale provision of OST in prisons will dramatically reduce unnatural deaths among opioid-dependent prisoners.

3.8 The impact of OST on mortality following release from prison

Prisoner populations are growing in many countries worldwide and the immediate period post-release from prison carries an extremely high risk of mortality for ex-prisoners, particularly among those who use (and return to) drugs (Merrall et al. 2010).

There has been little evaluation of any interventions to reduce this mortality risk. Despite community evidence that OST for opioid dependence reduces mortality risk, no study to date has reported the impact of OST treatment, provided during and after incarceration, upon mortality in the high-risk first month post-release. This study has been published and full details can be obtained elsewhere (Degenhardt et al. 2014b).

In this study, a cohort was formed of all opioid dependent people who entered OST in NSW between 1985-2010, and who following OST entry, were released from prison at least once between 2000-2012 (n=16,453 individuals, who were released 60,161 times across this period). We linked data on OST history, court and prison records, and deaths. Crude mortality rates (CMRs) were calculated according to OST retention; multivariable Cox regressions for post-release periods undertaken to examine the association between OST exposure (a time dependent variable) and mortality post-release, for which covariates were updated per-release.

There were 100,978 person-years of follow-up post-release during the study period, during which time 1,050 deaths occurred, for a crude mortality rate (CMR) of 10.4 per 1000 person-years (95% CI: 9.8-11.0). Accidental drug-induced deaths were the most common cause of death.

Most individuals had received OST at some point while incarcerated (76.5%) and individuals were receiving OST in around half (51%) of prison releases during this period. Lowest post-release mortality was among those continuously retained in OST post-release (CMR 4-weeks post-release: 6.4 per 1,000PY; 95% CI: 5.2, 7.8) and highest among those with no OST (CMR: 36.7 per 1,000PY; 95% CI: 28.8, 45.9). Multivariable Cox regression models showed that OST exposure in the four weeks post-release reduced the hazard of death by 75 percent (adjusted hazard ratio 0.25; 95%CI: 0.15, 0.52); OST receipt in prison had a short-term protective effect that decayed quickly across time.

Our study provides persuasive evidence that OST provision in prison and post-release reduces mortality risk in the immediate post-release period. We concluded that OST in prison and post-release reduces mortality risk in the immediate post-release period. OST in prison should be scaled up, and post-release OST continuation maximised.

3.9 Cost effectiveness of OST in reducing mortality post-release among this group

This study aimed to undertake a cost-effectiveness analysis of the immediate uptake of OST post-release from prison relative to not receiving OST immediately upon release in saving lives in the first six months post-release. Full details of this work are presented elsewhere (Gisev et al. in preparation).

A cohort was initially formed of all opioid dependent people who entered OST between 1985 and 2010, and who, following first OST entry, were released from prison at least once between 2000 and 2012 (Degenhardt et al. 2014b). The first recorded OST episode was used as a proxy for the onset of opioid dependence. In order to allow for each person to have six months of follow-up, the cost-effectiveness analysis focused on those 16,073 people who were released on or before 30 June 2011.

Using information from each individual's first recorded prison release after commencing treatment, we identified two groups of people: those who were released onto OST (n=7,892) and those who were not released onto OST (n=8,181). Mortality was evaluated at six months after the first prison release. Release onto OST was defined as anyone who received OST at any point from the day of release to seven days post-release (to account for a possible lag in uptake from prison to the community). People not released onto OST were those who did not receive OST on the day of release and who had no evidence of entering treatment in the first seven days after release. Individuals who received OST on the day of release but who did not receive any treatment in the seven days post-release were also considered the no treatment group (n=344).

Costs and resources included were all OST received by both groups in the six months follow-up (as measured in AUD2012), costs to the criminal justice system (proven charges processed by the court, police, penalties, prison) as well as the social costs of crime from the first day post-release to death, or 180 days post-release (whichever occurred first).

The crude average costs incurred per person across treatment, police, courts, penalties, custody and the social costs of crime, for the first six months post release, were estimated for each group: those released onto OST and those not released onto OST. These were \$14,962 per person for those released onto OST and \$11,878 for those not released onto OST. In total across the six month period, there were 35 fewer deaths observed among those released onto OST. This equates to a cost of about \$88.14 per death prevented.

4. SUMMARY AND DISCUSSION

This study has served to elucidate the patterns of offending, engagement with treatment and incarceration of all opioid dependent people in NSW across more than two decades.

There have been few population-based linkage studies of all criminal charges for an entire population of opioid dependent people. Most cohort members (75.8%) had appeared before court for criminal charges, with men more likely to do so, and more likely to do so on a larger number of occasions than women.

We found that during 2000-2012, over one-third of the cohort was incarcerated at least once, typically more often, and that the costs associated with this are considerable. In any given year, around one in seven was incarcerated, with some variation across calendar years in such levels. The cumulative incidence of incarceration in the cohort is lower than has previously been reported in studies using smaller or convenience samples of opioid users or people who inject drugs (Ross et al. 2005; Phillips & Burns 2012), but sensitivity analyses suggested that our results were not biased downwards by the inclusion of older opioid users in our analysis. Our findings clearly suggest that care should be taken in extrapolating incarceration prevalence from selected samples of opioid users, given the lower levels in this cohort compared to convenience samples.

Through the use of a population-wide linkage we were able to avoid the limitations of small, selected and possible unrepresentative samples. Although it is possible that opioid dependent people who seek treatment differ from those who do not; we are confident in the representativeness of this cohort as studies in NSW consistently find that the majority of heroin users have received OST at some point in their lives; indeed, in recent NSW studies of people who inject drugs, almost six in ten reported *currently* being in OST (Stafford & Burns 2012; Phillips & Burns 2012) and eight in ten an OST history (Kirby

Institute 2012). This large-scale linked data study has demonstrated the high mortality risk that opioid-dependent prisoners face after prison release, particularly from accidental drug-induced deaths, suicide, accidental injury and violence. This is not unexpected considering that, upon release, these people often experience poor social support, isolation, medical comorbidities, financial stress, debts, and continued exposure to drugs in the communities to which they return (Binswanger et al. 2012).

This study provides unequivocal evidence of the significant benefit of OST on post-release mortality of opioid dependent people leaving prison. Post-release OST exposure was highly effective in reducing the mortality risk in the first month at liberty. The lowest mortality rates were seen in those persons who were continuously retained in OST in the post-release period, whereas the highest mortality rates were seen in those opioid dependent persons with no OST in the post-release period.

We have demonstrated that OST provided in prison and post-release independently reduce mortality in the immediate post-release period. Prison OST is also effective in reducing drug-related HIV risk behaviours (Larney 2010), and significantly increases the probability that someone will enter OST in the days after release (Kinlock et al. 2007); there are also impacts of prison-based and post-release OST on risk of reincarceration (Larney et al. 2012). Despite these benefits, considerable inequities remain in the provision of care for opioid dependent people in prisons compared with those in the community (Harm Reduction International 2012; Nunn et al. 2009). Although international agencies have emphasised its effectiveness (Jürgens et al. 2009; Stallwitz & Stover 2007), policymakers in many countries are resistant to calls for OST in prison settings (McKenzie et al. 2009). In light of the increasingly robust scientific evidence demonstrating the benefits of prison OST, continued resistance to implementing and expanding OST in correctional settings seems unwarranted.

We have demonstrated a clear benefit of post-release OST in preventing death, but ensuring recently released prisoners enter and remain in treatment in the community can be complex. People released from prison typically have few social supports, inadequate housing and employment, limited financial means and complex health needs (Binswanger et al. 2012; Baldry et al. 2006). Daily attendance at a clinic, as is often required in order to obtain OST, is therefore just one of many competing priorities for releasees, but may provide a structure and opportunity for social interaction for those in treatment. As noted above, access to treatment while incarcerated increases the likelihood of post-release treatment entry (Kinlock et al. 2007), but access to in-prison OST is limited in many parts of the world (Harm Reduction International 2012; Nunn et al. 2009).

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