Quantifying the Social Costs of Pharmaceutical Opioid Misuse & Illicit Opioid Use to Australia in 2015/16

National Drug Research Institute, Curtin University

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national drug research institute

Curtin University

Preventing harmful drug use in Australia

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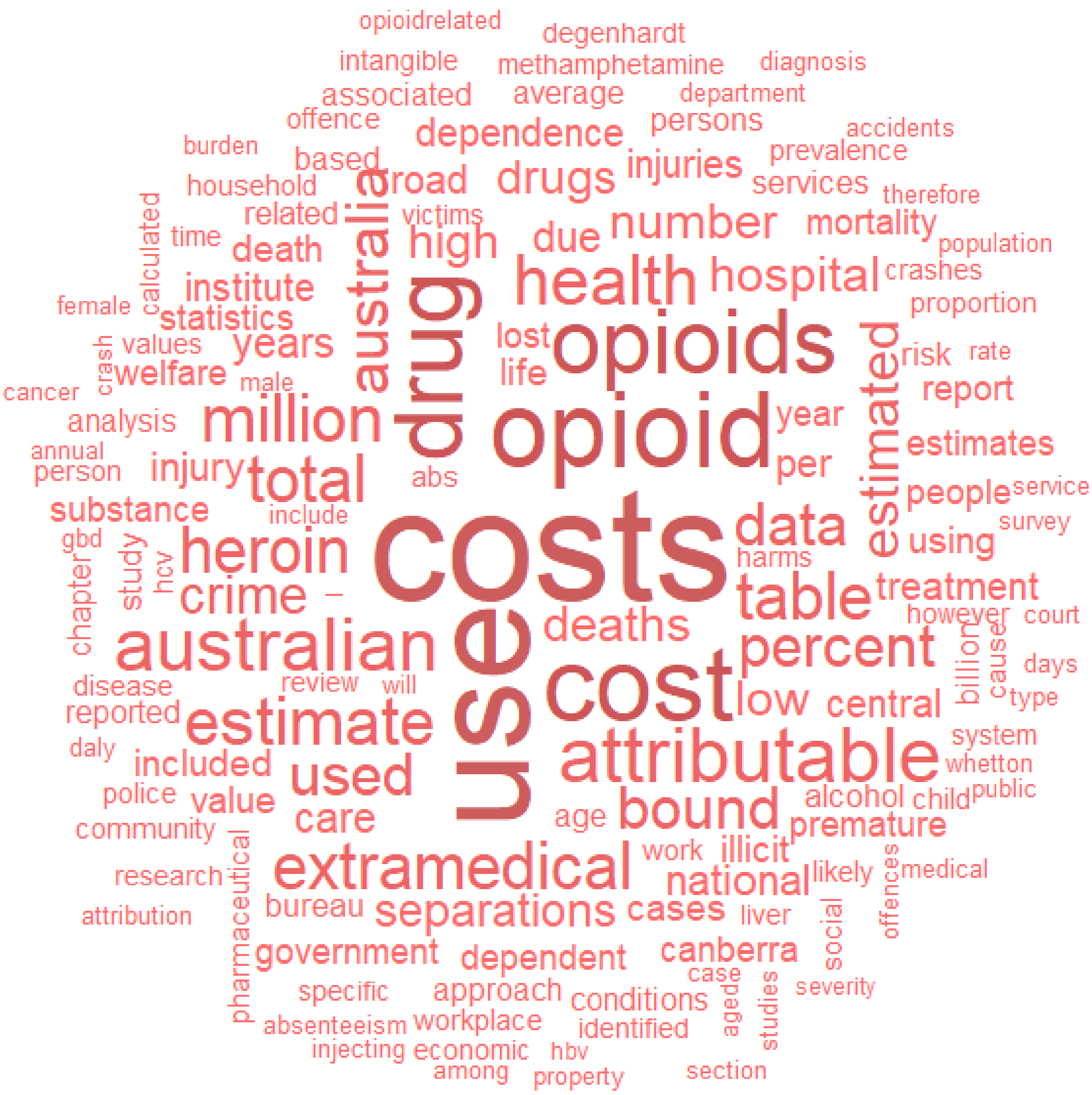
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QUANTIFYING THE SOCIAL COSTS OF PHARMACEUTICAL OPIOID MISUSE & ILLICIT OPIOID USE TO AUSTRALIA IN 2015/16

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EXECUTIVE SUMMARY

We use the term '**extra-medical opioid use**' to include the use of any illegal opioids and the use of pharmaceutical opioids not as prescribed.

Introduction

In recent decades the range and patterns of opioids used for extra-medical purposes have changed. The use of pharmaceutical opioids exceeds the use of heroin. In 2017, 63 percent of opioid deaths were attributed exclusively to pharmaceutical opioids, 28 percent to illicit opioids and 8 percent to both illicit and pharmaceutical opioids (aged 15-64 years) (Chrzanowska et al., 2019). The extra-medical use of opioids is also likely to result in other adverse outcomes including those that: require the use of health services; reduce work productivity; or, result in contact with the criminal justice system.

The objective of this report was to estimate the social costs arising from extra-medical opioid use in Australia for the financial year 2015/16. Due to data limitations in most cases we only estimated the costs occurring in this 12 month period. For example, on-going care of chronic conditions was not included. The exceptions to this were for certain harms which occurred in 2015/16 but which had longer-term ramifications, for example premature deaths, where discounted streams of future costs (lost economic activity and lost contributions to household chores) and partially offsetting savings (future health expenditure 'avoided' by premature deaths) were estimated. We also included the long-term costs of road traffic accidents, as were the expected future costs of opioid attributable imprisonment for those sentenced in 2015/16.

Using the Global Burden of Disease Study, we estimated that there were 104,026 people who met the criteria for dependence on opioids (Global Burden of Disease Collaborative Network, 2018). We focused on those who were dependent as research shows that costs associated with dependent use are much greater than for other people who use opioids not categorised as dependent (Moore, 2007). Further, there are economic arguments that those who are not 'dependent' may be making rational and informed decisions regarding their consumption of opioids and this type of cost should not be included with social costs (Cawley and Ruhm, 2011). Nevertheless, in some areas, such as deaths and criminal justice, the cost accruing from any level of opioid use was eligible for inclusion. We estimated that the total tangible cost was **$5.63 billion.** There was a further **$10.13 billion** from intangible costs, giving a total of **$15.76 billion** [1](Summary Table 1 and Summary Figure 1).

We identified 2,203 deaths with over 70,000 years of life lost. These deaths had a (gross) tangible cost of $2.62 billion: the largest tangible cost domain. However, there was an offset of $138.6 million in 'avoided' health care costs from these deaths, leaving a net cost of $2.49 billion.

The cost of in-patient care, which involved nearly 32,000 hospital separations, was over $249.3 million. In addition, there was expenditure on other (out-of-hospital) health care. This included GP services, opioid agonist therapy and treatment of opioid attributable diseases and contributed a further $829.5 million. The costs of crime, including police, courts, prisons and victims of crime was substantial and constituted

[1] Due to the rounding up and down of each figure to one decimal place, the rounded totals may not add up exactly.. See Summary Table 1 for detailed estimates.

the second largest tangible cost domain, totalling $936.1 million. Opioid use also had impacts on business through workplace injuries and absenteeism totalling over $458.7 million. Workplace costs due to premature mortality and road traffic accidents were counted elsewhere.

In addition to the tangible costs of extra-medical opioid use, there are very significant intangible costs (e.g. the value of life lost). These costs are due to premature mortality and in 2015/16 we estimated that these costs amounted to over $10.13 billion. This was based on the valuation of a statistical life year being $286,553.

Summary Table 1: Summary of opioid-related costs (with ranges) in 2015/16

Domain	Central estimate ($)	Low bound ($)	High bound ($)
Tangible costs			
Tangible costs of premature mortality (gross) (Chapter 3)	2,623,976,267	2,334,000,842	3,133,336,196
Avoided healthcare costs (Chapter 3)	-138,572,724	-131,958,751	-148,291,545
Hospital inpatient care (Chapter 4)	249,336,383	180,093,533	366,781,646
Other health care (chapter 5)	829,458,043	512,389,905	1,215,407,757
Other workplace costs (Chapter 6)	458,666,743	173,689,506	743,643,980
Criminal justice (Chapter 7)	936,070,281	565,013,385	1,755,302,874
Traffic accidents (Chapter 8)	480,624,725	270,294,018	691,951,715
Other costs (Chapter 11)	193,964,241	183,282,646	204,645,837
Total tangible costs	**5,633,523,959**	**4,086,805,084**	**7,962,778,460**
Intangible costs			
Intangible cost of premature mortality (Chapter 3)	10,127,150,276	5,668,284,222	36,200,205,774
TOTAL COSTS	**15,760,674,235**	**9,755,089,306**	**44,162,984,234**

There were also some cost domains where we produced tentative estimates that were not included in our overall figures. There is increasing interest in the harms that people experience from the substance use of others. To date, most of the focus has been on alcohol and tobacco (Laslett et al., 2015; Nayak et al., 2019; US Department of Health and Human Services, 2006). We estimated that about 70,000 children live with a person with extra-medical opioid dependence. In addition, we estimated that about 41,000 adults are the partner of a person with extra-medical opioid dependence. This results in lost quality of life for these co-residents that we valued at $11.98 billion. This was not included in our main estimates due to uncertainty as to the extent to which the assessed loss of quality of life for resident family members is captured in other elements of the costing such as victim of crime costs. Similarly, being dependent on drugs results in reduced quality of life for the drug consumer. With respect to extra-medical opioids we estimated this cost at $14.93 billion (Summary Table 2).

Summary Table 2: Summary of costs for tentative estimates and 'internalities' (with ranges) in 2015/16 but not included in the overall total

Domain	Central estimate ($)	Low bound ($)	High bound ($)
Harms to others – partners & children (Chapter 9)	11,977,778,228	1,880,978,459	35,169,824,629
Value of DALY lost by 'dependent' use (Chapter 10)	14,934,290,151	2,345,266,170	43,850,900,857
Extra-medical opioid purchases (Chapter 10)	1,443,408,941	244,936,850	2,641,881,032
TOTAL COSTS	**28,355,477,320**	**4,471,181,479**	**81,662,606,518**

DALY = disability adjusted life years

Limitations

There are technical challenges associated with any social cost study, for example in estimating costs from administrative data. Investigations of illicit drug use raise other challenges such as in estimating the size of the population in question, especially those with more significant problems who could be classified with drug dependence. We believe that the Global Burden of Disease (GBD) compare tool (2018) provides the best estimate of the number of Australians dependent on opioids in Australia (n = 104,026). However, this does not differentiate between those dependent on illegal drugs, such as heroin and those misusing pharmaceutical drugs. Our estimation assumes that any harms or costs are equivalent regardless of the specific opioid used. In addition, injecting drug use confers additional risks and potential harms but the GBD tool does not provide a separate estimate of these cases. Therefore, a further layer of uncertainly is introduced in estimating the proportion of people who consume opioids via injection.

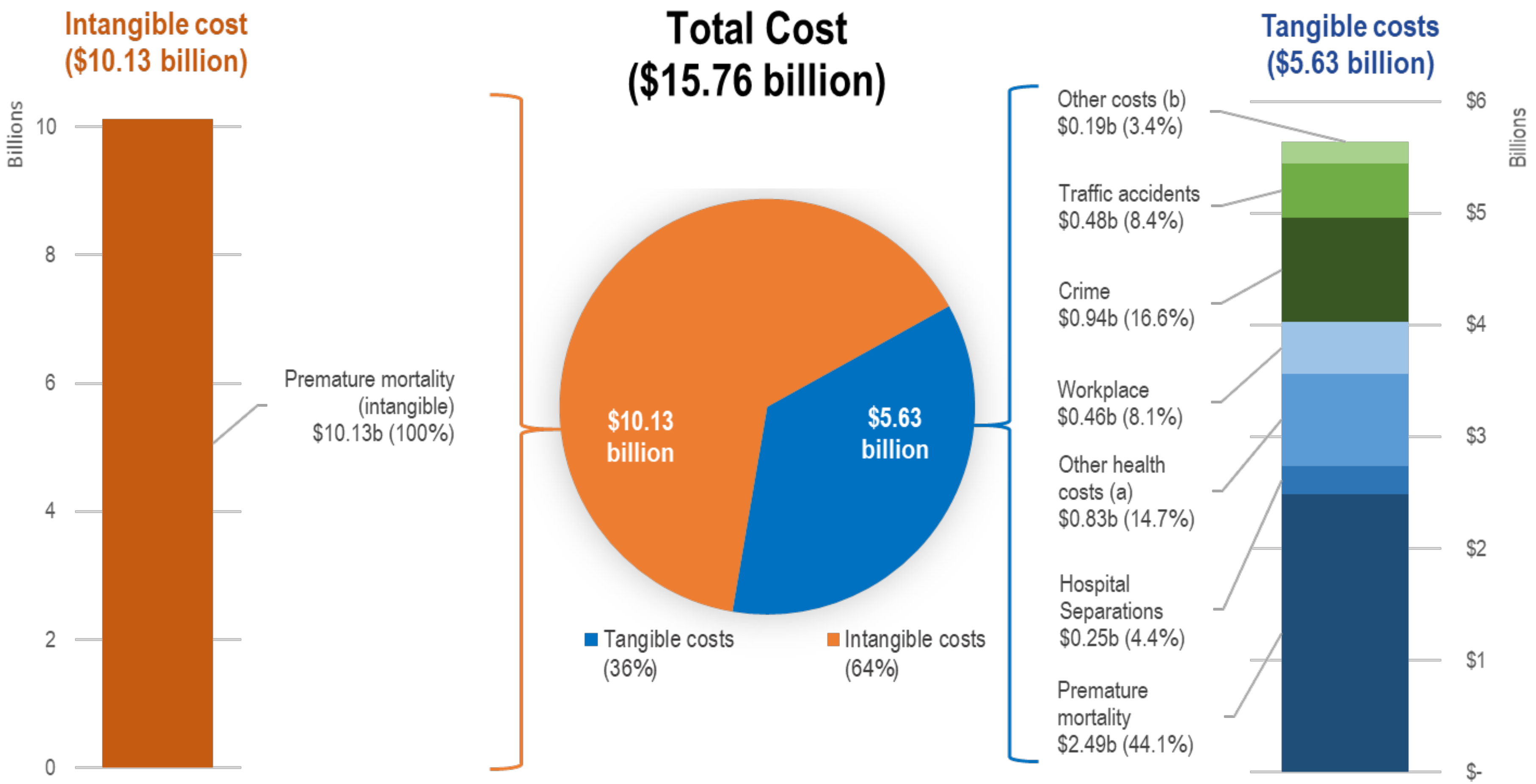
As with the recent analysis of costs due to methamphetamine use (Whetton et al., 2016), there were major domains where there were clearly costs, but we were unable to identify a method of attributing a fraction of these cost to opioids. For example, the budgets for the Australian Federal Police and Border Protection. There are also allied health services such as dental care and (out-of-hospital) physical rehabilitation where we could not attribute costs.

The costs across the criminal justice system constitute one of the major cost domains. We used an established method with attributable fractions (AF) generated from self-reported attribution of the relevant most serious offence by police detainees to drug use. However, the potential for error in this method needs to be acknowledged. The level of confidence is greatest with respect to the attribution of police costs (as the AF derive from a survey of persons in police custody), however the potential for error increases as these AF are generalised to more distal areas (courts, prisons, victims of crime).

Conclusions

The extra-medical use of opioids places considerable social and economic costs on Australia. In particular, the number of premature deaths result in substantial tangible and intangible costs in addition to the impact on family and friends. Against this backdrop we note the importance of providing comprehensive treatment programs including opioid agonist treatment in improving multiple health and social outcomes (Degenhardt et al., 2019). In addition, improved treatment for blood borne viruses combined with Australia's harm reduction interventions, such as needle and syringe programs, have prevented many deaths. Further, strategies to prevent and respond to overdoses including the recent provision of intra-nasal naloxone to enable laypeople to reverse opioid overdoses provides hope of further reductions in these deaths. While each of these individual programs provide benefits, a comprehensive 'overdose' prevention strategy is required to coordinate activities to maximise their effectiveness.

Summary Figure 1: Distribution of intangible and tangible costs in 2015/16 [1]



[a]Other health costs include ED, GP, outpatient, ambulance, specialist treatment, cessation meds, community mental health, aged/residential care & informal care.
[b]Other costs include child protection and child death reviews, needle syringe programs, supervised injecting centres and prevention programs.

Infographic

WHAT DOES EXTRA-MEDICAL OPIOID USE COST AUSTRALIA?

Extra-medical opioid use includes the **illegal use of heroin** and the **misuse of pharmaceutical opioids** (use not as prescribed)

645,260 Australians USE extra-medical opioids

104,000 Australians are DEPENDENT on extra-medical opioids

2,203 Australian DEATHS are attributable to extra-medical opioid use

The tangible costs of extra-medical opioid use amount to $5.63 BILLION

$2.48 billion
Premature death

$936 million
Drug-related crime

$481 million
Road traffic accidents

$1.08 billion
Healthcare costs

$459 million
Workplace costs

$194 million
Other (including prevention programs)

$311 million
Pharmaceuticals for treatment of medical conditions related to opioid use

$127 million
Specialist drug treatment including opioid substitution therapy

$85 million
Other health costs

$41 million
Ambulance and Emergency Department services

$249 million
Inpatient hospital treatment

$234 million
Primary healthcare treatment

$31 million
Outpatients

The intangible cost of extra-medical opioid use is $10.13 BILLION

due to the premature death of 2,203 people and over 70,000 years of life lost

THE TOTAL COST OF EXTRA-MEDICAL OPIOID USE IS $15.76 BILLION

Data from 12-month period July 2015 to June 2016

Whetton, S., Tait, R.J., Chrzanowska, A., Donnelly, N., McEntee, A., Mukhtar, A., Zahra, E., Campbell, G., Degenhardt, L., Dey, T., Halim, S.A., Hall, W., Makate, M., Norman, R., Peacock, A., Roche, A. and Allsop,S. (2020). Quantifying the social costs of pharmaceutical opioid misuse and illicit opioid use to Australia in 2015/16. National Drug Research Institute, Curtin University, Perth, Western Australia.

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Abbreviations

ABDS	Australian Burden of Disease Study
ABS	Australian Bureau of Statistics
AF	aetiological or attributable fraction
AIC	Australian Institute of Criminology
AIWH	Australian Institute of Health and Welfare
AODTS	Alcohol and Other Drug Treatment Services
AR-DRG	Australian Refined Diagnosis Related groups
BBV	Blood-borne viruses
BEACH	Bettering the Evaluation and Care of Health
BITRE	Bureau of Infrastructure, Transport and Region Economics
CAD	Canadian dollar
CI	confidence intervals
CNS	central nervous system
COD	cause of death
COPD	chronic obstructive pulmonary disease
CPI	consumer price index
CVD	cardio-vascular disease
DALY	disability adjusted life years
DPP	Department of Public Prosecution
DUI	driving under the influence
DUMA	Drug Use Monitoring Australia
ED	emergency department
EUR	European currency unit
GBD	Global Burden of Disease
GBP	Great British pound
GDP	gross domestic product
GP	general practitioner
GST	goods and services tax
HBV	hepatitis B virus
HCV	hepatitis C virus
HIV/AIDS	human immunodeficiency virus / acquired immunodeficiency syndrome
ICD	International Classification of Disease
IDRS	Injecting Drug Reporting System
IDU	injecting drug use
IHD	ischaemic heart disease
IRI	injecting-related injury
MSIC	Medically Supervised Injecting Centre
MSO	most serious offence
NAS	neonatal abstinence syndrome
NCETA	National Centre for Education and Training on Addiction
NCIS	National Coronial Information System
NDSHS	National Drug Strategy Household Survey
NGOTGP	Non-Government Organisation Treatment Grants Program
NHDC	National Hospitals Data Collection
NHMD	National Hospital Morbidity Database
NPV	net present value
NSP	needle and syringe program
OR	odds ratio
OTC	over-the-counter (medication)
OAT	Opioid agonist therapy
PBS	Pharmaceutical Benefits Scheme
PHN	Primary Health Networks
PWID	person who injects drugs
PYLL	person years life lost
RBA	Reserve Bank of Australia
Real	value or rate of change after adjusting for the rate of inflation
RoGS	Report on Government Services
RPBS	Repatriation Pharmaceutical Benefits Scheme
RR	relative risk
SPI	substance producing injury
SMR	standardised mortality ratio
SMSDGF	Substance Misuse Service Delivery Grants Fund
USD	United States dollar
VoSL	value of a statistical life
VoSLY	value of a statistical life year
WHO	World Health Organization
YLD	years of life lost to disability
YLL	years of life lost

CHAPTER 1: INTRODUCTION

Steve Whetton, Robert J. Tait, Agata Chrzanowska, Neil Donnelly, Alice McEntee, Aqif Mukhtar, Emma Zahra, Gabrielle Campbell, Louisa Degenhardt, Tania Dey, Suraya Abdul Halim, Wayne Hall, Marshall Makate, Richard Norman, Amy Peacock, Ann Roche & Steve Allsop

This report draws extensively on the previous analysis of the social cost of methamphetamine (Whetton et al., 2016) and the recent social costs of tobacco report (Whetton et al., 2019) with considerable duplication of the underlying rationale and methods.

1.1 Rationale

The National Drug Research Institute at Curtin University was engaged by the Australian Government Commonwealth Department of Health to undertake research into the costs of extra-medical opioid use and heroin use to Australia in collaboration with a multi-disciplinary team of Australian researchers from the South Australian Centre for Economic Studies, University of Adelaide, the National Drug and Alcohol Research Centre, University of New South Wales, the NSW Bureau of Crime Statistics and Research, the National Centre for Education and Training on Addiction, Flinders University, the Centre for Youth Substance Abuse Research, University of Queensland, and the School of Public Health, Curtin University.

The overarching objective was to produce as comprehensive as possible an estimate of the costs of the misuse of pharmaceutical opioids and the use of illegal opioids. Costs arising for the side-effects of pharmaceutical opioids used as prescribed are excluded from these estimates. Henceforth, we use the term **“extra-medical opioid use”** to include the use of illicit opioids and the use of pharmaceutical opioids that have not been used as directed or have been used without a prescription. We address these separately in estimating specific cost items where possible.

The remainder of this chapter sets out the background for the project. Chapter 2 provides a rationale and description of the methods used and the epidemiology underpinning the analyses. The starting point in determining the methods for the study was the approach used in the recent analysis of tobacco social costs (Whetton et al., 2019). However, we also drew on the 2016 analysis of methamphetamine social costs (Whetton et al., 2016). For example, the methamphetamine study used direct attribution on the cause of premature mortality based on coronial finding that were reported in the National Coronial Information System (NCIS). In the analysis of premature mortality due to tobacco, we used indirect attribution from the Australian Institute of Health and Welfare (AIHW) mortality data. In the current study a combination of the two approaches was used, with deaths directly caused by extra-medical use of opioids (such as acute toxicity) identified through the NCIS data, and types of death partially caused by opioids calculated using the indirect approach.

In addition, Chapter 2 reports on the conditions wholly or partially caused by opioids and the attributable fractions (AF) calculated for each condition. Premature mortality and the methods used in determining eligible cases are detailed in Chapter 3. The costs of hospital inpatient morbidity and the extraction of information from the National Hospital Morbidity Database (NHMD) held by AIHW are described in Chapter 4. Chapter 5 addresses other health care costs such as general practitioners, specialist drug treatment agencies and ambulance.

The costs of determining workplace absenteeism and injuries associated with extra-medical opioid use are evaluated in Chapter 6. Chapter 7 examines the costs of the criminal justice system (police, courts and prisons) and the costs to victims of crime. The chapter drew on "Drug Use Monitoring in Australia" (DUMA) data to derive AF for each offence category. In Chapter 8, the role and associated costs of extra-medical opioid use in road traffic accidents are presented. Other resident, in particular parents, partners and children living with a person dependent on extra-medical opioids are likely to have a reduced quality of life: Chapter 9 provides a tentative estimate of these costs. Chapter 10 assesses the internalities for people who use extra-medical opioids including the intangible costs of the lost quality of life arising from associated ill health. In Chapter 11 some of the smaller cost items such as child protection, child death reviews and harm reduction measures are addressed. Chapter 12 provides concluding remarks and highlights areas for future research and additional data requirements.

1.2 Background

Globally, in 2017, there were 53.4 million past-year users of extra-medical opioids. This equates to 1.1 percent of the global population aged 15-64 years (United Nations Office of Drugs and Crime, 2019b). Extra-medical opioids account for 73 percent of drug-related deaths and 73 percent of drug-related disability adjusted life years (DALY) (Degenhardt et al., 2018). Of particular concern, about 26.8 million people have problems of sufficient severity to be classified as dependent on opioids (Degenhardt et al., 2018). There are also 11.0 million people who inject drugs (PWID) (Degenhardt et al., 2017) of whom the majority primarily inject opioids, with the concomitant risk of blood borne infections (Degenhardt et al., 2017).

Between 2010 and 2016, in the USA, there was a more than six-fold increase in the rate of deaths caused by synthetic opioid overdoses (e.g., fentanyl). Most notably, the percentage of opioid-related deaths due to synthetic opioids rose from 14 percent in 2010 to 46 percent in 2016 (Jones et al., 2018; Seth et al., 2018). By 2017, opioids accounted for 67.8 percent of the more than 70,000 drug overdose fatalities with fentanyl and its analogues accounting for over 28,000 or 58.8 percent of deaths involving opioid drugs (Scholl et al., 2019). A major problem in relation to fatal and non-fatal overdoses with the synthetic opioids is their extreme potency, with fentanyl being 100 times and carfentanil 10,000 times more potent than morphine (Comer and Cahill, 2019).

Although the types of opioids used in Australia also changed in the twenty-first century, this was less dramatic than in the USA. Using NCIS data, Roxburgh et al. (2017) reported that 559 opioid overdose deaths occurred in 2001. Over half (55%) of these deaths were attributable to pharmaceutical opioids (Roxburgh et al., 2017). The number of opioid-induced deaths increased to 1,153 (all ages) in 2017, according to Chrzanowska et al. (2019) who used ABS data. Approximately two thirds of these deaths (671, 63%) were attributed exclusively to pharmaceutical opioids, one quarter (301, 28%) to illicit opioids, and 8 percent (88) to both illicit and pharmaceutical opioids (aged 15-64) (Chrzanowska et al., 2019).

The prevalence of recent (last year) heroin use among Australian adults has remained stable at about 0.2 percent since 2001 (Australian Institute of Health and Welfare, 2017a). However, the stigma associated with illicit drug use and the sample frame ("households") means that this figure is likely to be an under-estimate. The questions in the National Drug Strategy Household Survey (NDSHS) on the misuse of pharmaceuticals changed for the 2016 survey, so long-term comparisons are not possible. In 2013, 2.3 percent of those aged 14 and older reported recent misuse of pharmaceutical analgesics / opioids (excluding over-the-counter products) and in 2016 the figure was 3.6 percent (Australian Institute of Health and Welfare, 2017a).

In 2016, in Australia, it was estimated that about 39,700 people had used illegal opioids (heroin or opium), about 715,000 had used pharmaceutical opioids for non-medical purposes and 3.1 million had used prescription opioids[2] as prescribed (Australian Institute of Health and Welfare, 2017a, 2018d). In the USA, although most people who use heroin report the misuse of prescription opioids prior to initiating heroin use, few who misuse prescription opioids use heroin and the rate of transition to heroin is low (Compton et al., 2016). A similar pattern can be observed in Australia, with 61.6 percent of those who used heroin in the past year also reporting misuse of prescription opioids, whereas only 2.9 percent of those reporting last year extra-medical use of prescription opioids reported heroin use in the last year (Australian Institute of Health and Welfare, 2017i).

1.3 Previous cost estimates

We identified four studies, published since 2000, on the costs of illicit opioids in Australia (Table 1.1). The economic costs in Victoria of heroin dependence were estimated at $845 million in 2002. The analysis included the costs of drug treatment, health care, criminal activity, prisons, reduced taxes and social security payments, but which excluded premature mortality (Clark et al., 2003). An analysis covering Victoria and New South Wales focused on the health care and treatment costs of heroin dependence. In 2002, for 596 clients, the total cost was $3.9 million (Shanahan et al., 2006). A national estimate of health care, crime and road accident costs for people who use heroin was $4.6 billion (Moore, 2007). Importantly, this latter study illustrated the difference in per annum costs between a dependent ($105,342) and a non-dependent ($1,965) person who uses heroin. An estimate of hospital costs for illicit opioid treatment found that in 2004/2005 the total was about $16 million (Riddell et al., 2007). We note that the availability of data and the methods used may also impact on the comparability of social cost estimates.

Table 1.1: Previous Australian estimates of the social costs of illicit opioids

Report	Target year	Conditions included	Total ($)	2015/16 values ($) [1]
Riddell (2007)	2004/05	National hospital separations	16,386,976	21,795,683
Moore (2007)	2004	Deaths, national hospital costs; other health care; cost of crime; and road accidents	4,574,000,000	6,151,632,754
Shanahan (2006)	2002	Health service use: substance use treatment NSW & Vic cohort (n=596)	3,901,416	5,521,064
Clark (2003)	2002	Hospital & other healthcare costs; excess social welfare; excess government administration; reduced tax revenue; costs of crime	844,751,000	1,195,443,974

[1] Adjusted using the RBA consumer price index inflation calculator to December 2015 values (Reserve Bank of Australia, 2019)

1.4 Conclusions

We were unable to identify any recent Australian data on the social costs of either the misuse of pharmaceutical opioids or use of illegal opioids. However, data from the USA suggest that the costs of both the misuse of pharmaceutical opioids and of illicit opioids are significant, with costs per person who uses drugs in the order of USD 41,000 for misuse of pharmaceutical opioids in 2013 (Florence et al., 2016) and USD 50,799 per person who uses heroin in 2015 (Jiang et al., 2017). When the intangible costs of premature mortality are included, the estimated social cost increase significantly, with the US President's Council of Economic Advisers (2017) estimating the total cost of all illicit opioid use in the USA at USD 210,000 per case in 2015.

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[2] Excludes private prescriptions and over-the-counter codeine products available at that time (Australian Institute of Health and Welfare, 2018d)

Box 1.1 Key opioid definitions:

Naturally derived opioids

These are products that can be derived either directly from opium poppies (e.g. opium, morphine) or synthesised from them (e.g. heroin, codeine, buprenorphine, hydrocodone, oxycodone).

Synthetic opioids

These products can be manufactured without materials from opium poppies and include tramadol, methadone and fentanyl.

Weak *versus* strong opioids

Products within either of the above classes can also be classified in terms of their potency relative to oral morphine. Codeine, tramadol and opium are considered to be "weak" or less potent than oral morphine whereas heroin, methadone, buprenorphine and fentanyl are considered to be 'strong", with the latter being 100 times more potent than oral morphine (Australian Institute of Health and Welfare, 2018d; United Nations Office of Drugs and Crime, 2019b).

Hazardous use

A pattern of consumption that increases the risk of subsequent harmful outcomes for the consumer – these include social, physical and mental health outcomes. This term is used by the World Health Organisation but is not a diagnostic category within the International Classification of Diseases (ICD) (World Health Organization, 1993, 2009).

Harmful use

A pattern of consumption that is causing damage to physical or mental health or adverse outcomes for interpersonal relationships (with respect to opioids, ICD code F11.1) (World Health Organization, 1993).

Dependent use

A cluster of cognitive, behavioural and physiological phenomena such as impaired control, craving, tolerance / withdrawal, continued use despite clear evidence of harm and pre-occupation with use (with respect to opioids, ICD code F11.2). Both dependence and harmful diagnostic criteria require these to have persisted for at least one month or repeatedly over 12 months.

Adapted from Larance et al. (2011) and AIHW (2018d)

CHAPTER 2: METHODS

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2.1 Background

As noted above (Section 1.1), as a starting point, the methods sought to replicate those used in the Social Costs of Tobacco report (Whetton et al., 2019) or the Social Costs of Methamphetamine study (Whetton et al., 2016) where possible. For example, premature mortality directly caused by extra-medical use of opioids was calculated using the same direct attribution method as in the methamphetamine report with data from the National Coronial Information System (NCIS), whereas causes of death partially caused by opioids such as deaths from blood borne viruses or accidental injuries, were calculated using the indirect approach as was the case in the tobacco analysis. This decision was driven by the limited AF available for opioid and methamphetamine use (see Section 11.2 and Table 11.1 for further details of the differences in the methods used between reports).

Typically, the objective of "social cost studies" is to provide an estimate in monetary terms of the overall costs of a condition, disease or behaviour. For illicit substance use, in particular for those with a substance use disorder, these costs are likely to include: medical costs arising from conditions caused (wholly or partly) by the substance; substance use treatment; costs of crime caused by use of the substance (including victims of crime costs); lost workplace productivity and injury; other tangible costs such as road traffic accidents; and, intangible costs (e.g. the intangible costs of premature death and reduced quality of life from ill-health attributable to substance use). Costs especially difficult to quantify are the tangible and intangible costs of substance use on other people, such as resident partners and children. Social costs studies are most frequently used for advocacy in public health and in the identification of high-cost areas.

In conducting social cost studies decisions need to be made regarding:

- What costs are eligible for inclusion in the analysis, in particular whether or not costs to the person who uses the substance are included with broader social costs?
- The timeframe for the analysis – that is, do the costs in the target period include use during that period and include the cost of previous use or is the analysis focused on use in the target period and future costs?

Having determined the overall scope of the study, it is necessary to:

- Estimate the prevalence of use, by level of potential harm for different types of use where possible;
- Quantify the types of harm that are either wholly or partially caused by the drug (e.g. via AF calculated from RR); and,
- Identify sources of cost data for each outcome and the proportion of the total cost that can be attributed to the target substance.

2.2 Approach to economic analysis

2.2.1 Private and social costs

In conducting social cost studies, the typical approach is to exclude any (net) private costs, i.e. costs that accrue to the individual who is purchasing the substance in question. This is on the assumption that in purchasing any particular good or service an individual will only do so where the benefits are expected to be the same or greater than the cost of consumption, including an evaluation of potential non-financial costs such as increased risk of ill-health or other adverse outcomes. Where this is the case there is no need for public policy intervention.

While this approach is generally accepted for standard products, there is debate about its applicability for substances with 'addictive' potential, especially where costs are incurred by those classified with a substance use dependence. In these cases, consumption decisions may not necessarily be rational and informed. Cawley and Ruhm (2011) provided an excellent review on this topic, which underpins this section (See Appendix 2.1).

The 'rational addiction' hypothesis (Becker and Murphy, 1988) has been widely used in modelling the consumption of addictive substances. By definition it assumes people make rational evaluations of the current and future costs of their drug use and it contends that people who use addictive substances consider the risk of dependence when they start using a substance. Therefore, based on this theory any harms arising to that individual should not be a factor in policy decisions and costs to a person who uses drugs are excluded from social cost analyses.

The validity of the 'rational addiction' hypothesis for those with a drug dependence has been called into question by research findings that undermine its fundamental assumptions, namely that people:

- Typically underestimate the risk of becoming dependent on a drug (Gruber and Köszegi, 2001; Kenkel, 1991);
- Underestimate the potential harms to themselves and have incomplete information on the future adverse effects of using the particular drug (Gruber and Köszegi, 2001; Kenkel, 1991);
- Have inconsistent preferences for the drug in question over time with the likelihood of a present-bias, such as a desire to consume now versus quitting in the future (Angeletos et al., 2001; Gruber and Köszegi, 2001; Laibson, 2001); and,
- Make decisions based on heuristics using incomplete evidence, and do not consider the full future consequences (Akerlof, 1991; Suranovic et al., 1999).

Overall, if the key assumptions of the 'rational addiction' hypothesis are incorrect, then at a minimum, some of the costs of drug dependence can be considered within a social cost framework and can be used to justify public policy interventions that aim to reduce consumption to the point where all costs are factored into consumption decisions (US National Cancer Institute and World Health Organization, 2016). The form that policy interventions take could include actions that decrease availability, increase price, or provide more comprehensive information to existing and potential persons who use drugs.

Those costs borne by the person who is dependent that are not factored into the consumption decision are termed 'internalities'. Internality Theory allows for time inconsistent decisions by consumers and states that government policy decisions should factor in both internal and external costs. Therefore, changes in taxation levels or other interventions can be justified even when there are no external costs to ensure that people who use substances take all costs into account in their decision making (US National Cancer Institute and World Health Organization, 2016). Thus, social cost studies need to decide if these costs are eligible, and if so, how they should be included.

There are three approaches typically used in addressing 'internalities' in social cost studies:

- Exclude all costs accruing to the person who uses the substance based either on, a) the belief that the framework provided by the 'rational addiction' hypothesis still confers some utility or, b) the inherent difficulty of quantifying internalities;
- Exclude costs incurred by non-dependent persons who use but include those costs incurred by those with a drug dependence (i.e. drug-purchases). For instance, where it is reasonable to assume that the person held incomplete information (such as the costs related to premature mortality), include the intangible costs of premature mortality of all persons who use the substance, and the cost of drug purchases by persons who are dependents (Collins and Lapsley, 2008); and,
- Consider any indirect costs arising from consumption of a substance as a social cost as well as costs directly arising from dependence. The rationale for this approach is that few of the key assumptions underpinning the 'rational addiction' hypothesis are likely to be fulfilled in this situation, with continued consumption amongst those who are dependent likely to be mainly driven by the dependence rather than fully informed and rational decisions. Expenditure on the drug incurred by those who are not dependent is still considered as ineligible.

Consistent with the approach used in our previous analyses of the costs of tobacco and methamphetamine use (Whetton et al., 2015; Whetton et al., 2019), and the evidence that persons who are dependent do not necessarily fully integrate these costs into their decision making, some internal costs were included in our analysis. We included those internal costs that appear to arise from dependence and those costs where it was not possible to separate those who were dependent and not dependent (such as premature mortality). Internal costs for those who were not dependent, such as illicit opioid purchase costs by those who were not dependent, were excluded.

2.2.2 Timeframe

The period selected for the study was the financial year 2015/16. This was the most recent year with reasonably comprehensive data. In the current analysis the availably of information on deaths from the NCIS was the critical component in selecting the target year. Coronial findings may be subject to delay, in particular in cases where there are criminal or other proceedings. We selected 2015/16 as the year that provided the best compromise between contemporaneous and comprehensive data. This also coincided with the triannual National Drug Strategy Household Survey (NDSHS) which was conducted in 2016 (Australian Institute of Health and Welfare, 2017g). As detailed below, substance use leading to some of the adverse health conditions could have occurred many years earlier. For example, the burden of liver cancer secondary to hepatitis C and B infection arising from opioid injecting drug use (IDU) occurs a number of years after the hepatitis infection. Therefore, where necessary we used (and report) the prevalence of IDU from an earlier period.

2.2.3 Approaches to estimating cost

Consistent with earlier analyses undertaken for the Australian Government, that quantified the social costs of substance use, including illicit drugs, methamphetamine, alcohol and tobacco (Collins and Lapsley, 1996, 2002, 2008; Whetton et al., 2016; Whetton et al., 2019), this study estimated the costs of illicit opioids for one recent year, namely the financial year 2015/16.

Two broad approaches [3] can be taken to assessing the costs related to a particular study year for a social cost study:

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[3] Unique to their studies, Collins and Lapsley (1996, 2002, 2008) adopted an alternative method to costing premature mortality which they called the demographic approach. This involved estimating the number of premature substance use attributable

(a) The "incidence approach" involves valuing the marginal impact of drug use in the target year for all subsequent harms of that drug use. The identified future costs are then converted back to their present value equivalent by applying an appropriate discount rate e.g. seven percent. To calculate future harms in the incidence approach, 'damage functions' are required for each attributable form of illness and premature mortality, in order that the increased probability of illness and death for all future years that arose from drug use in the target year can be calculated; or,

(b) The "prevalence approach" involves valuing the costs incurred in the target year from the harms that occur in that year, whenever the drug use began that produced that harm. The prevalence approach estimates the monetary value of all forms of harm attributable to the drug identified in the target year. In the case of harms which occur in the target year but incur costs into the future, such as the lost economic output due to premature mortality, these costs are estimated and then discounted back to their present values by applying an appropriate discount rate.

These two approaches have their own strengths and weaknesses. Where the aim of the study is to assess the future cost of a policy or treatment change, then the incidence approach is preferred. The incidence approach assesses the 'flow' of new harms into the future from consumption in the study year. In contrast, the prevalence approach includes some acute harms ('flow') and some harms that have arisen from prior exposure ('stock' measures). If the aim of the analysis is to evaluate the resources required to address the harms in the target year, then the prevalence approach is preferred. This is especially the case when the stream of future costs is uncertain, if the 'damage functions' applicable to the drug are not known for all types of harm, or when there is uncertainty about the lag between exposure and the harm.

In the case of the social cost of extra-medical opioids, there are limited epidemiological data to calculate damage functions, and inform assumptions about the lags between exposures and harms, especially extra-medical opioid attributable ill-health for 'chronic' conditions. Therefore, we have adopted a prevalence approach focussing on the costs of harm that occurred in the study year. Where possible we have adopted 'stock' measures of cost, for example the extra-medical opioids attributable costs of formal and informal care are included for the stock of those receiving care for impairments arising from liver cancer, regardless of when the cancer was first diagnosed. However, in those cases where harms that occurred in the study year produce long-lived impacts (for example premature deaths, or imprisonment for opioid attributable crime) we have included the present value of all future costs of those harms. Overall, we anticipate that the incidence and prevalence approach would produce similar results in the analysis of extra-medical opioid costs given the preponderance of acute harms compared with chronic harms. This is in contrast to tobacco-related social costs where chronic conditions predominate.

2.2.4 Summary of approach to identification of social costs of extra-medical opioids use in Australia in 2015/16

The objective of this study was to determine the (net) social costs arising from the extra-medical use of opioids in the financial year 2015/16. To achieve this, we estimated the number of people whose death was attributable to extra-medical use of opioids (via the NCIS, the GBD study and AIHW data[4]), the number of hospital separations attributable to opioids (extracted from NHMD), and other health care costs. We also

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deaths that occurred over the 40 years preceding the study year, and then estimating how many of these prematurely deceased individuals would have still been alive in the study year (and how many would have been in workforce in the study year). This approach was not used for the current study as, in our opinion, the epidemiological data on historical substance use attributable deaths was not of sufficient quality.

[4] See Chapters 3 and 4 methods for details on the identification and attribution of deaths and separations

estimated the long-term future costs of lost productivity and the avoided health care costs associated with extra-medical opioid attributable deaths that occurred in 2015/16. We also estimated the intangible value of those deaths. Hospital separations attributable to extra-medical opioids were costed based on acuity adjusted average cost of hospital separations, weighted for the cost of the treatments used. From the DUMA data we estimated the scale of opioid attributable crime, with costs to police, courts and corrections systems identified from administrative data and the costs to victims of crime from estimates produced by the Australian Institute of Criminology. Costs of absenteeism and workplace injury were estimated from NDSHS (Australian Institute of Health and Welfare, 2017g) and Safe Work Australia (2015) reports. While the specific details in the remainder of this chapter relate most closely to Chapters 3 and 4, the issues of identification of relevant cases and their attribution to opioids is applicable throughout.

2.3 Attribution of causality

The use of opioids is the causal factor for a number of conditions and one of several potential causal factors for other conditions. In estimating the costs of extra-medical opioid use, we needed to correctly apportion the premature deaths and morbidity for conditions that are partially caused by their use. Social cost studies have developed three approaches to estimating these costs.

2.3.1 Indirect attribution

Indirect attribution involves using AF calculated from relative risks (RR) or odds ratios (OR) for the role of opioids use in the condition and population specific exposure to opioids. This method is considered to be the most robust as it draws on estimates of relative risk identified from large populations together with time and location specific exposure data to identify the share of harms attributable to the risk factor in question. In order to calculate the AF, we require the RR from case-control or cohort studies, showing the risk of dying or developing the condition for those who use opioids extra-medically compared with those who do not. Further, we need the population prevalence of extra-medical use of opioids use by age and gender, typically from self-reported surveys. This was our preferred method for calculating the proportion of hospital separations in this study (see Section 4.3) and for partially attributable causes of death (see Section 3.1.7).

English et al. (1995) developed the method used in calculating AF from RR. The formula below is used to determine the AF for a specific condition where the extent of risk varies by the level of consumption of the target substance for a given population (World Health Organization, 2000).

$$AF = \frac{\sum_{i=1}^{n} P_i (RR_i - 1)}{\sum_{i=1}^{n} P_i (RR_i - 1) + 1}$$

Where -

- i = the consumption levels (in most cases for this study this will be dependent use from the GBD (Global Burden of Disease Collaborative Network, 2018));
- P_i = the proportion of the target population who are using at level of consumption i; and,
- RR_i = the relative risk of a person at consumption level i of having the condition.

For conditions such as blood borne viruses (BBV) and consequences of those infections (liver cancer and cirrhosis), AF were initially calculated for injecting drug use as a whole using the relevant age group and gender specific RR for persons who inject drugs for each condition, and the prevalence of injecting drug use. The AF were then adjusted by the prevalence of injecting opioids among people who regularly inject drugs to apportion a fraction of each of the AF of the condition due to extra-medical opioid use by injecting.

Table 2.1 shows for each condition (by specified ICD-10-AM code) the method of attribution used together with the AF or RR used in the analyses. We note that extra-medical opioid use is associated with mental health disorders such as depression and anxiety, but currently there is no suitable quality review estimating the effect sizes for these conditions (Degenhardt et al., 2019.

Table 2.1: Opioid attributable conditions

Condition/Risk/Injury	ICD-10-AM code	Level of attribution	Approach	Relative risk (RR) (95 % CI) Attributable Fraction (AF)	Source
Unintentional opioid toxicity/poisoning/overdose	T40.0 - T40.4, T40.6	Wholly	Direct	AF = 1	NCIS / ICD-10-AM
Mental and behavioural disorders due to use of opioids	F11*	Wholly	Direct	AF = 1	ICD-10-AM
Injecting-related skin and vascular infections**	L02*, L03*, I80*, L97*, L98.8, M79.3, A48.0, G06*, G09, K63.0, K65.0, K75.0, M54.02, M72.6*, N10, R02, A40*, A41*, I26.9, I40.0, R57.2, R65.1, R65.9, M86*, M89.9	Wholly Partially	Direct	AF = 1 of fraction adjusted for polysubstance use (see Table 4.4)	ICD-10-AM
Non-fatal brain injury due to toxicity**	G40*-G47*, G92, G93.1, G93.6, G93.9, G94.2, R40*, R09.0	Wholly Partially	Direct	AF = 1 of a fraction adjusted for polysubstance use (see Table 4.5)	ICD-10-AM
Suicide and self-harm	X60-84, Y87.0	Partially	Indirect	RR = 9.01 (6.28-12.92)	Larney (2019)
Road crash injuries	V12-V14 (.3 -.9), V19.4-V19.6, V19.9, V20-V28 (.3 -.9), V29-V79 (.4 -.9), V80.3-V80.5,V81.1, V82.1, V82.9, V83-V86 (.0 -.3), V87.0-V87.9, V89.2, V89.3, V89.9, V02-V04 (.1, .9), V06.1, V09.2, V09.3	Partially	Indirect	RR = 7.35 (4.69, 11.51) [a]	Larney (2019) Data on the age profile of drivers culpable for road crashes resulting in serious injury Drummer (2003)
Other accidental injuries	V01-V99 not included in road crash accidents, W00–W19; W20–W64; W65–W74; W75–W84; W85–W99; X00–X19; X58–X59; Y85- Y86	Partially	Indirect	RR = 7.35 (4.69-11.51)	Larney (2019)
Acute hepatitis C virus	B17.1, B18.2	Partially	Indirect	AF in Table 4.5	GBD (2018)
Acute hepatitis B virus	B16*, B17.0, B18.0, B18.1	Partially	Indirect	AF in Table 4.5	GBD (2018)
Human immunodeficiency virus	B20*-B24*	Partially	Indirect	AF in Table 4.5	GBD (2018)
Liver cirrhosis secondary to hepatitis B or C	K70.2, K70.3, K70.4, K72.1, K74.0, K74.3, K74.4, K74.5, K74.6, I85.0, I85.9, I86.4, I98.2, I98.3	Partially	Indirect	AF in Table 4.5	GBD (2018)
Liver cancer secondary to hepatitis B or C	C22*	Partially	Indirect	AF in Table 4.5	GBD (2018)
Low birthweight	P07.0, P07.1	Partially	Indirect	RR = 3.28 (2.47-4.39)	Hulse (1997)
Interpersonal violence	X85–Y09, Y87.1	Partially	Excess attribution	AF = 0.0214	DUMA data, analysis by AIC
Neonatal abstinence syndrome	P96.1	Partially	Excess attribution	AF = 0.965	Abdel-Latif (2013)
Infective endocarditis	I33.0	Partially	Excess attribution	AF = 0.008 [b]	Larney (2019)

*Code starting with; **coupled with opioid-related ICD-10-AM code in additional diagnosis (see Sections 4.2.2 and 4.2.3 for more details)

[a] Attributable fractions for road crash accidents were calculated for specific age groups using the prevalence of persons dependent on opioids, this was then weighted to give an all ages AF using the age profile of culpable drivers: [b] of the population of PWID

AIC = Australian Institute of Criminology

2.3.2 Excess attribution

Excess attribution estimates are derived from studies that identified 'excess' mortality or morbidity from the condition, as well as incidence of crime attributable to the substance, giving an AF or proportion of cases attributable to opioids directly.

2.3.3 Direct attribution

Direct attribution involves the use of expert opinion to attribute additional specific cases. Expert attribution has important limitations, in particular in the criteria used to attribute cases, variation between experts and the extent to which the cases reflect the exposure patterns in the population. However, in the case of rare events, such as illicit drug-related deaths, the level of uncertainly due to random variation between risk and outcomes means that 'correct' apportionment using the indirect approach is problematic. Therefore, in determining deaths directly attributable to illicit opioids, we used direct attribution based on the forensic pathologists' reports in coronial files (see Sections 3.2.1 and 3.2.2 for details). Direct attribution is also implicitly used in those cases which are attributable wholly to opioids, by definition in that we are reliant on the coding undertaken in the hospital as to the cause being one that is wholly attributable to opioids.

2.4 Epidemiological basis for cost calculations

2.4.1 Which people who use substances are included?

The total and component parts of extra-medical opioid use (pharmaceutical opioid misuse and illegal opioid use) are critical in many of the calculations of their attributable harms. The attributable harms arising from pharmaceutical opioid misuse and illegal opioid use are likely to vary with the type, quantity and frequency with which the drugs are used, the context of use, level of drug dependence and, method of use (e.g. injected). In some instances, the prevalence of interest may be "any use" over the past year which approximates to all persons who currently uses. In other cases, the focus of interest is on persons who are dependent in estimating the extent of harm. Finally, there are some types of harm where the drug use per se is not the causal factor, but the critical factor is whether or not the drug is injected, such as in the transmission of BBV. Notably, treatment data showed that 81 percent of those seeking treatment for heroin use reported injecting as the most common route of administration (Australian Institute of Health and Welfare, 2017a).

One key source of data was the NDSHS (Australian Institute of Health and Welfare, 2017g). The NDSHS is a triennial national survey of the use of licit (i.e. alcohol, tobacco) and illicit drugs (cannabis, methamphetamine, cocaine, heroin etc.). The survey collects demographic information, measures wellbeing, and gathers opinions on alcohol and other drug issues. The NDSHS uses a complex multi-stage probabilistic sampling framework in order to collect data on a representative sample of people. In 2016, 23,772 individuals aged 12 years and over in Australia were surveyed with a response rate of 51.1 percent achieved. Many questions however were not asked of 12 and 13 year-olds (Australian Institute of Health and Welfare, 2017g). In 2016, 0.2 percent of Australians aged 14 years or older had used heroin in the past 12 months and 3.6 percent had misused pain-killers/pain-relievers and opioids in the last 12 months (Australian Institute of Health and Welfare, 2017i).

Table 2.2: Estimated 2015/16 prevalence of heroin use and misuse of pharmaceutical opioids aged 14 years or older by frequency of use over the past year

Heroin	Source	N (%)
Daily + once a week or more ("Dependent use")	1	14,739 (0.074)
Once a month + every few months	1	7,657 (0.033)
Once or twice a year	1	7,772 (0.039)
Any use – total [a]	1	30,167 (0.152)
Pharmaceutical opioid (misuse)		
Daily + once a week or more ("Dependent use")	1	184,959 (0.932)
Once a month + every few months	1	269,131 (1.356)
Once or twice a year	1	181,421 (0.091)
Any use – total [b]	1	635,511 (3.202)
Extra-medical opioid use		
Daily + once a week or more ("Dependent use") [c, d]	1	190,525 (0.960)
Any use [a]	1	645,260 (3.251)
Clinical criteria Dependent use	2	104,026 (0.480)

Source: 1 = National Drug Strategy Household Survey (Australian Institute of Health and Welfare, 2017i): 2 = Global Burden of Disease (Global Burden of Disease Collaborative Network, 2018)

[a] Recent use but did not answer frequency of use = 3,000

[b] Recent use but did not answer frequency of use = 79,153

[c] Heroin and / or pharmaceutical opioid:

[d] There were 64 people who reported illicit use of methadone or buprenorphine (unable to cut down or stop) who were not classified as "dependent" on either heroin or pharmaceutical pharmaceuticals – these were not included in the count as frequency of use was not asked for illicit methadone or buprenorphine.

The prevalence estimates for alcohol and tobacco use, and commonly used illicit drugs, such as cannabis, is generally regarded as reliable, especially over time, in the NDSHS. The accuracy of data for other illicit drugs, those with a drug use disorder, and those who inject, is likely to be less reliable (Hickman et al., 2002). *Household* surveys rely on self-report and will miss the most disadvantaged persons who use drug, such as those who are homeless, living in hostels, institutions or in unstable accommodation. Furthermore, heavy or problematic substance use is not uniformly distributed geographically, and thus may not be adequately sampled in national household surveys (McKetin et al., 2005). Finally, at least in the case of methamphetamine, media attention appears to have increased stigmatisation of methamphetamine use, resulting in under-reporting in the NDSHS in comparison to cocaine and ecstasy use. With respect to heroin use, the pattern of data did not allow clear conclusions to be drawn about the extent of under-reporting (Chalmers et al., 2016).

For some forms of harm the relevant prevalence is not persons who use extra-medical opioids, but persons who are dependent on opioids. The NDSHS does not estimate dependence; instead the prevalence of extra-medical opioid dependence was from the GBD Results Tool. As this tool reports data by calendar year, we took the mean for the years 2015 and 2016 (2015 – 101,934 (87,777-117,298): 2016 – 106,118 (91,192-123,093), to give an average for 2015/16 of **104,026** (Global Burden of Disease Collaborative Network, 2018). For males aged 15-49 years, the prevalence was 1.118 percent (range 0.935-1.325 percent): for females it was 0.479 percent (range 0.386-0.586).

The GBD systematically reviews the literature on each topic (e.g. opioid dependence) to identify reports on the prevalence, incidence, remission and excess mortality, which must include a measure of clinical "caseness" (e.g. based on ICD criteria.) Prevalence by age, sex, year and country is estimated using DisMod-MR modelling. The GBD study acknowledges the potential for under-reporting of stigmatised behaviours, such as illicit drug use, in data collected through direct survey methods. Therefore, preference is given to indirect methods including back-projection and capture-recapture and these estimates are used to adjust ("crosswalk") prevalence estimated derived from surveys (Vos et al., 2017). However, the GBD study does not provide an estimate of the prevalence of non-dependent extra-medical opioid use.

We used these data on the prevalence of persons dependent on opioids in estimating the intangible costs to people who used extra-medical opioids in 2015/16 in terms of suffering disability, pain and other reductions to quality of life due to opioid attributable disease. It was also the prevalence used in many of the indirect attribution estimates of opioid attributable mortality and morbidity. Spending on extra-medical opioids by persons who are dependent was also calculated. For some measures, such as harms to others, where the household structure of people who were dependent on opioids were required, a proxy measure of dependence had to be derived from the NDSHS data. This estimate was based on the frequency of use (daily + once a week or more often) to approximate 'dependence' (See Table 2.2) (Australian Institute of Health and Welfare, 2017g).

2.4.2 Polysubstance use

Polysubstance use is common among people who use drugs of all types. For example, among those seeking treatment for heroin use, 52 percent also listed an additional drug of concern (amphetamine 23%, cannabis 19%, nicotine 17%, alcohol 12%, benzodiazepines 11%) (Australian Institute of Health and Welfare, 2017c). This has implications for all aspects of the current analysis in attributing costs (e.g. health care, crime). However, polysubstance use is a particular complication in attributions of mortality, with nearly half of opioid-induced deaths in 2016 involving benzodiazepines, 26 percent antidepressants, 16 percent antipsychotics and 15 percent alcohol (Roxburgh et al., 2018). In 2017 this had increased, with over half of opioid-induced deaths involving benzodiazepines, 32 percent antidepressants, 19 percent antipsychotics, 16 percent paracetamol and 16 percent alcohol (Chrzanowska et al., 2019). For further details on the classification of polysubstance use and mortality, see Chapter 4. Therefore, except for instances where the AF is one, such as opioid dependence, the attribution of harms to a particular substance carries a measure of uncertainty and, in some cases, uses relatively crude estimates of the attributable costs.

2.4.3 Generalising from a sample

As noted above (Section 2.3.1), even nationally representative data sets may not provide reliable data on the extent of extra-medical opioid use, especially for those with more severe substance use problems or in specific groups or locations not well represented in the data. However, national data are not available for all extra-medical opioid-related harms (e.g. Section 11.2.3 Child protection costs). Therefore, we have had to rely on state–based or even single-study estimates of some harms. In these cases, this has been acknowledged in the limitations section of the respective Chapters.

2.4.4 Range of costs

As a result of these uncertainties, in addition to our best estimate of costs, we also estimated a lower and upper range where possible, using plausible alternative values or sources of data. Where data are available, we present our best estimate of costs together with a high and low range. Where a range was not calculated we used the central estimate to replace the missing boundary(s) (e.g. Summary Table 11.3.). Alternatively, where we were only able to estimate the outer boundaries, their mean was used as the central estimate (e.g. expenditure on extra-medical opioids Chapter 10).

2.5 Included and Excluded Costs

The issue of excluded costs, in particular where data were missing, is detailed in Chapter 12. Nevertheless, we are aware of areas where costs were incurred but we were unable to quantify them – for example, the Australian Federal Police and border control operations. In addition, it seems likely that those living in remote and regional areas will have different costs to those in metropolitan areas: we were unable to quantify the extent of this difference.

Our analysis has not attempted to estimate the "opportunity costs" in this area. For example, expenditure on the treatment of extra-medical opioid related conditions could have been used in other areas of government expenditure.

CHAPTER 3: PREMATURE MORTALITY

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3.1 Background

Of all illicit drugs, opioids make the largest contribution to the global burden of disease (GBD), and their use is associated with the highest risk of premature mortality arising from illicit drugs (United Nations Office of Drugs and Crime, 2019a). In 2017, globally a total of 585,000 people died due to illicit drug use, with opioids responsible for two-thirds of these deaths (United Nations Office of Drugs and Crime, 2019a). Opioid use disorders accounted for over half of the 42 million years of healthy life lost due to all illicit drug use disorders and related infectious diseases; hepatitis C virus (HCV), human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS) (United Nations Office of Drugs and Crime, 2019a).There are estimated to be 26.8 million cases of opioid dependence globally, which equates to 353.0 cases per 100,000 people (95% uncertainty interval 309.9-405.9) [5] (Degenhardt et al., 2018).

Box 3.1: Terminology used to describe cause of death

An **opioid-induced** death has an underlying cause of death directly attributed to one or more opioids, e.g. poisoning, overdose or toxicity.

An **opioid-related** death is when opioid use was found to be contributory to the death (indirectly, partially attributable), e.g. transport accidents, suicide, interpersonal violence and disease processes like blood-borne virus infections.

This report will use the term **opioid deaths** to include both **opioid-induced** and **opioid-related** deaths. When the separation between these two types of causes of death is to be made, the specific terminology will be stipulated.

Our definitions align with the ABS terminology for causes of death, Australia, 2016 (Australian Bureau of Statistics, 2017b).

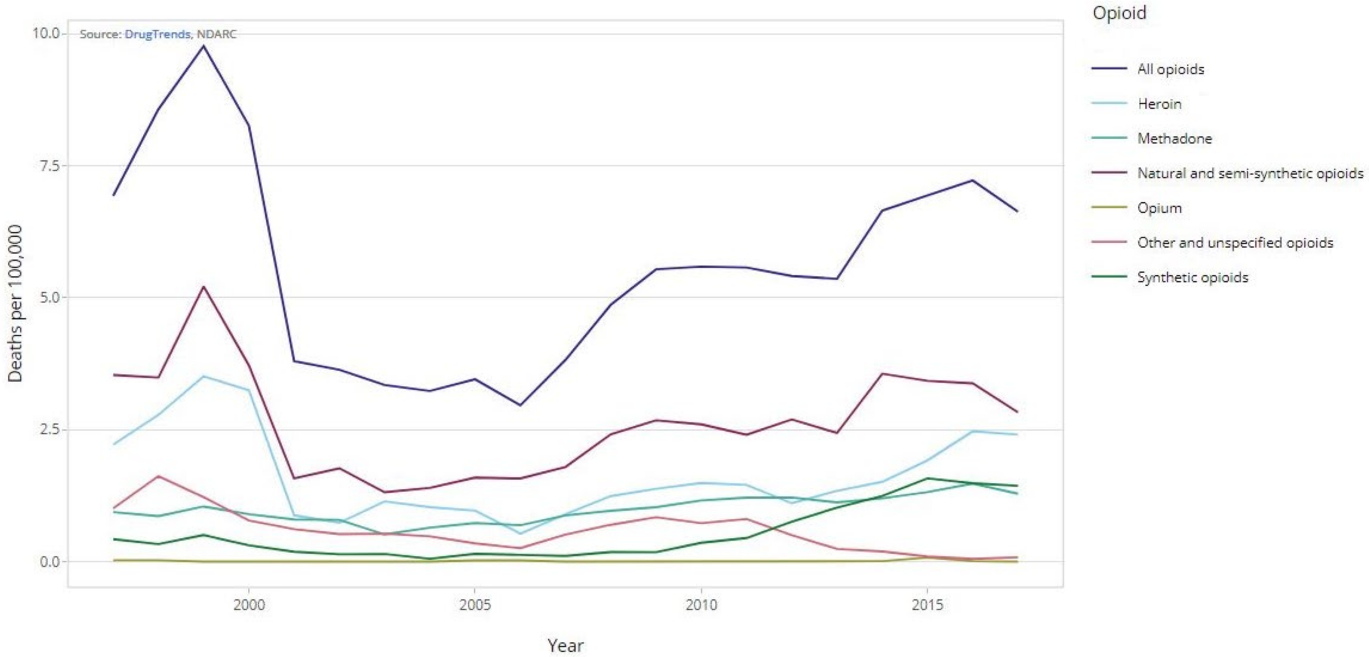
Findings from a meta-analysis of forty-three cohorts, estimated the pooled all-cause standardized mortality ratio (SMR) of people that use extra-medical opioids compared to their counterparts, was 10.0 (95% CI 7.6, 13.2). Extra-medical use of opioids increases the risk of death from overdose, communicable and non-communicable disease, suicide, and injuries (Larney et al., 2019).

In 2016, a total of 1,119 opioid-induced deaths were reported in Australia, representing 0.7 percent of all deaths that occurred that year (Australian Institute of Health and Welfare, 2018). The median age of opioid-induced deaths was low, 38 years, compared to the median age for all causes of death, at 81 years. The number and rate of opioid-induced deaths has continued to increase since 2007, and comparatively the total number in 2016 was almost double that of the number recorded in 2007 (Australian Institute of Health and Welfare, 2018d). In Australia there has been a shift in the pattern of opioid attributable overdose deaths. While rates of heroin overdoses remained relatively stable between the years 2001 and 2012, rates of

[5] There is currently debate as to whether the term 'uncertainly interval' should replace 'confidence interval' (Gelman and Greenland, 2019): The Degenhardt paper used 'uncertainly interval', so that was reported here.

pharmaceutical opioid overdose deaths have increased (Roxburgh and Burns, 2017). Figure 3.1 shows the changes in the types of opioids cited in opioid-induced deaths between 1997 and 2017.

Figure 3.1: Rate of opioid-induced deaths per 100,000 people aged 15-64 for all opioid types, heroin, methadone, natural and semi-synthetic opioids (e.g., morphine, oxycodone), opium, synthetic opioids (e.g., fentanyl, tramadol) and other opioids, 1997-2017



Reproduced with permission from (Chrzanowska et al., 2019)

The deaths wholly attributed to opioid use (opioid-induced) arise due to drug toxicity, however opioid use has a partially causal role for other conditions and injuries which can be categorised into the following causes; diseases (and their subsequent impacts), suicide, interpersonal violence, accidental injury, and low birthweight resulting from in-utero exposure to opioids. Deaths in which opioids play a partially causal role, will be referred to as opioid-related in this report (Box 3.1).

3.1.1 Drug toxicity

Opioids have a high lethal potential due to their pharmacological mechanisms of action. As a central nervous system (CNS) depressant, they act on the opiate receptors in the brain producing analgesic, sedative and euphoric effects. Symptomatology of opioid toxicity is clinically acknowledged as the overdose triad of miosis (pupil constriction), respiratory depression and reduced level of consciousness. These effects are further intensified with concomitant use of other CNS depressants, such as alcohol, barbiturates and benzodiazepines, which are a common occurrence in identified overdoses. Without timely administration of the opioid antagonist naloxone, toxicity can result in coma, respiratory and cardiac arrest. Asphyxia, pulmonary aspiration, anoxic brain damage, increased intracranial pressure and hypotension are also recognized consequences of greater than therapeutic and lethal opioid toxicity (Darke et al., 2019; Leikin and Paloucek, 2015).

It is challenging to quantify what opioid levels will result in death, as multiple factors are important. These include characteristics of the substance (e.g., adulterants, purity), the individual (e.g., tolerance, concurrent injuries or illness) and the environment or context (e.g., polysubstance use and external exposures). Focusing on the two key factors of opioid type and tolerance, it should be noted that opioids have varying toxicity levels as their properties differ (Baselt, 2008). Meaning, each drug has individual pharmacokinetic characteristics, and therefore different potencies and associated risks. For example, fentanyl is highly potent and has a more rapid onset of action, but a shorter duration of effect compared to morphine. As fentanyl is lipophilic (dissolving in fats), whilst morphine is hydrophilic (dissolving in water), fentanyl crosses over into the brain at a faster rate (Bryant and Knights, 2014).

Tolerance to opioids can occur with long-term use, and conversely tolerance can be lost in times of abstinence. As a result of this, people who use opioids are at greater risk of overdose after times of abstinence, such as release from prison, or returning to the community from hospital or rehabilitation services (Marsden et al., 2017). On the other hand, it has been theorised that long-term use of opioids, even without periods of abstinence, can increase the risk of overdose, as tolerance to the euphoric effects builds faster than tolerance to the effects on the respiratory system. Essentially, people that use opioids long-term require larger doses to achieve previous euphoric experiences, but the respiratory system is overwhelmed by the effects causing respiratory depression/arrest (Darke, 2016; White and Irvine, 1999).

3.1.2 Injuries and diseases related to injecting risks

Opioid-related diseases that lead to premature mortality, are not only linked to the pharmacological properties of the substance, but also the different routes of drug administration. The mortality rate for people who inject drugs (PWID) (including cohorts that inject opioids, amphetamine and cocaine), is 15 times that of people who do not inject (Mathers et al., 2013). The harms associated with injecting drug use (IDU) include the transmission of communicable diseases, with the predominant pathogens being hepatitis C virus (HCV), hepatitis B virus (HBV) and HIV (Degenhardt et al., 2017).

Other risks of IDU include but are not limited to, cardiovascular disease (heart and blood vessels), skin and soft tissue conditions, nerve damage, and the dispersion of foreign material amongst the body causing inflammation and/or occlusions (Darke et al., 2019; Larney et al., 2017b). Unsterile injecting practices and methods of tampering with pharmaceutical opioids that are designed for alternate administration, such as oral tablets or transdermal patches, can lead to disease and fatal outcomes (Peacock et al., 2015). Furthermore, intravenous administration is a direct bolus of the substance into the circulatory system, therefore concentrations will peak faster and at higher concentrations, as other processors of metabolism have been bypassed, increasing the danger of toxicity (Bryant and Knights, 2014). Finally, HBV and HCV increase the risk of developing cirrhosis of the liver and liver cancer.

Not all these risks are currently able to be quantified from the available epidemiological data, however RR for IDU are available for HBV and HCV, HIV, liver cirrhosis secondary to HBV and HCV, liver cancer secondary to HBV and HCV, and infective endocarditis.

3.1.3 Suicide

The GBD estimated the pooled RR of suicide for opioid dependence was 6.9 (95% CI: 4.5, 10.5) (Degenhardt et al., 2013b). In Australia in 2016, the AIHW estimated that 14 percent of all deaths directly caused by opioids (opioid-induced) were the result of suicide. Gender and age comparisons of suicides involving opioids revealed that the largest disparity was in the age group of 25 years or under, with male suicide rates twice as high as female rates (Australian Institute of Health and Welfare, 2018d).

More specifically, it has been found that people with heroin dependence, as opposed to opioid dependence more broadly, are at greater risk of attempted and completed suicide. In comparison to the general population, people with heroin dependence are 14 times as likely to complete suicide (Darke, 2011).

3.1.4 Interpersonal violence

Persons who use drugs extra-medically (particularly with heavier and dependent use) are both more likely to commit violent crime, but are also more likely to be victims of violent crime (Darke, 2010; Torok et al., 2008) Mechanisms for the increased probability of committing violent crime include economic crime to fund drug consumption (economic/compulsive crime), crime aimed at supporting or protecting systems of drug distribution and use, such as violence used to recover debts from people who use drugs (systemic crime), and violence that results from the altered mental state and/or reduced inhibition caused by consumption of many illicit drugs, or withdrawal from them (pharmacological crime) (Darke, 2010; McKetin et al., 2006; Nicosia et al., 2009; Stretesky, 2009; Torok et al., 2008).

Torok and colleagues (2008) surveyed a group of people who regularly used methamphetamine and heroin, 161 of whom primarily used heroin. Of the primarily heroin using group, 62 percent reported having been charged with a violent crime at some point in their lives (with 58% reporting having been convicted) and 35 percent reported having committed at least one violent crime in the past 12 months, with 72 percent of those committing violent crime having committed multiple offences. The persons using heroin also reported high rates of being victims of interpersonal violence, with 40 percent having been a victim of violent crime in the past 12 months, 87 percent of whom had been the victim on more than one occasion.

The specific rates of crimes of violence committed by, and experienced by, the cohort included in the Torok study may not be representative of the broader population of persons who use opioids extra-medically, as the severity of dependence was high amongst the sample population, with a mean severity of dependence scale score of 9.0 for the sub-sample who primarily used heroin. Instead, for this analysis we have used the estimated AF for violent crime derived from the Drug Use Monitoring Australia (DUMA) (Australian Institute of Criminology, 2019) survey, which for heroin is 0.021 (see Chapter 7 for details).

3.1.5 Accidental injury (trauma)

As explained above, opioids have sedative effects, causing cognitive impairment and drowsiness (Chihuri and Li, 2017). This means that people who use opioids may be more prone to accidental injuries and trauma; such as motor vehicle accidents, drownings, falls and workplace incidents. Furthermore, individuals with decreased levels of consciousness are vulnerable to other harms. These harms can occur from external hazards, such as smoke and fire, or other environmental factors such as low temperatures leading to hypothermia (although as the evidence for opioid attribution of the latter form of accidental death is not available it has not been included in this analysis). An unconscious state is particularly dangerous as the airway can easily become compromised, positional asphyxia or aspiration of gastric contents can be a consequence of this situation (Darke et al., 2019).

For premature deaths arising from road crashes, the AF was calculated based on the age share of at fault drivers to weight the age specific AF for opioid dependence (Drummer et al., 2003). This weighted AF was then applied to all road crash deaths, as it is the opioid attribution of the 'at fault' driver that is relevant rather than the potential opioid attribution of the decedent. As such, deaths for those aged less than 15 are included in the calculation of opioid attributable road crash deaths.

For all other included forms of accidental deaths, age and gender specific AF were calculated from the appropriate relative risk and the estimated prevalence of opioid dependence for that age group and gender category.

3.1.6 Low birthweight

Low birthweight is acknowledged as a risk factor for premature mortality (World Health Organization, 2019). Use of opioids during pregnancy increases the risk of low birthweight by 3.28 (2.47-4.39) (Hulse et al., 1997), with an estimated prevalence of opioid dependence amongst patients who were pregnant of 0.66 percent (Abdel-Latif et al., 2013), giving an AF of 0.015 (0.010 – 0.022).

3.1.7 Identification of opioid attributable deaths

There are three approaches that can be adopted in estimating the number of deaths attributable to a specific substance. The first being an indirect method, in which AF are deduced from strong epidemiological research, and then applied to the gross number of deaths attributable to the cause or risk factor. The second being through direct attribution, in which deaths that have been deemed attributable to a substance in the coronial record, as determined by the forensic pathologist, are examined. Finally, deaths can be attributed to a substance through an ‘excess risk’ approach which identifies the extent to which harms are more prevalent amongst the exposed population compared to the non-exposed population.

This study has used a mix of the two approaches. For those deaths where the cause of death was drug toxicity, drug toxicity and disease processes, and drug effect and disease processes, we have used the direct approach to identify them in the National Coronial Information System (NCIS) database based on the assessment made by the forensic pathologist as to whether or not opioids were the causal factor. For those conditions where opioids are one of several (or indeed many) potentially causal factors, we have used the indirect method where possible to attribute a proportion of those deaths to opioids based on RR identified from the literature and data on the prevalence of use (or dependent use) in that age and gender category. These causes of death were:

- Suicide;
- Road crash and other accidental injuries;
- Interpersonal violence; and,
- Low birthweight.

Causes of death resulting from injecting drug use were also estimated using the indirect method, with the relevant exposure prevalence being injecting drug use where the most frequently injected drug in the last month was opioids. These causes of death were:

- Acute HCV;
- Acute HBV;
- HIV;
- Liver cirrhosis secondary to HBV;
- Liver cirrhosis secondary to HCV;
- Liver cancer secondary to HBV; and,
- Liver cancer secondary to HCV.

Relative risk estimates were not available for the extent to which interpersonal violence can be attributed to extra-medical use of opioids. Instead the excess attribution approach was used, with the source of the AF being the DUMA survey of Australian police detainees.

Injecting drug use is a causal factor for infective endocarditis and is estimated to be responsible for 6.8 percent of cases in Europe (Slipczuk et al., 2013). Unfortunately, the deaths data in the GBD compare database aggregates for infective endocarditis with other forms of endocarditis, and so it has not been possible to estimate the number of deaths attributable to injecting drug use. Similarly data gaps precluded the inclusion of neonatal abstinence syndrome in the deaths data. Both of these conditions were included in the morbidity calculations, with the AF identified using the excess risk approach.

3.2 Identification of deaths wholly attributable to opioids

3.2.1 National Coronial Information System

NCIS is a centralised database of Australian and New Zealand coronial cases. The system was established by the Australian Coroners Society to achieve a collection of national information. Contributions from all Australian states and territories commenced from the 1st of July 2000, except for Queensland which followed on the 1st of January 2001. The database is a valuable retrospective tool utilised by researchers to inform public policy and clinical practice through analysis of unnatural death and injury data.

A death is determined to be reportable to a coroner in accordance with the corresponding jurisdictional Coroners Act, meaning specific requirements differ for each state and territory. However, as broadly defined, a reportable death is: “unexpected or unexplained; the result of an accident or injury; in care or custody; healthcare related; or the person’s identity is unknown” (National Coronial Information System, 2019a). As reported on 9th January 2019, 12.4 percent of all deaths in 2015 and 2016 were recorded in the NCIS (Table 3.1) (Australian Bureau of Statistics, 2016b, 2018c; National Coronial Information System, 2019b)

A complete coronial case includes four reports: a findings report completed by the coroner; an autopsy report completed by the forensic pathologist; supporting medical investigations (i.e. toxicology report and/or imagery reports); and, a police narrative of the circumstances preceding/surrounding the death. Inquests and public health recommendations are made by the coroner when required. The structure and comprehensiveness of these reports differ depending on the jurisdiction and date of completion. A coronial case is ‘closed’ upon completion of the coroner’s investigations. After closure, the case becomes available for review by authorised researchers. Therefore, a delay exists between the time of death and the ability for researchers to access case files - this can span months to years.

At the time this study was conducted, the share of closed cases for deaths notified in 2015 and 2016 were 91.1 percent and 87.0 percent respectively (Table 3.1) (National Coronial Information System, 2019b). It is likely that there are systematic variations in the types of cases that remain open, in particular cases involving criminal proceedings may be delayed.

Table 3.1: Total number of deaths in Australia, 2015 & 2016 as per Australian Bureau of Statistics (ABS), compared to number of National Coronial Information System (NCIS) cases

Category	2015	2016
Total Deaths in Australia [1]	159,052	158,504
Total NCIS notified cases in Australia [2]	19,774	19,678
NCIS Closed cases in Australia [2], n (%)	18,011 (91.1)	17,112 (87.0)

[1] (Australian Bureau of Statistics, 2019b): [2] Numbers reported at time of case extraction, 9th January 2019 (National Coronial Information System, 2019b): calculations by the authors.

3.2.2 Search strategy in NCIS

A retrospective file review of closed coronial cases in Australia, with date of death between 1st July 2015 and 30th June 2016, was conducted between February and May 2019. All cases coded by NCIS with a positive detection of an opioid or its metabolite in the toxicology report were retrieved. This was achieved by searching the field 'Object or Substance Producing Injury', for each opioid parent drug type, as listed in Table 3.2. Additionally, text searches for opioid names and related terminology in cause of death fields were conducted, see Table 3.2 for the full list. Both illicit and pharmaceutical opioids were evaluated.

Table 3.2: Illicit and pharmaceutical opioids, by NCIS coded parent drug type

NCIS coded parent drug type for 'Substance producing injury' field	Text searches in Cause of Death fields
Buprenorphine	"bupren"
Codeine	"codeine"
Dextromethorphan	"dextromethorphan"
Dextropropoxyphene	"dextropro"
Dihydrocodeine	"dihyro"
Fentanyl	"fentanyl"
Poppy Capsules	"poppy", "opium"
Heroin and Metabolites	"heroin"
Hydrocodone	"hydrocodone"
Hydromorphone	"hydromorphone"
Loperamide	"loper"
Methadone	"methadone"
Morphine and Metabolites	"morphine"
Opioids (not classified)	"opiate", "opioid", "narco"
Oxycodone	"oxycodone", "endone"
Pethidine	"pethidine"
Pholcodine	"pholcodine"
Tapentadol	"tapentadol"
Thebaine	"thebaine"
Tramadol	"tramadol"
Synthetic Opioids	
Other semisynthetic opioid analgesics	
Other synthetic opioids	

NCIS = National Coronial Information System

For the purposes of this analysis, pharmaceutical opioids listed as a cause of death are deemed 'extra-medical use' as it has resulted in grievous harm contributing to death. As further explained in the limitations of this chapter, we are unable to determine if the pharmaceutical opioid/s listed were diverted or not used as prescribed (i.e. right person, dose, route, indication, time). Therefore, the inclusion of cases reflects the determined cause of death listed by the forensic pathologist.

The results were compiled, and duplicate cases were removed. Each case was reviewed to determine if an opioid was listed as a cause of death by the forensic pathologist and separated into one of three categories:

1) Medical Cause of Death (COD): directly attributable when an opioid was listed as the medical cause of death;
2) Unspecified Multiple Drug: cause of death recorded as unspecified multiple drug toxicity or drug effect. For example, 'multidrug toxicity', 'mixed drug effect'; or,
3) Substance Producing Injury (SPI): when the substance was not listed as a cause of death but was detected in the toxicology screen. These cases have been separated out, as the role of the opioid is not definitively linked to the cause of death by the forensic pathologist.

3.2.3 Case selection in NCIS

This study analysed COD and Unspecified Multiple Drug cases only, as opioid-related SPI cases are not deemed directly attributable to the cause of death by the forensic pathologist. The intention of the individual/s actions in the event resulting in the death is reported as coded by NCIS. The cases of interest were categorised by the following codes:

1) Unintentional;
2) Intentional-self harm;
3) Undetermined intent;
4) Unlikely to be known; and,
5) Blank *(In the instance where the case is classified as 'death due to natural cause/s' at case closure, includes disease processes)* (National Coronial Information System, 2018).

The role of the opioid in the death, as documented in the coronial record, will be presented in the following categories:

1) Direct cause;
2) Antecedent cause; or,
3) Other significant conditions contributing to the death but not relating to the disease or condition causing it.

3.2.4 Attributing deaths to illicit opioids from NCIS data

All opioid directly attributable cases, including unspecified multiple-drug cases, were classified as attributable to opioids. This approach was consistent with other previous opioid studies conducted in Australia. Additionally, the risk is increased when opioids are taken in conjunction with other CNS depressants due to the synergistic effect (Darke et al., 2019).

In order to acknowledge common poly-substances use, we have presented case numbers separating out solitary drug listings. The number of cases with a solitary opiate/opioid, multiple opioids and multiple drugs listed in the cause of death, were n = 230, n = 55 and n = 737 respectively.

3.2.5 Concomitant drugs in cause of death

COD cases were further examined to determine the type of opioid listed in the cause of death and other concomitant drug types. As multiple variations in the number of poly-substance types exist, the total number of drug listings (n = 1,140) will not reflect the total number of COD cases (n = 585: Figure 3.3). As the terminology for drug listings in the cause of death is not uniform, we have also included the grouping of opioids, which are often stated as the cause of death, without further indicating the specific type/s that contributed.

Table 3.3 Drug categories for count of concomitant drug cases

Opioid Drug Grouping	Non-opioid drug grouping
Buprenorphine	Alcohol
Codeine	Anaesthetics
Dextromethorphan	Antidepressants
Dextropropoxyphene	Antiepileptics
Dihydrocodeine	Antipsychotics
Fentanyl	Barbiturates
Poppy Capsules	Benzodiazepines
Heroin and/or Metabolites	Cannabinoids
Hydrocodone	Hallucinogens
Hydromorphone	Nonsteroidal anti-inflammatory drugs
Loperamide	Non-opioid pharmaceuticals (Such as, but not limited to antihistamines, betablockers, paracetamol, pregabalin)
Methadone	Novel Psychoactive Substances
Morphine and Metabolites	Psychostimulants (ecstasy, methamphetamine, cocaine)
Opioids	Tobacco
Oxycodone	
Pethidine	
Pholcodine	
Tapentadol	
Thebaine	
Tramadol	

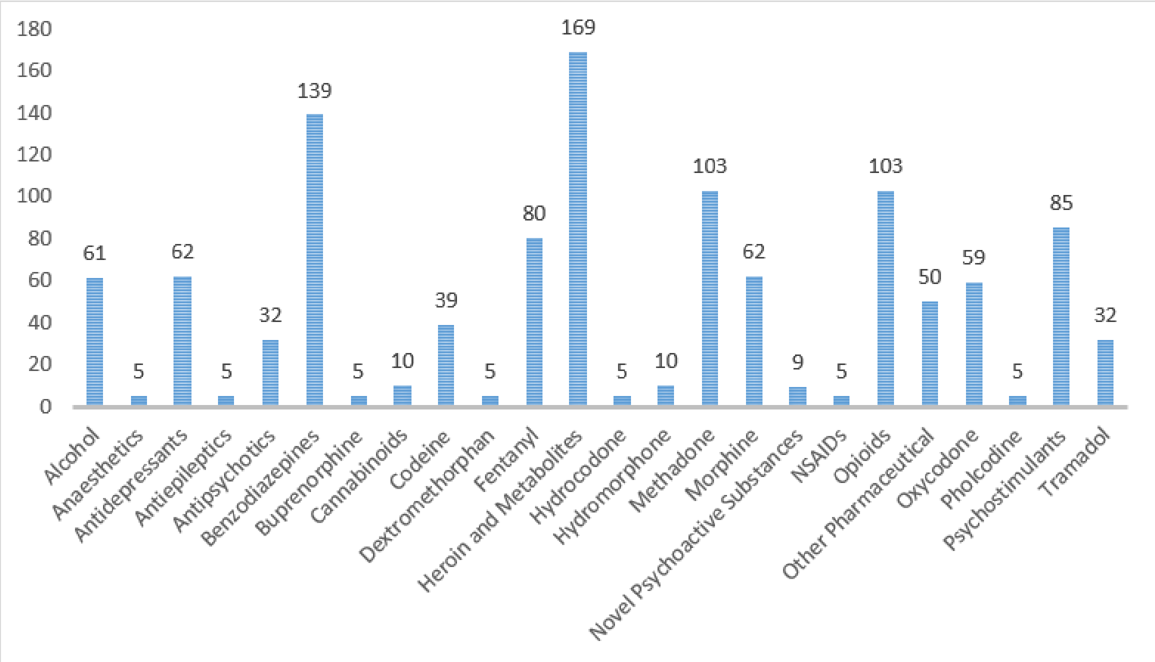
3.2.5.1 Poly-substance use findings

The following categories were not listed in COD fields; tobacco, thebaine, tapentadol, pethidine, loperamide, hallucinogens, dihydrocodeine and dextropropoxyphene. The following drug categoriesappeared in 5 or fewer cases; anaesthetics, antiepileptics, buprenorphine, dextromethorphan, hydrocodone, non-steroidal anti-inflammatory drugs, and pholcodine. To conceal small numbers for ethical reasons, these categories have been represented as '5' in Figure 3.2. The most commonly listed substance was heroin at n = 169, followed by benzodiazepines at n = 139. The broader terms opioid/s were listed 103 times, while methadone (n = 103) was listed more often than fentanyl (n = 80).

3.2.6 Results of NCIS analysis

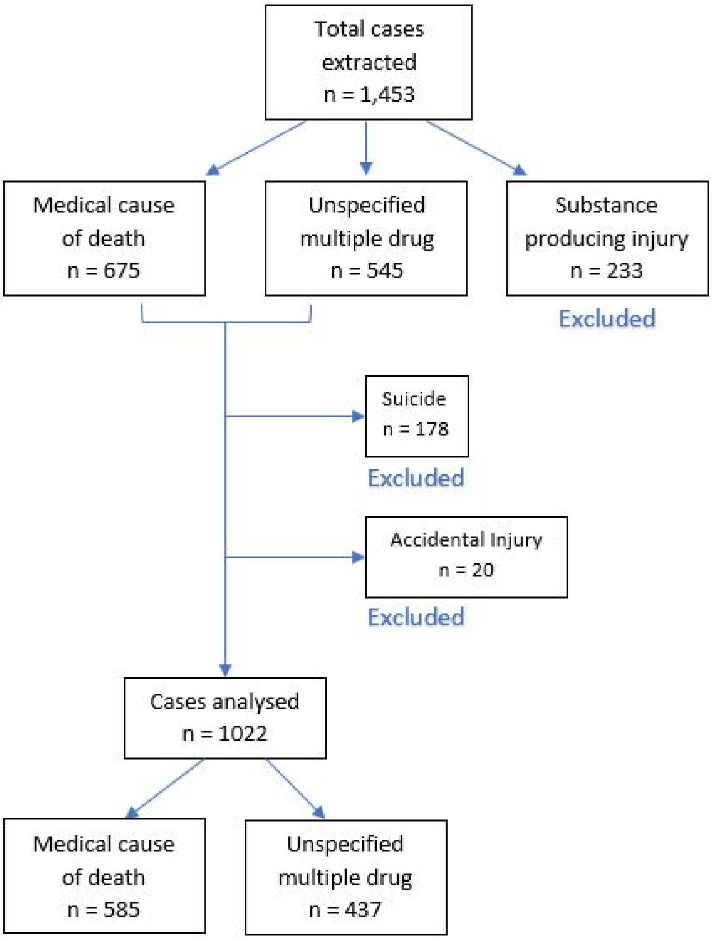
A total of 1,453 cases were identified in which an opioid was listed in the COD or was detected in the toxicology screen and NCIS coded as such. After the review of each case it was determined that in 675 instances the forensic pathologist listed an opioid as a medical cause of death. There were 545 cases classified as unspecified multiple drug contribution in the form of "use", "abuse" "effect" or "toxicity". The remaining 233 cases were categorised as SPI, i.e. an opioid was detected in the toxicology screen but was not deemed a contribution to the death. The categories of cause of death were explored, and suicide (n =178) and accidental injury/trauma (n = 20), were excluded from further analysis, as these categories will be estimated using indirect methods, as outlined above. Figure 3.3 provides a flowchart of the NCIS case selection.

Figure 3.2: Count of substances listed in cause of death



Drug categories with a count ≤5 have been represented as 5, to ensure individuals cannot be identified.

Figure 3.3: Flowchart of case selection



Examination of the medical COD cases in combination with the unspecified multiple drugs cases (Table 3.4, n = 1022), revealed that males represented 68.9 percent of the group, with the mean age being 43.0 years (SD 11.3), median 42.0 years (range 12-98). An opioid was recorded by the forensic pathologist as a direct cause of death in 92.0 percent of cases, an antecedent cause of death in 5.3 percent of cases, and a significant contributing condition in 2.7percent of cases. Drug toxicity, including both multiple drug (n = 552) and solitary drug (n = 183), accounted for almost three quarters of the deaths at 71.9 percent. Drug toxicity in conjunction with a disease process was the cause of death in almost a quarter of cases (24.2%).

Table 3.4: Australia opioid deaths identified via coronial (NCIS) data (financial year 2015/2016): n = 1022

Characteristic			Value	
Age	mean (SD)		43.0	(11.3)
	median (range)		42.0	12-98
Gender % (n)				
	Male		68.9	(704)
	Female		31.1	(318)
Intent % (n)				
	Unintentional		86.7	(886)
	Undetermined/Unlikely to be known		10.1	(103)
	Blank (Death due to natural cause/s)*		3.2	(33)
Role of Drug Class in Death % (n)				
	Direct cause of death		92.0	(940)
	Antecedent cause		5.3	(54)
	Significant contributing condition		2.7	(28)
Category of Cause % (n)				
	Drug toxicity		71.9	(735)
		Solitary		*(183)*
		Multiple		*(552)*
	Drug toxicity and disease process		24.2	(247)
		Solitary		*(37)*
		Multiple		*(210)*
	Drug effect and disease process		3.9	(40)
		Solitary		(10)
		Multiple		(30)

NCIS = National Coronial Information System

N.B: Multiple Opioids (n = 55) are grouped within multiple drugs (n = 792). Solitary Opioid (n = 230).

* In the instance where the case is classified as 'death due to natural cause/s' at case closure, includes causes of death from disease processes (National Coronial Information System, 2018).

3.3 Identification of opioid attributable deaths from other sources

For those conditions for which opioids were one of several potential causal factors, the numbers of opioid attributable deaths were estimated using the indirect approach, using the RR set out in Chapter 2. Conditions partially caused by opioids included in this analysis are:

- Suicide/intentional self-harm;
- Road injuries and other accidental injury;
- Interpersonal violence; and,
- Low birthweight.

Causes of death resulting from injecting drug use were also estimated using the indirect method, with the relevant exposure prevalence being IDU where the most frequently injected drug over the past month was extra-medical opioids:

- HIV;
- Acute HBV;

- Liver cirrhosis secondary to HBV;
- Liver cancer secondary to HBV;
- Acute HCV;
- Liver cirrhosis secondary to HCV;
- Liver cancer secondary to HCV; and,
- Infective endocarditis (not estimated due to data limitations)

Data on deaths by sex and age group for those causes of death partially caused by extra-medical use of opioids was sourced from the GBD project's compare database (Global Burden of Disease Collaborative Network, 2018). Data on interpersonal violence came from the ABS National Hospitals Data Collection (Australian Bureau of Statistics, 2019b) while data on low birthweight were sourced from data extracted by the AIHW from the National Mortality Database (2018).

3.3.1 Suicide/intentional self-harm

An estimated 158 persons died prematurely in 2015/16 from intentional self-harm attributable to opioid dependence (82.6 to 288.1). Males were significantly more likely to die due to opioid attributable suicide (139 deaths), and almost all of the premature deaths, 130 out of 158, occur in those aged 15 to 49 years. Deaths arising from suicide and intentional self-harm amongst those aged less than 15 years were excluded from the calculations.

Table 3.5: Opioid attributable deaths due to suicide/intentional self-harm (n = 158)

Category	Estimate	15-49 years	50-69 years	70+ years	Total 15-70+ years
Female	central	15.2	2.8	0.7	18.7
	low	7.6	1.3	0.3	9.3
	high	28.9	5.7	1.5	36.1
Male	central	114.9	20.0	4.3	139.2
	low	61.4	9.7	2.0	73.2
	high	203.7	39.6	8.6	252.0
Persons	**central**	**130.1**	**22.9**	**5.0**	**158.0**
	low	**69.1**	**11.1**	**2.4**	**82.5**
	high	**232.6**	**45.4**	**10.1**	**288.1**

NB Totals may differ due to rounding

3.3.2 Accidental injury

Persons who are opioid dependent are more likely to experience (or be the cause of) an accidental injury, including fatal injuries. An estimated 121.8 (47.2 to 288.7) premature deaths resulted from opioid attributable accidental injury in 2015/16, with the majority of the deaths amongst males (Table 3.6). 'Road crash injuries' (59.6 deaths) and 'Falls' (35.5 deaths) were the most common types of opioid attributable accidental injuries causing premature death.

For road crash injuries, as the prevalence of interest is that of the culpable driver rather than the injured person, these AF were then weighted by the proportion of accidents where a person in that age group was culpable, as assessed by Drummer and colleagues (2003), to give a pooled AF that was applied to all road crash injuries regardless of the age of the injured person.

This means that the estimated opioid attributed deaths for road crash injuries includes all ages of decedents. For all other accidental injury deaths, only those aged 15 or older were included in the calculations, as the relative risk was based on persons dependent on illicit opioids. This may understate opioid attributable accidental injury deaths slightly as there could be deaths resulting from inadequate supervision of children where the responsible adult was intoxicated by opioids. We were not able to find robust estimates of this risk and so these deaths were not included.

Table 3.6: Opioid attributable deaths due to accidental injury

Cause of injury	Female			Male			Persons		
	central estimate	low bound	high bound	central estimate	low bound	high bound	central estimate	low bound	high bound
Road crash injuries									
Pedestrian road injuries	3.6	1.3	9.0	7.9	3.0	19.1	11.5	4.3	28.1
Cyclist road injuries	0.2	0.1	0.6	1.6	0.5	4.3	1.9	0.6	5.0
Motorcyclist road injuries	0.6	0.2	1.7	7.4	2.7	18.3	8.0	2.9	20.0
Motor vehicle road injuries	13.1	5.3	29.8	24.6	9.9	56.2	37.8	15.2	85.9
Other road injuries	0.2	0.1	0.5	0.2	0.1	0.6	0.4	0.1	1.2
Other transport injuries	0.4	0.1	1.2	6.2	2.2	15.8	6.6	2.3	17.1
Falls	11.3	4.6	26.7	24.2	9.7	55.9	35.5	14.3	82.6
Drowning	0.6	0.2	1.5	6.5	2.5	15.4	7.1	2.7	17.0
Fire, heat, and hot substances	0.4	0.1	0.9	2.0	0.7	5.0	2.4	0.9	5.8
Unintentional firearm injuries	0.1	0.0	0.2	0.4	0.1	1.2	0.5	0.1	1.5
Other exposure to mechanical forces	0.3	0.1	0.7	4.3	1.7	10.3	4.6	1.8	11.0
Pulmonary aspiration and foreign body in airway	1.0	0.4	2.4	3.1	1.2	7.5	4.1	1.6	9.9
Other unintentional injuries	0.1	0.0	0.2	1.3	0.5	3.4	1.4	0.5	3.6
Total accidental injury	**31.8**	**12.4**	**75.5**	**90.0**	**34.8**	**213.1**	**121.8**	**47.2**	**288.7**

3.3.3 Interpersonal violence

Interpersonal violence attributable to opioid use was estimated to result in 5.5 premature deaths in 2015/16. Deaths categorised by the ABS (2019e) as 'murder' and 'manslaughter' were included, deaths by dangerous driving were excluded as these are included under accidental injury. Attributable fractions are those for violent crime calculated from the DUMA survey (AIC DUMA collection 2015/16 [computer file]; confidence intervals calculated by authors using Wilson estimator). Males are almost twice as likely to die as a result of opioid attributable interpersonal violence than females: 3.6 premature deaths compared to 1.9 deaths. The lower bound estimate for deaths due to opioid attributable interpersonal violence is 3.4 premature deaths, and the high bound is 9.0 premature deaths

Table 3.7: Premature deaths from opioid attributable interpersonal violence

Category	0–19 years	20–34 years	35–54 years	55 + years	Total
			Central Estimate		
Females	0.3	0.5	0.6	0.4	1.9
Males	0.4	1.1	1.4	0.6	3.6
Persons	**0.7**	**1.7**	**2.0**	**1.1**	**5.5**
			Low bound		
Females	0.2	0.3	0.4	0.3	1.1
Males	0.3	0.7	0.8	0.4	2.2
Persons	0.5	1.0	1.2	0.7	3.4
			High Bound		
Females	0.5	0.9	1.0	0.7	3.1
Males	0.7	1.9	2.3	1.1	6.0
Persons	1.2	2.8	3.2	1.8	9.0

Source: Australian Bureau of Statistics, 2019. Recorded Crime – Victims, Australia, 2018, cat no. 4510.0, AIC DUMA collection 2015/16 [computer file]; confidence intervals calculated by authors using Wilson estimator

3.3.4 Low birthweight

There were 83 infant deaths attributed to low birthweight in 2015/16 (data extracted by the AIHW from the AIHW National Mortality Database, unpublished), with an estimated number of opioid attributable deaths of 1.2 (0.8-1.8).

3.3.5 Blood-borne viruses and sequelae of infection

Table 3.8 shows the number of deaths by specific BBV and their sequelae separately for males and females: Table 3.9 shows the combined totals. Opioid attributable blood-borne viruses (BBV) and their consequences were responsible for an estimated 894.0 premature deaths (765.0 to 1,051.1). Cirrhosis secondary to HCV infection was the most significant cause amongst both females and males of BBV-related death, causing an estimated 476.9 [6] premature deaths. Males were more likely than females to die prematurely due to an opioid attributable BBV, with male deaths accounting for 65 percent of the deaths.

[6] Total in table differs due to rounding

Table 3.8 Opioid attributable deaths from blood-borne viruses 2015/16, by sex

		Males				Females			
Condition	**Estimate**	**15-49 years**	**50-69 years**	**70+ years**	**Total 15-70+ years**	**15-49 years**	**50-69 years**	**70+ years**	**Total 15-70+ years**
Acute hepatitis B	central	0.7	1.2	0.3	2.5	0.1	0.3	0.2	0.7
	low	0.2	0.4	0.1	0.9	0.0	0.1	0.1	0.2
	high	1.5	2.6	0.8	4.8	0.2	0.6	0.5	1.3
Acute hepatitis C	central	0.1	0.2	0.3	0.4	0.0	0.1	0.4	0.4
	low	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.1
	high	0.1	0.4	0.6	0.9	0.1	0.3	0.8	0.8
HIV/AIDS	central	1.0	0.4	0.0	1.4	0.3	0.2	0.0	0.4
	low	0.8	0.3	0.0	1.1	0.2	0.1	0.0	0.4
	high	1.3	0.5	0.0	1.7	0.4	0.2	0.0	0.5
Liver cirrhosis due to hepatitis B	central	2.4	1.0	3.8	7.2	0.6	1.3	1.0	2.8
	low	6.4	2.8	10.7	19.9	0.2	0.6	0.4	1.2
	high	2.7	1.2	4.7	8.5	1.0	2.1	1.8	4.9
Liver cirrhosis due to hepatitis C	central	39.5	172.6	104.2	316.3	19.0	65.9	75.7	160.5
	low	33.8	148.8	89.3	272.0	16.4	55.9	62.2	134.5
	high	46.3	197.2	121.3	364.8	22.1	75.7	91.1	188.9
Liver cancer due to hepatitis B	central	0.9	3.6	1.2	5.6	0.3	0.9	0.6	1.9
	low	0.3	1.3	0.4	2.1	0.1	0.4	0.2	0.7
	high	1.6	6.8	2.5	10.9	0.6	1.9	1.3	3.8
Liver cancer due to hepatitis C	central	6.5	109.0	130.4	246.0	3.5	42.9	101.5	147.9
	low	4.9	91.0	112.4	208.3	2.7	36.6	84.4	123.6
	high	8.6	128.6	149.4	286.6	4.4	50.3	117.2	171.9

NB Totals may differ due to rounding.

Table 3.9 Overall opioid attributable deaths from blood-borne viruses 2015/16, persons

Condition	**Estimate**	**15-49 years**	**50-69 years**	**70+ years**	**Total 15-70+ years**
All opioid attributable BBV	**central**	74.8	399.5	419.6	894.0
	low	66.2	338.3	360.5	765.0
	high	90.8	468.2	492.1	1,051.1

3.4 Total opioid attributable deaths

Drawing together the deaths identified through the analysis of the NCIS data with the estimated derived using the indirect method, we estimate that there were 2,203 premature deaths attributable to opioids (range 1,921 to 2,661) (Table 3.10). Opioid toxicity or effect with/without contributing disease process (unintentional and undetermined intent only) accounted for just under half of these deaths (n = 1,022) with BBV and their consequences the next most significant cause of opioid attributable deaths (with a central estimate of 894 opioid attributable deaths).

Table 3.10: Total estimated opioid attributable deaths

Cause	Female			Male			Persons		
.	central estimate	low bound	high bound	central estimate	low bound	high bound	central estimate	low bound	high bound
'Opioid deaths' (NCIS data)	318.0	a	a	704.0	a	a	1,022.0	a	a
Blood-borne viruses & their consequences	314.6	260.7	372.5	579.4	504.2	678.6	894.0	765.0	1,051.1
Suicide/ intentional self-harm	18.7	9.3	36.1	139.2	73.2	252.0	158.0	82.5	288.1
Accidental injury	31.8	12.4	75.5	90.0	34.8	213.1	121.8	47.2	288.7
Interpersonal violence	1.9	1.1	3.1	3.6	2.2	6.0	5.5	3.4	9.0
Low birthweight	0.5	0.3	0.7	0.8	0.5	1.1	1.2	0.8	1.8
Total opioid attributable deaths	**685.5**	**601.8**	**805.9**	**1,517.0**	**1318.9**	**1854.8**	**2,202.5**	**1920.9**	**2660.7**
Total years of life lost to opioid attributable death	**20,932.0**	**18,720.8**	**24,362.8**	**50,029.4**	**43,446.7**	**61,732.3**	**70,961.4**	**62,167.5**	**86,095.0**

[a] low/high bound duplicates the central estimate.
Totals may not sum due to rounding

3.5 Calculating the social cost of premature mortality

Two broad forms of social cost arise as a result of premature mortality: tangible and intangible costs. Tangible costs are those costs for which a market price exists as they can effectively be traded in the market economy. Intangible costs are those costs that cannot be traded, such as reduced quality of life from ill-health or the value placed on the lost years of being alive.

The 'years of life lost' (YLL) for each premature death were calculated using age and gender specific estimates for years of life remaining from the ABS life tables (Australian Bureau of Statistics, 2018d).

YLL were calculated in both undiscounted and discounted forms, with the latter used in the cost calculations. This approach was taken as confidentiality restrictions on the NCIS dataset precluded the provision of premature death estimates in narrow age bands; instead, for these data, YLL (and discounted YLL) were calculated for the specific age at death of each opioid premature death, with only aggregate results by gender supplied for the cost calculation. Age and gender specific probabilities of employment were used to calculate the expected number of working years lost in the study year and the present value over the analysis period. Discounting was undertaken using a real discount rate of 7 percent as recommended in Australian Government guidance (Department of Finance and Administration, 2006; Department of the Prime Minister and Cabinet, 2016)

3.6 Tangible costs of premature mortality

Tangible costs of premature mortality include: the present value of lost expected lifetime labour in paid employment (excluding where possible the present value of any private income that would have flowed to a non-dependent person who uses opioids); costs to employers of workplace disruption; the lifetime value of lost labour in the household; and, a net cost saving from the present value of avoided lifetime medical expenditure by government. Productivity impacts are calculated per year for some period into the future and so require the number of deaths in the reference year to be converted into a YLL estimate, whereas intangible costs are calculated directly from the number of deaths that occurred in the reference year.

No costs have been included in the analysis for funerals and associated expenses, as it has been assumed that the cost of these remain constant in real terms and so there is no net cost (or net saving) from them having occurred prematurely.

3.6.1 Reductions in workplace productivity due to premature mortality

The impacts of a premature death on workplace productivity, where the decedent is in paid employment, are the present value of expected future economic output from the deceased individual [7], together with the cost to employers of filling a job vacancy.

The impact of a smaller labour force on GDP due to opioid attributable deaths in 2015/16 was calculated as a present value over a 30-year timeframe (to align with the Department of Finance and Administration guidance (2006)) using a real discount rate of 7 percent. It is assumed that the costs of filling job vacancies occurred in 2015/16, the year in which the premature death occurred.

The age- and gender-specific probability that an individual will be in employment in each of the following 30 years was taken from analysis of 2016 Census of Population and Housing data (Australian Bureau of Statistics, 2017a, Data extraction by the authors). In the case of the data extracted from the NCIS dataset these age and gender specific averages were applied to each identified death, and discounted back to present values using a 5.5 percent real discount rate (a 7 percent real discount rate as per Australian Government guidelines, combined with an assumption that over the long-term, real output per worker will increase by 1.5 percent per annum). The estimates were then aggregated before being provided for the economic analysis to ensure confidentiality. In the case of deaths identified through the indirect method, where deaths data were available in age groups rather than single years of age, age group specific employment rates were calculated by averaging across the age band, with the analysis being otherwise the same.

Over the analysis period, an estimated discounted 14,518 years of working life were lost due to opioid attributable premature death (CI 12,883 to 17,417).

Data are not available on the way in which the economic output attributable to labour varies across the workforce, or how the economic impact of those who die prematurely from opioid attributable causes differs from the average. It has been assumed that the economic output of those in work would have equalled the population mean. Gross domestic product per employee was calculated from current price estimates of GDP for the year to June 2016 from the ABS national accounts and average employment over 2015/16 (Australian Bureau of Statistics, 2019a, d) and is $139,697 in 2015/16.[8]

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[7] To the extent that the deceased person was not an individual who was dependent on opioids, that proportion of expected lifetime economic output that would have flowed to them as wages should be excluded, as a private rather than social cost. However in this analysis all of the deaths estimated through the indirect approach are either opioid dependent persons (or in the case of road crashes, the estimated number of persons who died in a crash where a person dependent on opioids was culpable for the accident), or where the opioid dependence of the deceased individual is unknown – those identified through the NCIS data who died due to opioid toxicity.

[8] This GDP per worker is slightly different than that used in the recently released report into the social cost of smoking as the ABS has made minor revisions to their estimates of current prices, GDP and employment for 2015/16 since the smoking analysis was completed.

The total present value cost to GDP of premature opioid attributable mortality which occurred in 2015/16 assessed over 30 years was $2.0 billion in 2015/16 values (low bound $1.8 billion, high bound $2.4 billion) (Table 3.11).

In addition, employers face one-off costs to recruit new employees to replace deceased workers, and to train those new workers. The estimated cost of this was $6,422 per prematurely deceased employee in 2006 values (Bureau of Infrastructure Transport and Regional Economics, 2009). Converting to 2015/16 values using the change in the CPI (Australian Bureau of Statistics, 2019c) and applying the estimate of 1,175 persons who died from opioid attributable causes in 2015/16 and were in employment at the time of their death, gives a total cost of $9.5 million (Table 3.11).

3.6.2 Reductions in labour in the household

Collins and Lapsley based their estimates of the value of lost labour in the household on the ABS publication Unpaid Work and the Australian Economy 1997 (Australian Bureau of Statistics, 1997; Collins and Lapsley, 2008). This remains the best available source of data on unpaid work in the household despite now being very dated. Under the definitions used in the report, a household activity is considered unpaid work if an economic agent other than the household itself could have supplied an equivalent service. Such services include domestic activities, childcare, purchasing of goods and services, and volunteer and community work. These are all services that are lost by the community in the event of the death or severe illness of the person supplying them, and are therefore counted as a component of social costs (Collins and Lapsley, 2008).

The ABS report details two broad approaches that can be taken to valuing unpaid household labour; individual function replacement cost (which can be valued either by the cost of outsourcing each of the specific tasks, or by the cost of hiring a full time housekeeper to provide all of the services lost) and the opportunity cost of time (typically measured by the market value of the deceased person's time in work). In this analysis we have used individual function replacement costs, as using opportunity cost applies a zero value to work undertaken by individuals not in the labour force and therefore tends to systematically understate the value of work undertaken by women who have lower employment rates. This was also the approach taken by Collins and Lapsley in their study (Collins and Lapsley, 2008).

The total value of male unpaid labour in the household was estimated at $82 billion in 2007 values and female unpaid labour was valued at $154 billion. Converting these figures to per adult estimates using the population data used in the ABS estimates of the value of unpaid household labour (Australian Bureau of Statistics, 1997) and to 2015/16 values using the CPI (Australian Bureau of Statistics, 2019c) gives values of unpaid household work of $19,613 per adult male and $35,016 per adult female. We assumed that the value of unpaid labour in the household for those aged less than 18 and those aged over 75 years old was zero, as below-18 individuals are often dependent (at least partially) on service provision from adults in the household, and above the age of 75 a substantial proportion of the population are either in receipt of formal or informal care, or are providing informal care to another member of their household, which is captured as part of 'other medical costs', see Chapter 5, creating the risk of double counting.

At the same time as the total discounted years of life lost were estimated, we also estimated the number of years of life lost within the age ranges used for the household labour calculation to generate age and gender (or age group and gender) specific years of household labour lost.

Our central estimate was that there were 24,560 discounted years of household labour lost to opioid attributable death over the study period (low bound 21,773 high bound 29,334. This gives an estimated present value of **$586.3 million** ($522.3 million to $694.5 million).

3.6.3 Avoided health care costs

Opioid attributable diseases cause healthcare costs (see Chapters 4 and 5), however the premature deaths of persons who use opioids also produces partially offsetting reductions in lifetime healthcare costs which these individuals would have incurred in future years had they lived to their expected age at death.

As with the costs of lost economic output, age and gender (or age group and gender) specific discounted YLL for each premature death were calculated.

Annual average recurrent healthcare costs per person by five year age group for 2015/16 (all ages average: $6,671) were taken from AIHW data (Australian Institute of Health and Welfare, 2017f) and it was assumed that healthcare costs would grow in line with per capita GDP (e.g. YLL were discounted at 7 percent to allow for an estimated annual real increase in costs of 1.5 percent per annum).

The estimated total net present value (over 30 years using a 7 percent real discount rate) of healthcare costs avoided due to premature opioid attributable mortality was a **saving of $138.6 million** (low bound $131.9 million, high bound $148.4 million) (Table 3.11).

3.7 Intangible costs of premature mortality

Much of the cost to society arising from premature mortality relates to intangible costs, e.g. those costs from factors that cannot be traded or transferred. Valuation of the intangible costs of premature mortality is usually undertaken using what is known as the *value of a statistical life* (VoSL).

It is important to note that the concept being assessed is ***not*** the value of one or more of the individual lives lost prematurely due to the health condition or hazard in question. Rather the concept is based on society's average willingness to pay to reduce the risk of premature death by one case. Estimates of this value are generally derived from aggregating across individuals' direct market behaviour, such as willingness to pay for products that result in a small reduction of risk, e.g. additional safety features on cars, or the increase in wage demanded to take a job that has a higher risk of premature mortality.

Current guidance for cost benefit analyses undertaken for the Australian Government recommends using a VoSL that was developed by Abelson (Abelson, 2008). Abelson recommended using a VoSL of $3 to $4 million in 2006/07 values. Abelson's recommended value was not derived from a meta-analysis of valuation studies, which produce much higher estimates. Rather, whilst it took note of a range of published meta-analyses of both wage premium studies, product market, and willingness-to-pay approaches to valuing a statistical life, it was most strongly influenced by the values recommended by the UK government and the European Union member countries.

The Abelson estimate is in 2007 values and needed to be converted to 2015/16 vales for this analysis. The rate at which a value of statistical life should increase over time as national incomes increase is determined by the income elasticity of demand for reductions in the risk of premature death, with the elasticity representing the proportionate increase in the VoSL for a given increase in per capita incomes. For example, an income elasticity of 0.5 implies that for a 1 percent increase in per capita income, the VoSL would increase by 0.5 percent. These income elasticities have been variously estimated at 0.5 to 0.6 (Viscusi and Aldy, 2003), 1.32 (with a range from 1.16 to 2.06) (Kniesner et al., 2010) and 1.5 to 1.6 (Costa and Kahn, 2004). We followed the US Department of Transportation (US Department of Transportation, 2015) in adopting a relatively conservative assumption of an income elasticity of 1.0[9], slightly below the average of the three studies which was 1.16.

Therefore, the central estimate was converted from 2007 values to 2015/16 values using the change in the average nominal national per capita income over that period, giving a 2015/16 VoSL of $4.6 million.

Internationally, much higher values are often used reflecting the findings of studies into the VoSL [10]. The US Department of Transportation used a VoSL of USD 9.1 million in 2013 values (US Department of Transportation, 2015). This was derived by averaging 15 hedonic wage studies (e.g. studies which estimate the wage premium demand by workers for more dangerous occupations and use the difference in annual mortality rates between industries to calculate the implicit value placed on a premature death). The US Environment Protection Authority also adopts a similar approach, using a similar but slightly different value derived from a slightly different set of studies. Converting the US Department of Transportation VoSL estimate to Australian dollars using Purchasing Power Parity exchange rates (Organisation for Economic Cooperation and Development, 2016a), and then to 2015/16 values using the growth in per capita current prices GDP (Australian Bureau of Statistics, 2018b) from 2012/13 to 2015/16 gives a VoSL of $13.6 million. This value is used as our high bound estimates.

There is a debate in the literature as to whether studies should use a consistent value of averting a premature death, regardless of the expected age of person whose death is averted, or whether it would be more appropriate to use a consistent value for each expected year of life lost with the value of averting a premature death then varying substantially by age.

In general using a consistent value for an averted death tends to be used in studies of reductions in transport, health and environmental risks (see for example, (Abelson, 2008; HM Treasury (UK), 2018; US Department of Transportation, 2015)). Values based on life years tend to be used in drug or medical device funding approvals (see for example National Institute of Clinical Excellence (2004) for the UK and the processes adopted for adding pharmaceuticals for PBS subsidies in Australia (Community Affairs References Committee, 2015).

Adopting a value of a life year approach has the effect of giving greater weight to premature deaths amongst the young and much lower weight to deaths amongst the old. For example, using the value of a statistical life year derived from Abelson (2008) updated to 2015/16 values (see below for the approach to this) would imply that society would be willing to spend $5.15 million to avert the premature death of a 1 year-old female and $5.13 million to avert the premature death of a 1 year-old male, but the willingness to spend to avert the premature death of an 80 year-old would be $2.20 million for a female and $1.95 million for a male. On the other hand adopting a single value for a VoSL implies higher values per year of life gained for older persons and lower values per year of life gained for younger persons.

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[9] This is likely to be an underestimate, as empirical analysis suggests that on average people are risk averse (and in particular loss averse) which would imply a price elasticity of averting loss of >1 (Kniesner et al., 2010)

[10] Viscusi and Aldy undertook a meta-analysis of studies that used wage differentials and of those which looked at price premia paid for increased safety features in goods purchased and found the mean of the studies was USD 6.7 million in 2000 prices (Viscusi and Aldy, 2003)

This study has adopted a VoSL approach for its central estimate, reflecting the preponderance of usage in policy studies; the pattern of health spending by society over the life which tends to reflect need and therefore grow with age from the middle years of life (Australian Bureau of Statistics, 2017c), rather than see a drop off in the last years of life when the care could be expected to produce relatively few additional years of healthy life; and evidence on changes in individual willingness to pay for safety improvements which only appears to fall modestly with age once adjusted for ability to pay and then only after the age of 70 (Pearce, 2000).

However, as a low bound for our estimate of the intangible cost of opioid attributable mortality we have estimated the cost using a *value of a statistical life year* (VoSLY) approach.

VoSLY are derived from the value of a statistical life by treating the VoSL as the equivalent to the present value of an annuity over the expected years of life remaining, using the following formula:

$$VoSLY \quad = VoSL \times \frac{(1-(1+g)/(1+r))}{(1-(\frac{1+g}{1+r})^{years})}$$

Where

VoSL = the VoSL being used, in this case from Abelson, 2008 converted to 2015/16 values;

g = the annual escalation factor used for the VoSL, in this case the expected long-term per capita growth rate in GDP of 1.5 per cent per annum

r = the discount rate used, in this case seven per cent real per annum; and

years = the number of years of healthy life remaining assumed to be implicit in the VoSL calculation, in this case following Abelson (2008) we have used 40 years.

This VoSLY is applied to the estimated potential years of life lost calculated from the mortality data. Unlike the tangible cost estimates, costs are included for each expected year of life remaining even where that occurs more than thirty years in the future. These annual costs are then converted to a present value estimate using a real discount rate of seven per cent. Using the Abelson estimate of the VoSL, the VoSLY is $286,553.

In order to ensure consistency with other estimates, we used the Abelson values for our main estimates, which gives an expected intangible cost of opioid attributable premature mortality in 2015/16 of **$10.1 billion** (with a low bound and a high bound derived from the range of estimates of opioid attributable deaths of $8.8 billion to $12.2 billion).

If, instead, the VoSL estimate used by the US Department of Transportation (2015) were to be used, then the estimated intangible cost of opioid attributable premature mortality in 2015/16 would be $30.0 billion using the central estimate of opioid attributable deaths (with a low bound and a high bound derived from the range of estimates of opioid attributable deaths of $26.2 billion to $36.2 billion).

Finally, if intangible costs of premature mortality were valued based on potential years of life lost, then the intangible cost of opioid attributable premature mortality in 2015/16 would have an expected present value of $6.0 billion based on the central estimate of years of life lost to opioid attributable deaths (with a low bound and a high bound derived from the range of estimates of opioid attributable deaths of $5.7 billion to $6.4 billion.

3.8 Total costs of premature mortality

Drawing together the estimated tangible and intangible costs of premature opioid attributable mortality, our central estimate of the cost is **$12.6 billion** ($7.9 billion to $39.2 billion). Tangible costs are $2.5 billion, with intangible cost accounting for $10.1 billion (Table 3.11).

Table 3.11: Costs of Opioid Attributable Premature Mortality

Cost	central estimate: opioid attributable deaths, & Abelson (2007) VoSL	low bound: low bound estimate of YLD & Abelson (2007) VoSL	high bound: high bound of opioid attributable deaths & US DoT (2015) VoSL
Tangible costs			
NPV of lost economic output: non-employee	2,028,163,487	1,802,400,775	2,428,779,202
Recruitment/training costs to employers	9,540,983	8,543,130	11,209,849
NPV of value of lost unpaid household work	586,271,797	523,056,937	693,347,145
NPV of healthcare costs avoided	-138,572,724	-131,958,751	-148,291,545
Total net tangible costs	**2,485,403,542**	**2,202,042,091**	**2,985,044,651**
Intangible costs			
Value of a statistical life	**10,127,150,276**	**5,668,284,222**	**36,200,205,774**
TOTAL COSTS	**12,612,553,819**	**7,870,326,313**	**39,185,250,425**

3.9 Conclusions

Our estimates show the extent of premature mortality caused by opioids, with an estimated 2,203 deaths attributed to opioids in 2015/16. The direct impact of opioid toxicity or effect with/without contributing disease process (unintentional and undetermined intent only) account for just under half of the estimated deaths with substantial numbers of deaths arising from conditions partially caused by opioids, particularly cirrhosis secondary to HCV, and liver cancer secondary to HCV.

Due to differences in the approach taken and the conditions included, these estimates cannot be directly compared to the AIHW's estimates of opioid-induced deaths (Australian Institute of Health and Welfare, 2018d). In particular, the AIHW estimates focus on those conditions for which opioids were the direct cause of death, excluding a number of conditions where opioids cause a proportion of the premature mortality, such as BBV and their consequences, and accidental injuries. The AIHW also drew exclusively on cause of death/substance inducing death categorisations in the NCIS dataset, whereas our estimates for conditions such as suicide and interpersonal violence drew on AF calculated using the indirect method.

3.10 Limitations

The predominant caveats of this study relate to features of the data system, the nature of antemortem and post-mortem drug detection, multiple drug toxicity and the complexity of events leading to injury and subsequent death. This study is a conservative estimation of opioid deaths.

As explained above, NCIS is a national database and jurisdictional variances exist. These differences include but are not limited to: jurisdictional Coroners Acts; the comprehensiveness of files; disparity between documentation methods; the ability to screen for novel substances; mandatory toxicology screening processes; and, the number of files available in each case.

Owing to the delay between the time of death and the closure of a coronial case, there is the potential that not all opioid deaths will be captured in this study. Last reported on 9th January 2019, the proportion of Australian closed cases (of all cases notified to the coroner) in 2015 and 2016, were 91.1 percent and 87.0 percent, respectively (National Coronial Information System, 2019b).

Another caveat of this Chapter is the inability to conclusively distinguish extra-medical use of pharmaceutical opioids or the source of where the substance was produced - for example, illicitly manufactured or pharmaceutically produced fentanyl. Adequate information to determine level of use, tolerance or access to substances, is not consistently reported and for the purpose of this study has not been further examined.

Lastly, not all coronial cases result in a conclusive explanation of the circumstances or the cause of death. This can be due to factors such as advanced decomposition of the corpse, lack of evidence or the inability to determine the series of events prior to death.

Toxicology results need to be considered and interpreted with caution. This study used a direct approach and categorised the attributable cause of death as per the forensic pathologist's findings. Issues related to post-mortem toxicology include: lag time between time of death and sample collection (as post-mortem changes occur, especially in the heart and abdominal cavity); and, variances between sample sites and sample contents (blood, urine or tissue). The differentiation between low, therapeutic and lethal levels of a substance can be problematic, as individuals have varying tolerance, dependent on many variables such as weight, metabolism, level of usage, and overall state of health. It is also important to note that drug levels for inclusion in the cause of death statement by a forensic pathologist is not standardised (Dinis-Oliveira et al., 2016).

The level of alcohol detected in post-mortem samples can be elevated due to body decomposition, whilst putrefaction affects the result levels of substances, increasing some levels and decreasing others. As with many diagnostic tests, drug screens can produce false positives. These factors highlight the complexity and specialised interpretation of toxicology results as processes can distort or impede the detection of substances (Leikin and Paloucek, 2015).

We included low birthweight as one of the conditions partially caused by opioids. However, we note that it is not in the conditions listed by the GBD study (Australian Institute of Health and Welfare, 2016a; Global Burden of Disease Collaborative Network, 2018) which does not include conditions caused by the secondary effects of drug use in the population aged <5 years, and that the cited meta-analysis is now dated (Hulse et al., 1997), although more recent studies have also identified similar magnitudes of risk. For example, Azuine and colleagues found that opioid exposure was linked to higher rates of foetal growth restriction (OR, 1.87; 95%CI, 1.41-2.47) and pre-term birth (OR, 1.49; 95% CI, 1.19-1.86) (Azuine et al., 2019). Nevertheless, it is included as we were not able to identify any subsequent meta-analyses which found an absence of a relationship between in-utero exposure to opioids and low birthweight.

Two conditions partially caused by opioid use were not able to be included in the estimate of premature mortality due to data limitations. Infective endocarditis can be caused by injecting drug use, and is therefore partially caused by opioid use. However, the GBD data does not allow infective endocarditis to be distinguished from other forms of endocarditis (for which opioids do not have a partially causal role) and so the number of opioid attributable deaths could not be calculated. Neonatal abstinence syndrome (NAS) is caused by exposure in-utero to substances that can cause dependence, with opioids estimated to be the cause of almost all hospital separations for NAS (Abdel-Latif et al., 2013), however the published perinatal deaths data does not separately identify NAS and it is instead aggregated within 'Other conditions originating in the perinatal period (ICD-10 code = P96)'. Recent studies suggest that although infants with NAS have a significantly higher rate of severe morbidity, it does not result in a statistically significant increase in perinatal deaths once other factors such as low birth weight have been taken into account, and so the exclusion of NAS is unlikely to have a meaningful impact on our estimates.

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CHAPTER 4: HOSPITAL INPATIENT MORBIDITY

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4.1 Introduction

Opioids (illicit and pharmaceutical) are respiratory depressants which affect the central nervous system, leading to a greater risk of overdose (both fatal and non-fatal) than other commonly used illicit drugs. In 2018, 42 percent of an Australian sample of people who regularly inject drugs (PWID) reported lifetime experience of non-fatal heroin overdose, and 14 percent reported past 12-month experience of heroin non-fatal overdose (Peacock et al., 2018). Analyses of routinely-collected healthcare data suggest opioid-related harms are increasing in Australia. Indeed, rates of opioid-related hospitalisations increased substantially between 2007/08 and 2016/17. The age-adjusted rate of hospitalisations where opioid poisoning was the principal diagnosis increased by 25 percent (from 14.1 to 17.6 per 100,000 population), while the rate of hospitalisations that included opioid poisoning as any diagnosis (principal or additional) increased by 38 percent (from 29.0 to 40.1 per 100,000 population) (Australian Institute of Health and Welfare, 2018d). Hospitalisations for opioid poisoning in 2016/17 were more likely to involve pharmaceutical opioids than heroin (3,147[11] versus 832 hospitalisations, respectively).

Beside overdose, opioid use and dependence are linked with an increased risk of a range of serious illnesses and injuries (Degenhardt et al., 2019). Opioid use has been identified as a risk factor for conditions such as human immunodeficiency virus (HIV), hepatitis C virus (HCV) and hepatitis B virus (HBV) through injection of opioids (Degenhardt et al., 2013c) and low birthweight as an outcome of maternal exposure (Cleary et al., 2011; Darke et al., 2019; Hulse et al., 1997; Ludlow et al., 2004). Injecting drug use is associated with liver cancer and cirrhosis secondary to HBV and HCV (Degenhardt et al., 2016b), skin infections and inflammation, and infective endocarditis (Ciccarone et al., 2016; Larney et al., 2017b). Furthermore, opioid toxicity can lead to further complications like hypoxic or anoxic brain injury (Andersen and Skullerud, 1999; Morrow et al., 2019). Using opioids during pregnancy can result in a drug withdrawal syndrome in new-borns exposed prenatally, known as neonatal abstinence syndrome (NAS) (Abdel-Latif et al., 2013; Rasul et al., 2019). Extra-medical opioid use is also associated with increased likelihood of suicide attempt (Ashrafioun et al., 2017; Kuramoto et al., 2012; Marchand et al., 2017), interpersonal violence (Darke, 2010; Goldstein, 1985; Torok et al., 2008) and accidental injuries, which mostly involve traffic accidents (Drummer et al., 2003; Verstraete and Legrand, 2014).

To estimate the cost of inpatient hospitalisations related to extra-medical use of opioids we used available medical and scientific information on the risk of opioids in causing specific conditions. Given the limited number of valid AF for opioid-related conditions, the current study used a variety of methods described in the methods section (Chapter 2):

1. **Direct attribution** for conditions **wholly attributable** to opioid extra-medical use and dependence, based on opioid diagnoses in the inpatient hospital separation data where the below conditions were coded at separation:
    - Principal diagnosis was mental and behavioural disorder due to use of opioids or opioid poisoning;

[11] This includes naturally derived opioids (such as oxycodone, buprenorphine and morphine), synthetic opioids (pethidine, fentanyl) and methadone.

- Injecting-related infection (IRI) was the principal diagnosis underlying the hospitalisation and mental and behavioural disorder due to use of opioids or opioid poisoning were identified in any of the additional diagnoses; and,
- Brain injury was a principal reason of hospitalisation and mental and behavioural disorder due to use of opioids or opioid poisoning were identified in any of the additional diagnoses.

2. **Indirect attribution** for conditions **wholly attributable** to extra-medical use of opioids and opioid dependence, where the AF was calculated based on the available relative risk (RR) and the exposed proportion of the population (or its best available estimate), and applied to the total number of hospital separations with a principal diagnosis indicating the specific condition or external diagnosis reflecting a particular injury (excluding any separation directly attributable to opioids and already counted for another condition using the direct approach):
   - HIV, HBV and HCV;
   - Liver cancer secondary to HBV and HCV;
   - Maternal exposure – low birthweight;
   - Intentional self-harm and suicide attempts; and,
   - Accidental injuries including road crash injuries.

3. **Excess attribution** for conditions **partially attributable** to opioid use extra-medically and dependence, where a RR was not available, but evidence of a causal effect was present. In these circumstances, the prevalence from within a single sample was used to estimate the percent of the condition-related hospital separations that were attributable to opioids:
   - Interpersonal violence;
   - Infective endocarditis (noting that this was calculated from the prevalence of the condition amongst people who inject drugs rather than the population as a whole); and,
   - NAS.

4.1.1 Data sources

Hospital separation data are an important source for estimating the incidence of non-fatal injuries as well as different conditions. Data from the National Hospital Morbidity Database (NHMD) for the 2015/16 financial year were obtained from the AIHW (Australian Institute of Health and Welfare, 2018c). This dataset is a collection of all de-identified patient-level separation records from public and private hospitals in Australia. All diagnoses for all hospitalisations in each jurisdiction were provided with the exception of Tasmania, where i) provision of records was restricted to those that included a drug and alcohol related principal and/or additional diagnoses and external causes, and ii) only the drug and alcohol related diagnosis codes were provided for those records.

In the NHMD extraction for 2015/16, diagnoses and external causes were coded upon separation using the International Classification of Diseases, Australian Modification ICD-10-AM 9th edition (Australian Consortium for Classification Development 2014). (The ICD-10-AM codes used in this study to identify the conditions of interest are listed in Table 2.1 with further details in Appendix 4.1.)

In this report we adopted the terminology relating to hospital separations used by AIHW (Box 4.1) (Australian Institute of Health and Welfare, 2017b).

Box 4.1: Summary of terms relating to hospital separations

An **admitted patient** is a patient who undergoes a formal admission process to receive treatment and/or care in hospital.

A **hospital separation** (also called hospitalisation) refers to a completed episode of an admitted patient's care in a hospital ending with a discharge, death, transfer or a portion of a hospital stay beginning or ending in a change to another type of care. There can be more than one hospital separation for each patient and separations can be either same-day (hospital admission and separation happen on the same day) or overnight (hospital admission and separation happen on a different date). Each NHMD separation record includes one principal diagnosis and up to 99 additional diagnoses.

The **principal diagnosis** is defined as the diagnosis established after study to be chiefly responsible for occasioning the patient's episode of admitted patient care. **Additional diagnoses** are conditions or complaints that either coexists with the principal diagnosis or develop during the episode of care and affect patient's management. In this report, we use **any diagnosis** to refer to the principal and/or additional diagnosis.

The environmental events, circumstances or conditions that caused injury, poisoning and other adverse effects are recorded in NHMD as **external causes**. Each NHMD separation record includes up to 100 external causes.

An **opioid-related code** refers to an ICD-10-AM code which is opioid specific, i.e. F11.0-F11.9, T40.0-T40.4, T40.6 (Table 2.1 and Appendix 4.1).

For a patient admitted to a hospital due to injury or poisoning, a principal diagnosis code from the range S00–T75 or T79 is allocated, and an external cause code describing the nature of the injury should be recorded as a first reported cause (Australian Institute of Health and Welfare, 2018a). In this report in the sections related to injuries, self-harm and interpersonal violence we were interested in separations caused unintentionally (accidental injuries) or intentionally (intentional self-harm, or assault) therefore we have only included separations with the first reported external cause code.

For the purpose of the government reimbursing hospitals for the cost related to the hospital separation, specific cost categories are assigned to each separation record based on the patient's diagnoses, primary type of treatment or service provided, the difficulty of the case, and the severity of any complications. This classification system is called the Australian Refined Diagnosis Related Group (AR-DRG) (Independent Hospital Pricing Authority, 2015). The NHMD 2015/16 data were coded using AR-DRG version 7.0. Each AR-DRG code is also assigned a costweight which indicates the average cost of administering that form of treatment relative to the average cost of an acuity adjusted hospital separation (($5,194 in 2015/16) Independent Hospital Pricing Authority, 2018). This allows the cost of specific separations to be estimated by multiplying their costweight by the average cost of a separation as per the below formula:

Total Cost = $5,194 x average cost weight x number of attributed separations

4.1.2 Polysubstance use

In determining which separations should be counted as solely due to opioids or due to multiple drugs, we worked to develop a consensus approach in defining, for each condition identified with a causal link to opioid use, whether there was at least a plausible causal link for other drugs. Since depressant drugs affect the CNS and can cause brain damage, co-use of depressant drugs such as benzodiazepines are likely to increase the risk of hypoxic or anoxic brain injury (Darke and Farrell, 2014), but co-use of hallucinogenic drugs would be unlikely to increase this risk (Darke et al., 2019). Similarly, PWID (whether they inject heroin or cocaine or another injectable drug) have an increased risk of skin and soft tissue infections, mostly due to using non-sterile injecting equipment and not cleaning injection sites, although risk may be elevated for certain substances where there are high levels of excipients (Grant et al., 2012; Larney et al., 2017b; McLean et al., 2017; Murphy et al., 2001).

Table 4.1: Possible causal links between use of drugs other than opioids and specific health conditions to inform identification of polysubstance hospitalisations

Other drug types / classes which could have a causal link with the health condition and, if their diagnosis code co-occurs with an opioid-related code, warrant partial attribution to opioids:	**Anoxic brain injury**	**Skin and soft tissue infections**
Alcohol (F10, T51)	Yes [1]	Yes [2]
Cannabis (F12, T40.7)*	-	-
Benzodiazepines (F13, T42.4)	Yes [1]	Yes [3]
Cocaine (F14, T40.5)	-	Yes [3]
Amphetamines (Psychostimulants with abuse potential) (F15, T43.6)	-	Yes [3]
Hallucinogen (Including LSD) (F16, T40.8, T40.9)	-	-
Multiple drug use (F19)	Yes	Yes [3]
Non-opioid analgesics (T39.0-T39.9)	-	-
4-Aminophenol derivatives (paracetamol) (T39.1)	-	-
Depressant (T42.0-T42.9 (excl T42.4))	Yes	-
Barbiturates (barbiturates, pregabalin) (T42.3)	Yes	Yes
Antiepileptic & sedative-hypnotic drugs, unspecified (Pregabalin) (T42.7)	Yes [1]	Yes
Antidepressants and Antipsychotics (T43.0-T43.5)	-	-

* Excluded from the companion report on cannabis related costs to avoid double counting

Sources: [1] (Darke and Farrell, 2014): [2] (Rehm et al., 2010): [3] (Australian Institute of Health and Welfare, 2019a; Peacock et al., 2019, (injecting drug use only)).

Note: Each row was considered a separate drug class in terms of count of substances in polysubstance case, e.g. opioid + benzodiazepines + depressant = opioid plus 2 extra drugs.

4.2 Hospital separations directly attributable to extra-medical use of opioids

4.2.1 Principal diagnosis – opioid use disorder or opioid poisoning

All hospital separations with a principal diagnosis indicating a mental or behavioural disorder due to use of opioids or poisoning by opioids were wholly attributed to opioids, regardless of other drugs being reported in additional diagnoses, and the total cost of these separations was counted for the purpose of this report. Hospital separations solely attributable to opioids were identified by principal diagnosis in the following ranges of ICD-10-AM:

- F11.0-F11.9 - Mental and behavioural disorders due to use of opioids,
- T40.0-T40.4, T40.6 - Poisoning by opioids.

There were 8,909 separations with an opioid-related ICD-10-AM code as the principal diagnosis in 2015/16: 4,754 hospitalisations codes as mental and behaviour disorder due to use of opioids and 4,155 hospitalisations due to opioid poisoning. These are further classified into AR-DRG such as drug intoxication and withdrawal, drug use disorder and dependence, poisoning and toxic effect of drugs. For the full list of opioid related principal diagnosis by the assigned AR-DRG with cost weights, frequencies and hospitalisation costs see Table 4.2. The total cost for hospital separations for opioid-related principal diagnoses was $39.2 million ($21.9 million for males and $17.3 million for females) [12].

Table 4.2: Number of hospital separations and costs associated with opioid-related principal diagnosis, Australia, 2015/16

DRG code	DRG description	Number of hospital separations*		Cost weight
		Male	Female	
X62B	Poisoning/Toxic Effects of Drugs and Other Substances W/O Cat or Sev CC	1302	1375	0.531
V66Z	Treatment for Drug Disorders, Same day	1191	981	0.109
V63Z	Opioid Use and Dependence	1081	671	1.122
X62A	Poisoning/Toxic Effects of Drugs and Other Substances W Cat or Sev CC	698	624	1.171
V61Z	Drug Intoxication and Withdrawal	440	357	1.917
X40Z	Injuries, Poisoning and Toxic Effects of Drugs W Ventilator Support	60	39	2.113
A06C	Tracheostomy W/O Ventilation >=96hrs, or Ventilation >=96hrs W/O OR Proc	19	≤10	10.754
B64B	Delirium W/O Catastrophic CC	≤10	≤10	1.488
X06A	Other Procedures for Other Injuries W Catastrophic or Severe CC	≤10	≤10	2.682
B64A	Delirium W Catastrophic CC	≤10	≤10	2.866
B82B	Chronic and Unspec Para/Quadriplegia W or W/O OR Proc W Cat CC	≤10	≤10	7.774
A06A	Tracheostomy W Ventilation >=96hrs W Catastrophic CC	≤10	≤10	32.589
X04A	Other Procedures for Injuries to Lower Limb W Catastrophic or Severe CC	≤10	0	3.280
801A	OR Procedures Unrelated to Principal Diagnosis W Catastrophic CC	≤10	0	6.861
X06B	Other Procedures for Other Injuries W/O Catastrophic or Severe CC	≤10	≤10	0.905
B63Z	Dementia and Other Chronic Disturbances of Cerebral Function	≤10	≤10	3.761
B82C	Chronic and Unspec Para/Quadriplegia W or W/O OR Proc W/O Cat CC	≤10	≤10	2.012
B42A	Nervous System Disorders W Ventilator Support W Catastrophic CC	0	≤10	5.7183
	Total number of separations	**4824**	**4085**	
	Average costweight	**0.874**	**0.816**	
	Cost ($)	**21,898,818**	**17,313,472**	
	Total cost ($)	**39,212,290**		

* Note. Cell counts less than 10 but not equal to zero are suppressed to protect confidentiality but included in the total count
CC = Complication and/or comorbidity: Cat = Catastrophic: Proc = Procedures: Sev = severe: W = with: W/O = without.

[12] The total cost includes the costs of the separations where there were ≤ 10 cases.

4.2.2 Injecting-related skin and vascular infections

Bacterial and fungal infections of the skin and soft tissue are a common problem among PWID, arising from use of non-sterile injecting equipment or poor personal hygiene. Other common consequences of injecting drugs are cellulitis, abscesses, bacteremia, sepsis and osteomyelitis (Larney et al., 2017b). Opioids are one of the most commonly injected drugs in Australia (Australian Institute of Health and Welfare, 2018d; Peacock et al., 2018) and globally (Degenhardt et al., 2017), with the estimated proportions of PWID reporting opioids as the main drug injected being 60.0 and 82.9 percent, respectively. Administrative data coding systems using ICD-10-AM do not capture injecting drug use. The challenge, given the lack of such information, was to ascertain which hospital separations were attributable to injecting opioid use and which to non-injecting opioid use.

Following the method previously used in estimating social costs of methamphetamine (Whetton et al., 2016), we selected hospital separations where an ICD-10-AM principal diagnosis indicated that the episode was related to skin infection, skin inflammation or other injecting-related infection and where one of the additional diagnoses was an opioid-related code (see Appendix 4.1 for the list of ICD-10-AM codes). The cost of separations where no other substance injected was identified was fully attributed to opioids. Poly-substance episodes involving other known substances which are injected (i.e. cocaine, amphetamine), were reported separately and only a fraction of the separation cost was assigned for that separation computed from the number of other drug types involved (Table 4.3).

There were 1,134 hospitalisations identified with a principal diagnosis of an injecting-related skin and vascular infections, coupled with an opioid-related code as an additional diagnosis. This included 858 separations involving opioids only and a further 276 separations coded as involving opioids and at least one other drug type. The total cost of these separations was $14.2 million ($8.3 million for males and $5.9 million for females).

Table 4.3: Number of hospital separations and costs associated with opioid-related skin and vascular infections in principal diagnosis, Australia, 2015/16

Number of drugs involved	Cost fraction	Number of hospital separations		
		Male	Female	Persons
Opioid only	1	487	371	858
Opioid and polysubstance use				
1 extra drug	½			
2 extra drugs	⅓	171	105	276
3 extra drugs	¼			
Average costweight adjusted for the polysubstance cost fraction	Opioid only	2.851	2.730	
	Polysubstance use	1.265	1.117	
Cost ($)		**8,335,082**	**5,869,817**	**14,204,899**

4.2.3 Brain injury

People who use opioids extra-medically may display a range of cognitive deficits and have a high rate of traumatic brain injury (Darke et al., 2019). Non-fatal overdose can cause a wide range of neuropathologic changes, particularly associated with hypoxia (Büttner et al., 2000; Darke et al., 2019). Brain injury can also occur as a result of stroke, infections and spongiform leukoencephalopathy (non-specific toxic demyelination). However, inspection of the NHMD separation records identified few separations with any diagnosis coded to G93.1 (anoxic brain damage, not elsewhere classified) that also included an opioid-related code in the principal or additional diagnosis fields. Since the separations with an opioid-related principal diagnosis were already counted in Section 4.2.1, our central estimate for brain injury related to extra-medical use of opioids was based on those records where G93.1 was coded in any diagnosis field and there was an opioid-related code in the additional diagnosis field.

We used G93.1 as the most likely code to use in case of brain injury due to drug toxicity. If anoxic brain damage was documented as the manifestation in the acute poisoning episode of care, then G93.1 could be assigned. This formed our central estimate. However, the manifestation of the poisoning may be documented in other diagnostic terms e.g. toxic brain injury, acquired brain injury, brain injury, toxic encephalopathy, encephalopathy, depression respiratory centre, hypoxia, anoxia, coma, stupor, somnolence, etc. with different diagnosis codes. Discussion with clinical coders did not produce a definitive list of codes that could be used in identifying these brain injuries. Therefore, given the diverse and non-specific brain injuries associated with opioids toxicity, the following codes in the principal diagnosis field - combined with an opioid-related code in the additional diagnosis field – were used in addition to the G93.1 diagnosis to compute a high bound estimate:

- G40-G47 Episodic and paroxysmal disorders;
- G92 Toxic encephalopathy;
- G93.6 Cerebral oedema;
- G93.9 Disorder of brain, unspecified;
- G94.2 Hydrocephalus in other diseases classified elsewhere;
- R40 Somnolence, stupor, coma;
- R09.0 Asphyxia; and,
- R09.2 Respiratory arrest.

Any separation meeting the definition of polysubstance use (see Table 4.1) would then have a fraction of the separation cost assigned for that episode depending on the number of other drug types that were identified in additional diagnosis fields.

There were 70 hospitalisations identified with a principal diagnosis of a brain injury, coupled with an opioid-related code as an additional diagnosis. This included 38 separations involving opioids only and a further 32 separations that were coded as involving opioids and at least one other drug type. The total cost of these separations was $1.5 million ($0.9 million for males and $0.5 million for females: Table 4.4).

Table 4.4: Hospital separations and costs associated with opioid-related brain injury, Australia, 2015/16

Number of drugs involved	Cost fraction	Number of hospital separations			
		Central estimate (G93.1)		High bound [a]	
		Male	Female	Male	Female
Opioid only	1	26	12	95	92
Opioid and polysubstance use					
1 extra drug	½	20	12	61	26
2 extra drugs	1/3				
3 extra drugs	¼				
4 extra drugs	1/5				
Average costweight adjusted for the polysubstance cost fraction	Opioid only	5.015	6.307	2.046	1.668
	Polysubstance use	2.581	1.842	1.360	1.247
Cost ($)		**945,360**	**507,911**	**1,440,452**	**965,450**
Total cost ($)		**1,453,271**		**2,405,902**	

Note. [a] Computed based on a broad group of possible brain injuries (G40-G47, G92, G93.1, G93.6, G93.9, G94.2, R40, R09.0, R09.0) + opioid related additional diagnosis.

4.3 Hospital separations indirectly attributable to extra-medical use of opioids

4.3.1 Blood-borne viruses and their secondary consequences

PWID are at high risk of blood-borne viruses, including HIV, HBV and HCV, because of sharing injecting equipment. Globally, it is estimated that 17.8 percent of PWID are living with HIV, 52.3 percent have HCV and 9.1 percent have HBV (Degenhardt et al., 2017).

To estimate the proportion of hospital separations coded to BBV that are attributable to injecting opioids we used the following formula:

$$AF_{cond,age,gender} = EF_{cond,age,gender} \times MIO_{gender}$$

Where:

- age = age group: 15-49, 50-69 and 70+ years
- gender = male, female
- con = HIV, HBV and HCV, lung cancer due to HBV and HCV
- $EF_{cond,age,gender}$ = age group-gender specific estimated fraction of condition in Australia attributable to injecting drug use, average of 2015 and 2016
- MIO_{gender} = gender-specific percentage of PWID in Australia who reported mainly injecting opioids

The GBD 2017 study estimated the burden of BBV at the country and global level for each age-gender group for the years 1990-2017. More details on the modelling methods used in the GBD study are published elsewhere (Degenhardt et al., 2018). Disability-adjusted life years (DALY) were used as a measure of overall disease burden. We obtained age group-gender specific estimated fractions of HIV, HBV and HCV attributable to injecting drug use for 2015 and 2016 in Australia from the GBD Results Tool (Global Burden of Disease Collaborative Network, 2018). We calculated the average of the 2015 and 2016 GBD estimates for males and females by age group (i.e., 15-49, 50-69 and 70+ years). We then applied the estimates of the percentage of PWID in Australia who reported mainly injecting opioids in the past month (69.7 percent for male PWID and 70.5 percent for female PWID) from the Illicit Drug Reporting System (IDRS) 2000 (Topp et al., 2001) to the averaged GBD estimates. We chose to use historical data because the period from transmission to chronic infection/experience of harms can be long (Gibson et al., 2011). The low and high bound of the estimated AF was calculated based on the low and high bound estimated fraction of HIV, HBV and HCV obtained from the GBD Results Tool.

We identified 630 potentially relevant cases of HIV, HBV and HCV in the NHMD by selecting separations with the principal diagnosis coded to HIV/HBV/HCV-specific ICD-10-AM codes (Appendix 4.1) and where patients were aged 15 years or older. We excluded all episodes already counted using the direct approach in Section 4.2. Finally, we applied the AF to the relevant condition, gender and age group. From this, we estimated the total number of HIV/HBV/HCV separations that could be attributable to extra-medical use of opioids. The total number of separations was 224 (161 among male and 63 among females). The total cost of these separations was $2.4 million ($1.9 million for males and $0.5 million for females, Table 4.5).

HBV and HCV infection can lead to the development of liver cancer, cirrhosis and other chronic liver diseases. Globally, 56 percent of liver cancer cases are estimated to be attributable to HBV and 20 percent to HCV (Maucort-Boulch et al., 2018). Similarly, 57 percent of cirrhosis was found to be attributable to either HBV or HCV (Perz et al., 2006).

To estimate the cost of hospital separations related to liver cancer secondary to HBV and HCV that could be attributable to extra-medical use of opioids (specifically, injection of opioids) we used a similar approach to that for BBV. We obtained the age group-gender specific estimated fractions of liver cancer due to HBV and HCV attributable to injecting drug use in Australia in 2015/16 from GBD, and weighted the estimates by the proportion of IDRS participants in 2000 who reported an opioid as the drug most injected in the last month (Topp et al., 2001). We chose to use historical data for patterns of injecting drug use because liver cancer is usually a long-term complication of HBV or HCV (Ananthakrishnan et al., 2006; Bosch et al., 2004). Due to lack of ICD-10-AM codes specific to liver cancer secondary to HBV/HCV we further adjusted the AFs by the proportion of liver cancer that could be attributable to HBV (11.4 percent for males 11.6 percent for females) and HCV (32.6 percent for males 41.5 percent for females). The estimated proportions were obtained from the GBD Results Tool (Global Burden of Disease Collaborative Network, 2018).

Finally, the adjusted AF were applied to the total number of hospital separations where liver cancer was the principal diagnosis (C22* - Liver cancer (Malignant neoplasm of liver and intrahepatic bile ducts)) and patients were 15 years or older. This excluded all episodes already counted using the direct approach outlined in Section 4.2.

A total of 4,944 liver cancer separations were identified in the NHMD. Applying the AF to relevant age and gender groups resulted in 1,113 liver cancer separations that could be attributable to extra-medical use of opioids (Table 4.5). After applying average costweight for these separations and the average acuity adjusted cost of a hospital separation, we estimated the total cost for liver cancer attributable to extra-medical opioid use to be $11.7 million ($8.8 million for males and $2.9 million for females).

A similar approach was used to estimate the cost of hospital separations related to cirrhosis and other chronic liver diseases due to HBV and HCV that could be attributable to extra-medical use of opioids (specifically, injection of opioids). The age group-gender specific estimated fractions of cirrhosis and other chronic liver diseases due to HBV and HCV attributable to injecting drug use in Australia in 2015/16 were obtained from GBD Results Tool (Global Burden of Disease Collaborative Network, 2018), and weighted by the estimated proportion of IDRS participants in 2000 who reported an opioid as the drug most injected in the last month (Topp et al., 2001). To apply the AFs to hospital separations related to cirrhosis we further adjusted the AFs by the proportion of all cirrhosis and other chronic liver diseases that could be attributable to HBV (26.6

percent for males and 17.6 percent for females) and HCV (27.9 percent for males and 26.5 percent for females). The estimated proportions were obtained from the GBD Results Tool (Global Burden of Disease Collaborative Network, 2018).

A total of 11,685 cirrhosis related hospital separations for patients aged 15 years or older were identified in the NHMD. Applying the AF to relevant age and gender groups resulted in 3,308 cirrhosis separations that could be attributable to extra-medical use of opioids (Table 4.5). After applying average costweight for these separations and the average acuity adjusted cost of a hospital separation, we estimated the total cost for cirrhosis attributable to extra-medical opioid use to be $30.4 million ($24.4 million for males and $6.0 million for females).

Table 4.5: Hospital separations and costs associated with opioid-related blood borne viruses and liver cancer due to HBV or HCV, Australia, 2015/16

Condition		Attributable fraction by age group and gender						Attributable separations
		Male			Female			Total
		15-49	50-69	70+	15-49	50-69	70+	
				Blood borne viruses				
HIV	Central estimate	0.033	0.017	0.006	0.028	0.017	0.008	
	Low bound	0.027	0.014	0.004	0.023	0.014	0.006	
	High bound	0.040	0.021	0.009	0.033	0.021	0.011	
HBV	Central estimate	0.071	0.055	0.030	0.047	0.039	0.022	
	Low bound	0.032	0.025	0.014	0.021	0.018	0.010	
	High bound	0.112	0.087	0.053	0.073	0.063	0.041	
HCV	Central estimate	0.635	0.635	0.634	0.626	0.627	0.598	
	Low bound	0.635	0.635	0.633	0.615	0.627	0.543	
	High bound	0.636	0.635	0.635	0.632	0.627	0.625	
Separations	Central estimate		161			63		224
	Low bound		157			61		218
	High bound		165			64		229
	Average costweight		2.222			1.597		
Cost ($)	**Central estimate**		**1,858,112**			**522,574**		**2,380,686**
	Low bound		**1,811,948**			**505,984**		**2,317,932**
	High bound		**1,904,276**			**530,868**		**2,435,144**
				Liver cancer				
Liver cancer due to HBV	Central estimate	0.008	0.006	0.004	0.005	0.004	0.003	
	Low bound	0.004	0.003	0.002	0.002	0.002	0.001	
	High bound	0.012	0.010	0.006	0.008	0.007	0.005	
Liver cancer due to HCV	Central estimate	0.207	0.207	0.207	0.260	0.260	0.254	
	Low bound	0.207	0.207	0.207	0.260	0.260	0.241	
	High bound	0.207	0.207	0.207	0.260	0.260	0.260	
Separations	Central estimate		765			348		1,113
	Low bound		754			337		1,091
	High bound		777			355		1,132
	Average costweight		2.420			2.328		
Cost ($)	**Central estimate**		**8,828,917**			**2,886,597**		**11,715,514**
	Low bound		**8,701,965**			**2,795,354**		**11,497,319**
	High bound		**8,967,410**			**2,944,660**		**11,912,070**

Condition		Attributable fraction by age group and gender						Attributable separations
		Male			Female			
		15-49	50-69	70+	15-49	50-69	70+	Total
Cirrhosis and other liver disease								
Cirrhosis	Central estimate	0.019	0.014	0.008	0.008	0.007	0.004	
due to	Low bound	0.009	0.006	0.004	0.004	0.003	0.002	
HBV	High bound	0.030	0.023	0.014	0.013	0.011	0.007	
Cirrhosis	Central estimate	0.177	0.177	0.177	0.166	0.166	0.159	
due to	Low bound	0.177	0.177	0.177	0.166	0.166	0.149	
HCV	High bound	0.177	0.177	0.177	0.166	0.166	0.165	
Separations	Central estimate		2,644			664		3,308
	Low bound		2,582			643		3,225
	High bound		2,711			685		3,396
	Average costweight		1.777			1.738		
Cost ($)	**Central estimate**		**24,403,201**			**5,994,820**		**30,398,021**
	Low bound		**23,830,962**			**5,805,224**		**29,636,186**
	High bound		**25,021,588**			**6,184,415**		**31,206,003**

4.3.2 Maternal exposure – low birthweight

Adverse pregnancy outcomes for both the mother and her baby impact the healthcare costs related to those patients. Using opioids [13] during pregnancy increases the risk of low birthweight by 3.28 (2.47-4.39) (Hulse et al., 1997). Analyses of all separations from public hospitals in New South Wales and the Australian Capital Territory in 2004 identified 879 female patients who reported use of a drug of dependence or its derivatives during pregnancy (1.4 percent of all patients who had given birth), of which 46.8 percent reported using opioids (including heroin, methadone, buprenorphine, codeine, pethidine and tramadol) (Abdel-Latif et al., 2013). Another retrospective chart review of infants born between 1998 and 2016 at the Royal Hospital for Women in Sydney found 58 percent of mothers who used drugs during pregnancy had used opioids (Rasul et al., 2019).

To estimate the cost of hospital separations related to low birthweight as a complication from maternal extra-medical use of opioids, we calculated the AF from the below formula.

$$AF = \frac{p(RR-1)}{p(RR-1)+1}$$

Where

p = the prevalence of the risk factor

RR = the relative risk of incidence of the disease of the exposed over the non-exposed

We used the Hulse et al. (1997) pooled RR estimate for low birthweight of 3.28 (2.47-4.39) and an estimate of opioid dependence among pregnant women was calculated from Abdel-Latif et al. (2013) (0.66 percent). Low and high bound estimates were calculated based on the low and high bound of the estimated RR.

We identified 142 hospital separations with a principal diagnosis and 16,214 separations with an additional diagnosis indicating low or extremely low birthweight [14] (P07.0, P07.1), of which 241 separations were

[13] Any level of use, not just opioid dependent cases

[14] Low birth weight 1000 – 2499 g: extremely low birth weight = 999 g or less

considered attributable to opioids. Applying the average costweight for these separations and the average acuity adjusted cost per hospital separation provided a total estimated cost of $2.4 million ($1.5 million for male infants and $1.0 million for female infants: Table 4.6).

Table 4.6: Hospital separations and costs associated with opioid-related low or extremely low birthweight, Australia, 2015/16

		RR	Dependence estimate	AF	Attributable separations		
					Male	Female	Persons
Separations	Central estimate	3.28	0.0066	0.015	126	115	241
	Low bound	2.47	0.0066	0.010	82	75	157
	High bound	4.39	0.0066	0.022	187	170	357
	Average costweight				7.511	6.995	
Cost ($)	**Central estimate**				**1,454,175**	**953,904**	**2,408,079**
	Low bound				**946,368**	**622,111**	**1,568,479**
	High bound				**2,158,180**	**1,410,119**	**3,568,299**

Note. RR: relative risk; AF: attributable fraction.

4.3.3 Intentional self-harm and suicide

There is growing evidence that opioid dependence could be associated with suicidal acts and self-harm behaviour (Krausz et al., 1996; Maloney et al., 2007).

The GBD Results tools were used to obtain age group-gender specific estimates of opioid dependence for 2015 and 2016 (Global Burden of Disease Collaborative Network, 2018). Age group-gender specific AF were calculated using 2015 and 2016 averages of those estimates and the pooled RR from a meta-analysis conducted by Larney et al. (2019). We then identified all separations where the first reported external cause was coded as intentional self-harm (ICD-10-AM codes X60-X84, Y87.0) and where the patient was aged 15 years or older. We excluded all episodes already counted using the direct approach outlined in Section 4.2. The AFs were applied to selected separations by age group and gender. Low and high bound estimates were calculated based on the low and high bound for the RR.

Using this method, we identified 33,826 separations, of which 1,568 were estimated to be attributable to extra-medical use of opioids. The estimated cost of these separations was $15.8 million ($10.0 million for males and $5.8 million for females: Table 4.7).

Table 4.7: Hospital separations and costs associated with opioid-related intentional self-harm and suicide, Australia, 2015/16

	RR (SMRs)	Attributable fraction			Attributable separations				Cost ($)
		15-49 years	50-69 years	70+ years	15-49 years	50-69 years	70+ years	Total cases	
					Male				
Central estimate	9.01	0.082	0.032	0.015	786	69	8	863	9,959,942
Low bound	6.28	0.047	0.017	0.008	450	37	4	491	5,666,664
High bound	12.92	0.136	0.057	0.028	1,305	125	15	1,445	16,676,843
Average costweight								1.244	
					Female				
Central estimate	9.01	0.037	0.014	0.008	658	43	4	705	5,847,847
Low bound	6.28	0.020	0.007	0.004	356	22	2	380	3,152,031
High bound	12.92	0.065	0.025	0.016	1,164	79	8	1,251	10,376,817
Average costweight								1.022	
					Persons				
Central estimate					**1,444**	**112**	**12**	**1,568**	**15,807,789**
Low bound					**806**	**59**	**6**	**871**	**8,818,695**
High bound					**2,469**	**204**	**23**	**2,696**	**27,053,660**

Note. RR(SMR): relative risk based on standardised mortality rates.

4.3.4 Accidental injuries

As explained earlier in (Section 3.1.5), opioids can cause cognitive dysfunction and drowsiness. This state increases the risk of accidental injury where drowsiness or cognitive dysfunction is likely to be a causal factor (e.g., motor vehicle accidents, drownings, falls and workplace incidents). The evidence for the relationship between opioid use and increased risk of accident is strongest for persons who are dependent on opioids, and our analysis of rates of accidental injury is restricted to this population.

The GBD Results tool was used to obtain age-gender specific estimate of opioid dependence for 2015 and 2016 (Global Burden of Disease Collaborative Network, 2018). We calculated the average of both years for age group-gender specific proportions. The pooled RR based on studies that reported standardised mortality rate from Larney (2019) was then used to calculate age group-gender specific AF for persons aged 15 years and older. For road crash injuries, as the prevalence of interest is that of the culpable driver rather than the injured person, these AF were then weighted by the proportion of accidents where a person in that age group was culpable, as assessed by Drummer and colleagues (2003), to give a pooled AF that was applied to all road crash injuries regardless of the age of the injured person.

We then selected all separations where the first reported external cause was coded to V01-X19, X50–X59, Y85 and where patients were aged 15 or older (or all ages for road crash injuries). We excluded all episodes already counted using the direct approach outlined in Section 4.2. The AF were applied to the selected accidental injury separations by age group and gender and the total cost was estimated. Low and high bound estimates were calculated based on the low and high bound for the RR.

We identified 43,228 hospital separations that matched our selection criteria for road crash injuries and 461,268 further accidental injuries. Of them, 13,472 separations were estimated to be attributable to extra-medical use of opioids (1,598 road crash injuries and 11,874 other accidental injuries). We estimated the cost of these separations to be $105.0 million ($78.4 million for males and $26.7 million for females: Table 4.8).

Table 4.8: Hospital separations and costs associated with opioid-related accidental injuries, Australia, 2015/16

	Separations	Attributable fraction	Attributable separations	Cost ($)
		Age 15 and over	Age 15 and over	
Road crash injuries				
		Male		
Central estimate	26525	0.037	981	8,735,880
Low bound	26525	0.018	483	4,301,152
High bound	26525	0.070	1,847	16,447,677
Average costweight			1.714	
		Female		
Central estimate	16703	0.037	617	4,111,116
Low bound	16703	0.018	304	2,025,574
High bound	16703	0.070	1,163	7,749,153
Average costweight			1.283	

	RR (SMRs)	15-49 years	50-69 years	70+ years	15-49 years	50-69 years	70+ years	Total	Cost ($)
Other accidental injuries									
				Male					
Central estimate	7.35	0.066	0.025	0.012	6,750	1,327	962	9,039	69,660,507
Low bound	4.69	0.033	0.012	0.006	3,375	637	481	4,493	34,626,027
High bound	11.51	0.122	0.051	0.025	12,478	2,708	2,004	17,190	132,477,499
Average costweight								1.484	
				Female					
Central estimate	7.35	0.030	0.011	0.007	1,393	518	924	2,835	22,542,430
Low bound	4.69	0.014	0.005	0.003	650	235	396	1,281	10,185,839
High bound	11.51	0.058	0.022	0.014	2,693	1,037	1,849	5,579	44,361,275
Average costweight								1.531	

	Attributable separations					
	Male		Female		Persons	
	Number	Total cost	Number	Total cost	Number	Total cost
Central estimate	**10,020**	**78,396,387**	**3,452**	**26,653,546**	**13,472**	**105,049,933**
Low bound	**4,976**	**38,927,179**	**1,585**	**12,211,413**	**6,561**	**51,138,592**
High bound	**19,037**	**148,925,176**	**6,742**	**52,110,428**	**25,779**	**201,035,604**

4.4 Hospital separations attributed to extra-medical use of opioids based on 'excess attribution' approach

4.4.1 Interpersonal violence (heroin only)

As noted in Section 4.1.4, those who use opioids extra-medically are likely to be at increased risk of both perpetrating and being the victim of interpersonal violence (Darke, 2010; McKetin et al., 2006; Nicosia et al., 2009; Stretesky, 2009; Torok et al., 2008). However, there may be differences in the extent of involvement with crime, and by implication some types of interpersonal violence, for people who use heroin compared to those who use pharmaceutical opioids (Krebs et al., 2017). To include the hospital cost related to assault and interpersonal violence we used the proportion of violent crime attributed to heroin (central estimate = 0.0214) reported in Chapter 7 which was derived by analysis of the DUMA survey (Australian Institute of Criminology, 2019). This will likely understate the extent of opioid attributable interpersonal violence as it does not capture attribution to extra-medical opioid use other than heroin. To identify the assault related hospital separations, we identified all separations where the first reported external cause was coded to X85–Y09. We also included Y87.1 'Sequelae of assault' so as to capture the long-term consequences of interpersonal violence. We excluded all episodes already counted using the direct approach outlined in Section 4.2.

We identified 23,314 hospital separations coded to assault and interpersonal violence. Our central estimate was that 500 separations could be attributable to extra-medical use of opioids at a cost of $2.8 million ($2.0 million for males and $0.8 million for females: Table 4.9).

Table 4.9: Hospital separations and costs associated with opioid-related interpersonal violence, Australia, 2015/16

	Attributable separations				Total separation	Average costweight	Cost ($)
	Under 15 years	15-49 years	50-69 years	70+ years	All ages		
Male							
Central estimate	9.9	252.8	48.0	7.3	318.1	1.199	1,981,179
Low bound	6.0	153.7	29.2	4.5	193.4	1.199	1,204,529
High bound	16.3	413.6	78.6	12.0	520.4	1.199	3,240,809
Female							
Central estimate	8.8	146.5	20.2	5.9	181.5	0.897	845,412
Low bound	5.4	89.1	12.3	3.6	110.3	0.897	513,999
High bound	14.4	239.7	33.1	9.6	296.8	0.897	1,382,923

4.4.2 Infective endocarditis

Injecting drugs can cause complications such as infective endocarditis, bacterial or fungal infection of the endocardial surface of heart, which may lead to serious morbidity and mortality.

It is estimated that the prevalence of infective endocarditis in the past 6-12 months among PWID is 1.3 percent (Larney et al., 2017b). We weighted this estimate by the percentage of PWID interviewed as part of the IDRS in 2016 (Stafford and Breen, 2016) reporting an opioid as the drug most injected in the last month (59.6 and 61.3 percent for males and females aged 17 years and older, respectively) and this gave us an estimated proportion of 0.008 of infective endocarditis attributable to injecting opioids in PWID, for both males and females. It is estimated that in 2014 there were 93,000 (68,000 and 118,000) PWID and the proportion of general population reporting injecting drugs was stable between 2013 and 2016 according to the NDSHS (Australian Institute of Health and Welfare, 2017g; Larney et al., 2017a). We applied the AF to the population of PWID and estimated the number of infective endocarditis cases due to injecting opioids to be 730 people.

Infective endocarditis is a severe disease with high morbidity and mortality rates that requires prompt treatment. People with infective endocarditis require frequent follow-ups and more than 50 percent undergo cardiac surgery during their initial presentation (Tornos et al., 2005). The clinical presentation of infective endocarditis and complications include fever, cardiac (e.g. congestive heart failure, new heart murmur and atrioventricular block) and non-cardiac (e.g. splenomegaly, rheumatological symptoms, neurological manifestations) manifestations (Habib, 2006).

We identified 1,987 hospital separations with a principal diagnosis of acute or subacute infectious endocarditis (I33.0) and further 1,266 separations where I33.0 appeared as an additional diagnosis. We estimated that 730 separations (491 for males and 239 for female) could be attributable to extra-medical use of opioids and the cost of these separations was estimated to be $19.6 million ($13.0 million for males and $6.6 million for females: Table 4.10).

Table 4.10: Hospital separations and costs associated with opioid-related infective endocarditis, Australia, 2015/16

Average costweight	Number of PWID			Proportion	Separations			Cost ($)		
	central	low	high		central	low	high	central	low	high
					Male					
5.104	63,500	46,000	80,500	0.008	491	356	623	13,017,027	9,438,008	16,516,513
					Female					
5.334	30,000	22,000	38,000	0.008	239	175	302	6,620,857	4,847,908	8,366,104
					Persons					
5.219	**93,500**	**68,000**	**118,500**	**0.008**	**730**	**531**	**925**	**19,637,884**	**14,285,916**	**4,882,617**

An alternative method by Riddell and colleagues (2008) used the AF from English et al. (1995). Given the time since the original studies and the estimated AF, we decided not to use this approach. However, for comparison, outcomes using this method are reported in Appendix 4.2.

4.4.3 Neonatal abstinence syndrome

Use of opioids during pregnancy can cause a drug withdrawal syndrome in newborns, called NAS, who then require longer hospitalisation to be treated. In the United States, NAS hospital admissions increased more than fourfold between 2003 and 2012, costing nearly USD316 million in 2012 (Corr and Hollenbeak, 2017).

We have identified two studies that reported on hospital inpatient treatment for NAS among newborns exposed to opioids. Rasul et al. (2019) found that half (54 percent) of 442 opioid-exposed infants were medicated for NAS, while Abdel-Latif et al. (2013) reported 96.5 percent of the infants that required NAS pharmacotherapy were prescribed morphine, and by implication, had incurred in utero exposure to opioids. The estimate from Abdel-Latif et al. was applied directly to the NAS related hospital separations identified by P96.1 code in principal diagnosis, to estimate the costs associated with NAS hospitalisations due to opioids. We excluded all episodes counted using the direct approach outlined in Section 4.2.

We identified 457 hospital separations which met the above criteria. We estimated that 440 separations could be attributable to extra-medical use of opioids at a cost of $4.2 million ($2.2 million for male infants and $2.0 million for female infants: Table 4.11).

Table 4.11: Hospital separations and costs associated with opioid-related neonatal abstinence syndrome, Australia, 2015/16

		Average costweight	Prevalence	Weight	AF	Cases	Cost ($)
Male infants	Central estimate	1.825	0.965	1	0.965	237	2,246,535
Female infants	Central estimate	1.892	0.965	1	0.965	203	1,994,891
Total cost ($)	**Central estimate**		**0.965**	**1**	**0.965**	**440**	**4,241,426**

4.5 Conclusions

Illness and injury attributable to extra-medical use of opioids are estimated to have caused 30,708 hospital separations in 2015/16, with a total cost of $249.3 million (with the cost estimate ranging from a low bound of $180.1 million to a high bound of $365.8 million). Hospital separations are much more frequent among males, accounting for around two-thirds of the total number of separations and, in turn, total costs incurred (Table 4.12).

Table 4.12: Hospital separations summary

Condition	Sex	Separations			Cost		
		Central	Low bound	High bound	Central $	Low bound $	High bound $
Opioid poisoning	Male	4,824	N/A	N/A	21,898,818	N/A	N/A
	Female	4,085	N/A	N/A	17,313,472	N/A	N/A
Injecting related skin & vascular injuries	Male	658	N/A	N/A	8,335,082	N/A	N/A
	Female	476	N/A	N/A	5,869,817	N/A	N/A
Acquired brain injury	Male	46	N/A	156	945,360	N/A	1,440,452
	Female	24	N/A	118	507,911	N/A	965,450
Blood borne viruses	Male	161	157	165	1,858,112	1,811,948	1,904,276
	Female	63	61	64	522,574	505,984	530,868
Liver cancer secondary to HBV & HCV	Male	765	754	777	8,828,917	8,701,965	8,967,410
	Female	348	337	355	2,886,597	2,795,354	2,944,660
Cirrhosis and other liver disease	Male	2,644	2,582	2711	24,403,201	23,830,962	25,021,588
	Female	664	643	685	5,994,820	5,805,224	6,184,415
Low birthweight *	Male	126	82	187	1,454,175	946,368	2,158,180
	Female	115	75	170	953,904	622,111	1,410,119
Intentional self-harm	Male	863	491	1,445	9,959,942	5,666,664	16,676,843
	Female	705	380	1,251	5,847,847	3,152,031	10,376,817
Accidental injuries	Male	10,020	4,976	19,037	78,396,387	38,927,179	148,925,176
	Female	3,452	1,585	6,742	26,653,546	12,211,413	52,110,428
Interpersonal violence	Male	318	193	520	1,981,179	1,204,529	3,240,809
	Female	181	110	297	845,412	513,999	1,382,923
Infective endocarditis	Male	491	356	623	13,017,027	9,438,008	16,516,513
	Female	239	175	302	6,620,857	4,847,908	8,366,104
Neonatal abstinence syndrome*	Male	237	N/A	N/A	2,246,535	N/A	N/A
	Female	203	N/A	N/A	1,994,891	N/A	N/A
All opioid attributable conditions	**Male**	**21,153**	**15,356**	**31,340**	**173,324,735**	**123,953,418**	**257,331,682**
	Female	**10,555**	**8,154**	**14,748**	**76,011,648**	**56,140,115**	**109,449,964**
	Persons	**31,708**	**23,510**	**46,088**	**249,336,383**	**180,093,533**	**366,781,646**

* Sex of infant.

N/A - Where low or high bound not available, central estimate was used to calculate the separations and cost totals for all opioid attributable conditions.

Accidental injuries are the dominant cause of the hospital separation costs arising from extra-medical use of opioids, with an estimated 13,452 separations at a cost of $105.0 million. The other substantial drivers of cost were opioid poisoning (8,909 separations at a cost of $39.2 million) and cirrhosis and other liver disease secondary to HBV and HCV (3,308 separations at a cost of $30.4 million). However, caution should be exercised in comparing different causes, as the identification process meant that any separation that included an opioid use or poisoning principal diagnosis, would be allocated to that category regardless of subsequent diagnoses or external cause.

4.6 Limitations

There are some limitations related to these data and the methods of calculating costs. When interpreting the data presented in this report, the following restrictions should be considered.

The ICD-10-AM classification itself has limitations and is dependent on the quality of clinical documentation and the quality of the coding process itself. Accuracy of the diagnosis codes depends upon the right code being entered and hence conditions may be under- or over-ascertained. Further, there could be variations among jurisdictions and between private and public hospitals in the way in which hospital services are defined and coded.

While the NHMD is extensive, there are some omissions. For 2015/16, almost all public hospitals and the great majority of private hospitals provided data for the NHMD, the exceptions were an early parenting centre and the private free-standing day hospital facilities in the Australian Capital Territory. In addition, the NHMD 2015/16 dataset included 5,913 (0.06 percent) hospital separations with a missing principal diagnosis code and most of them (n = 4,722) are for the records where the state of hospitalisation was Tasmania. In those cases, we were unable to identify the main reason for hospitalisation, even though we know they were potentially drug-related. Also in relation to Tasmania, the Tasmanian records accessed by the team only included those where there was a drug and alcohol related principal and/or additional diagnoses and external causes which enable the identification of separations with other potentially drug-related conditions. As a result, these findings likely represent an underestimate of costs as Tasmanian records could not be used in calculation of the indirectly attributed conditions. Finally, the NHMD 2015/16 does not contain cross-border separations: only separations where the patient's usual residence was within the state of hospitalisation were included.

Importantly for this study, there were 6.2 percent (n = 44,143) of all hospital separations with a principal diagnosis coded to an S-code (6.2 percent; n = 31,550 separation) or a T-code (6.3 percent; n = 12,593 separations) (injury or poisoning related) which did not have an external cause code specified, meaning we could not identify whether the separations arose from an accidental injury, or self-harm or assault. In addition, the NHMD does not capture features of opioid exposure, including whether use of pharmaceutical opioids was extra-medical in nature (i.e., outside the bounds of a doctor's prescription) (Larance et al., 2011) or the route of administration of the opioid, which is pertinent when computing costs arising from conditions where risk is via injecting drug use.

There is a limited literature and few other sources that provide AF for the diseases we considered in this report. We used other approaches such as the direct approach (selecting separations where both the ICD-10-AM condition code and opioids related codes were identified) and an approach based on excess attribution, which are likely to produce underestimation of costs. The ICD-10-AM coding system does not always have a unique code or combination of codes that would allow identification of the condition of interest (e.g. brain injury due to drug toxicity). Furthermore, using a RR based on standardised mortality rates for morbidity data (accidental injuries, intentional self-harm) is likely to produce estimates that are underestimated.

With respect to hospital separations, we only considered costs in the target year, whereas some conditions will have on-going costs. For example, it is possible that infants born with NAS who survive and leave hospital will have life-long health, social and educational consequences which will add to a social cost; however, we do not capture these costs in the report.

Due to the lack of appropriate AF, it is challenging to quantify the attribution of opioids to conditions in situations where multiple drugs were identified. The approach we undertook to divide the attribution equally between the involved substances may produce inaccurate estimates (over- or underestimates). Also, for conditions where AF was not available, we could capture only hospital inpatient costs for patients who turned up at the hospital under opioid influence at the time of hospitalisation. People who use opioids may have flow-on complications such as skin infection or brain injury, or further complications of other opioid-related conditions which will result in a hospital admission; however we were unable to identify those episodes and their cost was not included. Finally, hospital separations do not capture all health costs: in Chapter 5 further out-of-hospital health costs due to opioids are identified.

The current analysis took a different approach to the calculation of costs arising from IDU compared with the methamphetamine report (Whetton et al., 2016). In that instance, we used data on the total medical cost of those with HCV, HBV, and HIV and apportion that based on the proportion testing positive to the condition who reported having injected drugs and that methamphetamine was their most recent drug injected: secondary conditions such as cirrhosis and liver cancer were excluded. In the current report we took a condition by condition approach estimating the proportion attributable to IDU from RR and the prevalence of injecting drug use, then we gave opioids a share based on the proportion of IDU who inject opioids. Also in the methamphetamine study, we excluded infective endocarditis given the environmental changes (e.g. NSP) since the English et al. (1995) estimate. In the current study we had access to a recent estimate of the prevalence of infective endocarditis amongst dependent opioid users (Larney et al., 2017b) thus we included infective endocarditis in our analysis. As noted in Section 3.10, we were still unable to cost deaths from infective endocarditis.

For more information on the NHMD, go to the Admitted patient care 2015–16 report (Australian Institute of Health and Welfare, 2017b, 2019b).

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CHAPTER 5: OTHER HEALTH CARE COSTS

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5.1 Background

People dependent on extra-medical opioid drugs have a range of health and behavioural issues arising from their use. People who use extra-medical opioid drugs access many types of health services, including hospital emergency departments and outpatient services, general practice, specialist care, ambulance services, nursing homes and other carer services. In addition, they are likely to incur further costs for drug rehabilitation and the use of pharmaceuticals for the treatment of opioid drug-related conditions. The adverse health conditions incurred are also likely to have financial and other impacts on family members who act as carers. The costs arising from inpatient admissions are addressed in Chapter 4.

In 2015/16, $170.4 billion was spent on health care. Of this, $70.2 billion (41.2%) was spent by the Australian Government, $44.4 billion (26.1%) by state, territory and local governments and the remainder ($55.8 billion, 32.7%) by households and businesses (Australian Institute of Health and Welfare, 2017f). Public hospitals received 40 percent of government spending, with primary care and community health receiving about 30 percent of government spending (Australian Institute of Health and Welfare, 2017f). Ambulance services received government funding of $3.2 billion (Steering Committee for the Review of Government Service Provision, 2018b). Household and business spending predominately went toward primary care and allied health services.

Correct apportionment of these costs to extra-medical opioid use and related conditions was the first step towards estimating their overall costs. However, for most of these costs, such as general practitioner services, there is no unambiguous way of attributing costs to extra-medical opioids as there is no consistent and reliable equivalent to the ICD-10 coding used for hospital separations. The same limitation was also encountered in recent studies calculating societal costs for smoking tobacco or use of methamphetamine (Whetton et al., 2016; Whetton et al., 2019). To address this, in calculating the overall cost of tobacco to Australian society, the assumption was made that the proportion of other health costs attributable to smoking could be reasonably approximated by the proportion of hospital bed-days attributed to smoking on the basis that they had a similar distribution of underlying causes (Collins and Lapsley, 2008; Whetton et al., 2013). We have used this approach as the starting point in calculating the healthcare costs attributable to extra-medical opioid use.

However, there are likely to be potentially significant differences between the forms of injury and ill-health driving hospital separations and those driving some of the other healthcare costs. For example, many GP visits are for reasons entirely unrelated to those which cause hospital separations, such as renewal of prescriptions, general health check-ups and vaccinations.

Some component of allied health expenditure must be attributable to extra-medical opioid use or dependence. This could include increased dental problems due to poor dental hygiene and tooth decay caused by reduced production of saliva due to opioid use. This cohort is also at increased risk of accidental injury and stroke which may require them to use out of hospital rehabilitation services. Other problems include sleep disturbance and apnoea, lethargy, constipation, reduced libido and sexual dysfunction, potentially increasing the number of GP visits among this cohort. Other than GP costs, none of these forms of allied health expenditure potentially attributable to opioid use was able to be quantified using current data, and of allied health spending, only GP costs were included here.

This left the following areas of other healthcare costs for inclusion in this analysis:

- Ambulance costs;
- Non-admitted hospital care costs (ED and outpatient services);
- Primary healthcare costs, including GP visits and specialist visits;
- Treatment for opioid addiction including community mental health and specialist drug treatment services;
- Pharmaceuticals for opioid attributable diseases or conditions; and,

Long-term care costs*:*

- Residential and other aged care services; and,
- Costs to family members of providing care.

In each of these cases, we have initially taken the share of extra-medical opioid attributable hospital costs as the base for opioid attribution. We then adjusted that figure where possible, to reflect other evidence about the factors driving demand for that form of health service.

In 2015/16, total expenditure on hospital separations was $28.3 billion (Independent Hospital Pricing Authority, 2018). Extra-medical opioid attributable hospital separations are estimated to have had a total net cost of **$249.3 million** (see Chapter 4 for calculation), giving a cost share of **0.88 percent.** This then represents a base cost share for other medical costs, to be adjusted based on other evidence on the source of costs. A main cost estimate and a high and low bound are also presented where feasible. It should be noted that in addition to opioid poisoning and related medical conditions, the 0.88 percent cost share also includes the cost of opioid related conditions such as accidental injury, interpersonal violence and intentional self-harm.

5.2 Ambulance costs

In 2015/16, there were 1.8 million ED presentations where the arrival mode was recorded as ambulance, air ambulance or helicopter rescue service (Australian Institute of Health and Welfare, 2016c). In addition, there were 289,746 intra-hospital transfers for acute patients (Australian Institute of Health and Welfare, 2017b). Assuming that all intra-hospital transfers for acute patients used an ambulance service, the total ambulance activity in 2015/16 was estimated to be 2.1 million transfers. The total 'patient transport' expenditure in 2015/16 was $3.7 billion (Australian Institute of Health and Welfare, 2017f). Therefore, the average cost of an ambulance transfer was calculated as $1,776.

The overall proportion of patients presenting at ED via ambulance was 24 percent. However, the proportion of ambulance transfers vary according to the triage category such as T1: Resuscitation (83%), T2: Emergency (45%), T3: Urgent (33%), T4: Semi-Urgent (14%) and T5: Non-Urgent (4%). After applying these proportions to the 4,921 opioid-related ED presentations (Section 5.3), the estimated number of opioid-related ED presentations using an ambulance service was 1,908, with a total cost of **$3.4 million.** We use this as lower estimate for our ambulance costs.

Given the similarity of the population they serve, the proportion of ambulance costs attributable to specific causal factors is likely to be broadly similar to that of hospital separations. Thus, the proportion of hospital separation costs attributable to extra-medical opioid use should provide a reasonable proxy for the proportion of ambulance costs that can be attributed to this cohort of patients.

As mentioned above, the total 'patient transport' expenditure in 2015/16 was $3.7 billion. Applying the cost share from the hospital separations data, this suggests that the opioid attributable cost of ambulance service was **$32.8 million**. This forms the high bound for ambulance costs. We used the mean of low and high bound values as our central estimate of **$18.1 million**.

5.3 Emergency department presentations

Opioid poisoning often requires presentation to a hospital ED. Poisoning could be due to the combination of opioids and other depressant drugs, often also combined with alcohol. In such cases, only one drug is listed as the principal diagnosis, resulting in potential undercounting of ED presentations for a particular drug. This also makes it difficult to get accurate data and costings for a particular drug.

In 2018, AIHW published a report on opioid harm in Australia based on 2016/17 data (Australian Institute of Health and Welfare, 2018d). Since our study year (2015/16) is only a year earlier, we calculated the opioid related ED presentations based on 2016/17 estimates by applying the proportion (n=5,112: 0.07%) of all cause opioid events out of the total ED presentations in 2016/17 (Australian Institute of Health and Welfare, 2017e) to the 2015/16 total ED presentations data (Australian Institute of Health and Welfare, 2016c).

Using the above methodology, there were 4,921 estimated opioid-related ED presentations during 2015/16. These include presentations related to poisoning, dependence and other mental and behavioural issues. Almost half (44%) of the presentations were treated as Triage 1 (Resuscitation) or Triage 2 (Emergency) episodes. Therefore, we applied average cost by triage categories, derived from a report published by the Independent Hospital Pricing Authority (Independent Hospital Pricing Authority, 2018). The total cost of opioid-related ED presentations in 2015/16 was calculated to be **$3.9 million**. This figure is taken as the low bound cost estimate.

Total expenditure in 2015/16 on ED presentations which do not result in an admission to hospital was $4.7 billion (Independent Hospital Pricing Authority, 2018). Applying the cost share from the hospital separations data suggests that the extra-medical opioid attributable cost of ED presentations was **$41.4 million**, this was used as the high bound cost estimate. We used the mean of these two values as our central estimate of **$22.7 million**.

5.4 Non-admitted patient care

In 2015/16, about 33.4 million non-admitted patient care service events (previously referred to as outpatients) were provided in Australia (Australian Institute of Health and Welfare, 2017j). Of these, 860,772 (2.6%) service events were provided by alcohol and other drug clinics. The proportion of opioid-related episodes (F11 - Mental and behavioural disorders due to use of opioids) out of all hospital separations, under the ICD codes category F10-F19 (Mental and behavioural disorders due to psychoactive substance) use was 5.6 percent (Australian Institute of Health and Welfare, 2017b). Applying this proportion to 860,722 non-admitted patient service events for alcohol and other drugs clinics resulted in 47,998 estimated opioid related non-admitted patient service events. The unit cost of a service event in 2015/16 was $303 (Independent Hospital Pricing Authority, 2018), resulting in a low bound cost of **$14.5 million** for opioid-related non-admitted patient care.

The total expenditure on non-admitted patient care in 2015/16 was $5.4 billion (Independent Hospital Pricing Authority, 2018). Applying the cost share from the hospital separations data, this suggests that the opioid attributable cost of non-admitted patient care was **$47.4 million**. This forms the high bound for non-admitted costs. We used the mean of the low and high bound values as our central estimate of **$31.0 million**.

5.5 Primary health care

Dependence on opioids is associated with a range of health problems that may require treatment from a GP or other primary care physician. These include medical and psychological complications that often require a long-term care plan. Reviewing data from the Bettering the Evaluation and Care of Health (BEACH) survey (Britt et al., 2016) there appears to be at least 19.4 percent of GP visits that should be excluded from the calculation as wholly or largely unrelated to the conditions that result in hospital separations (e.g. visits for prescriptions, general check-ups and administrative visits).

In-scope 'un-referred medical services' are estimated at $9.5 billion (total un-referred medical services spending was $11.8 billion in 2015/16, with 19.4 per cent of this spending excluded as it related to ineligible costs identified from the BEACH data (Australian Institute of Health and Welfare, 2017f)). Applying the cost share from the hospital separations data (0.88%), this suggests that the extra-medical opioid attributable cost of the in-scope 'un-referred medical services' was **$83.3 million,** making the low bound cost estimate. The high bound estimate was calculated as **$103.4 million**, being 0.88 percent of the total un-referred medical service expenditure. The average of these two estimates, **$93.3 million** was taken as our central estimate.

There was additional expenditure of $17.7 billion in 2015/16 for 'referred medical services', e.g. specialist physicians (Australian Institute of Health and Welfare, 2017f). It is not clear whether this should be factored down on a similar basis to costs for GPs. Our high estimate of referred medical services is calculated from the unadjusted expenditure, on the basis that the reasons why patients will be referred to specialists are likely to be closer to the reasons for hospital separations than they are to the reasons for visits to GPs. For our low bound estimate of costs, we have factored referred medical costs down on the same basis as for un-referred medical costs, giving in scope costs of $14.3 billion.

Applying the cost share from the hospital separations data to the unadjusted referred medical costs gives a high bound estimate of extra-medical opioid attributable costs as **$155.7 million,** and a low bound, calculated from the adjusted spending, as **$125.5 million.** The mean of these two estimates, **$140.6 million** was taken as the central estimate.

5.6 Specialist health care and drug treatment services

Data on the number of opioid related treatment episodes were obtained from the AIHW dataset *Alcohol and other drug treatment services* (AODTS) (Australian Institute of Health and Welfare, 2017c). Opioids include morphine, buprenorphine, heroin, methadone and all other drugs categorised as 'other opioids'. Costs by treatment type and episode were obtained from a range of sources such as state health department, personal contacts and previous research. Costs per episode by treatment type, specifically for extra-medical opioid use dependence were not available. Therefore, the average costs were multiplied by the relevant frequency of episodes of care. The AODTS data also contain information on individuals who seek treatment or support for themselves as a consequence of another person's drug use.

In 2015/16, about 796 AODTS provided just over 206,600 treatment episodes with 96 percent (n = 198,747) of treatment episodes were for 'own drug use'. Of these, nine percent (n = 18,502) of treatment episodes were for extra-medical opioids. Of the opioids, heroin (59%) was the most frequent drug requiring treatment, followed by 'other' opioids (22%) (Australian Institute of Health and Welfare, 2017c).

Average treatment costs for different treatment types were replicated from a previous study where they had been sourced from public data (Mental Health Commission, 2015) and a personal communication (Personal communication TK, 2015). The 2013/14 figures were adjusted to 2015/16 using a CPI inflation calculator from the ABS (Australian Bureau of Statistics, 2016c). To avoid double counting, we only costed the pharmacotherapy sessions at counselling level service cost since there were resource implications for these type of service events. The actual cost of medications resulting from such events should be covered in the cost of pharmaceuticals in Section 5.7.

Table 5.1: Costs of treatment episodes, extra-medical opioids primary drug 2015/16 – for own use

Treatment type		**Number of episodes**	**Cost per episode ($)**	**Costs ($)**
Withdrawal		**2,478**		
	Non-residential [a]	*1,178*	$4,979	$5,865,592
	Residential [a]	*1,300*	$7,539	$9,800,213
Rehabilitation		**1,054**		
	Non-residential [a,b]	*165*	$2,077	$342,640
	Residential [a]	*889*	$7,539	$6,701,838
Counselling [a]		4,381	$2,077	$9,097,617
Support & case management only [c]		1,540	$1,802	$2,774,997
Information & education only [c]		453	$380	$172,022
Assessment only [c]		3,196	$117	$372,408
Other including pharmacotherapy [a]		5,400	$2,077	$11,213,680
Total		**18,502**		**46,341,007**

Sources: [a] (Mental Health Commission, 2015); [b] (Personal communication TK, 2015); [c] (Ngui and Shanahan, 2010);
Note: * these data do not include visits to general practitioners or other health care provided in community mental health which are captured elsewhere in the chapter

Overall, the total cost of treatment for own use of extra-medical opioids was **$46.3 million** (Table 5.1). Individual proportions by treatment type from AODTS data were applied to the total of those who were seeking assistance due to others' drug use. The same average costs of treatment were applied to these episodes.

Table 5.2: Costs of treatment for those seeking treatment due to others' extra-medical opioid use

Treatment type	**Total episodes - 'Seeking treatment for own other drug use' (n)**	**Episodes - 'Seeking treatment for own drug use' (% of total episodes)**	**Episodes - 'Seeking treatment for others' (n)**	**Costs ($)**
Counselling*	5,580	6.3%	351	$729,336
Support & case management only	738	5.7%	42	$75,682
Information & education only	951	2.5%	23	$8,914
Assessment only	431	9.7%	42	$4,867
Total	**7,700**		**458**	**$818,799**

Note: * these data do not include visits to general practitioners or other health care provided in community mental health which are captured elsewhere in the chapter.

To calculate treatment episodes for clients who were seeking treatment for 'other's drug use' such as a family member, relative or friend, we applied individual proportions out of the total by treatment types. Thus, for counselling own extra-medical opioid use accounted for 4,381 (6.3%) out of 69,604 counselling episodes. The same proportion was applied to the 5,580 episodes of counselling for other's drug use (n = 351 episodes).

The additional cost of episodes was $0.8 million (Table 5.2). The total costs of other specialist and drug treatment services for extra-medical opioid related cases was **$47.1 million** (Table 5.3).

Table 5.3: Total expenditure on treatment for extra-medical opioid at specialist treatment centres

Client Type	Costs
Treatment for own use	46,341,007
Treatment for others' use	$818,799
Total	**47,159,806**

5.7 Opioid agonist therapy

Opioid dependence is a chronic and relapsing disorder that affects physical and mental health and social wellbeing and function (Australian Institute of Health and Welfare, 2017g). From the GBD study in 2015/16 there were an estimated 104,026 (0.48%) people dependent on opioids in Australia (Global Burden of Disease Collaborative Network, 2018). Despite the low prevalence of use, the economic and social cost of extra-medical opioid drug use is relatively high due to medical and mental health consequences, loss of life due to overdose and social consequences to individuals and their communities (NSW Ministry of Health, 2018). Opioid agonist therapy (OAT) in the form of either methadone or buprenorphine (Pharmaceutical Benefits Scheme, 2018a), is the most commonly used treatment provided for opioid (mainly heroin) dependence in Australia and has been shown to be effective (Sordo et al., 2017; Teesson. et al., 2006).

The list of PBS medications to treat opioid dependence were identified via the PBS website for drugs under the category of '*Drugs used in opioid dependence*' (Pharmaceutical Benefits Scheme, 2018a). During 2015, the total cost of OST borne by PBS was $70.7 million. There were 1.54 million occasions when OST was dispensed, resulting in a total co-payment cost of $9.5 million with an overall cost of **$80.3 million** (Table 5.4).

Table 5.4: Cost of extra-medical opioid agonist therapy

Cost area	Central estimate ($)
PBS & RPBS pharmacotherapy	70,713,157
PBS & RPBS co-payments	9,547,059
Total	**80,260,216**

PBS = Pharmaceutical Benefits Scheme: RPBS = Repatriation Pharmaceutical Benefits Scheme

5.8 Cost of pharmaceuticals prescribed for illicit opioid attributable disease

Pharmaceuticals used in treating extra-medical opioid-related conditions, received during a hospital admitted episode, are included within the costs derived from diagnosis-related grouping codes, and form part of the costs reported in Chapter 4. Therefore, only the cost for treatment of extra-medical opioid-related conditions outside the hospital system needs to be estimated. Previous estimates have determined the net cost by adjusting for premature deaths in the target group, for example smokers (Whetton et al., 2019) by subtracting saving from premature deaths among smokers. The same approach was used in this instance, with the notional future savings reported in Chapter 3 with the mortality estimates.

Our preferred approach to estimate extra-medical opioid attributable pharmaceutical costs was to calculate it on a substance specific basis. As noted in Section 2.2, opioid attributable conditions were identified via the GBD Study (Degenhardt et al., 2013b; Degenhardt et al., 2013c) and the Australian Burden of Disease Study

(ABDS) (Australian Institute of Health and Welfare, 2018b). The conditions identified through this process were: BBV including human immunodeficiency virus (HIV), hepatitis B and C viruses (HBV, HCV) and liver cancer or cirrhosis secondary to HBV and HCV. Other conditions included skin and soft tissue infections, infective endocarditis low birth-weight and neonatal abstinence syndrome. (Costs of drugs used for treating opioid dependency are shown in Table 5.4). PBS items were designated to some of the above conditions while some conditions were excluded. The process is described below in detail.

The drugs used in treating HIV were identified via the PBS website for drugs under the category of '*Antivirals for treatment of HIV infections*'. The list of PBS medications for HCV were also identified via the PBS website for drugs under the category of '*Antivirals for treatment of HCV infections*' (Pharmaceutical Benefits Scheme, 2018a). The medications for HBV were identified through PBS review to examine the utilisation of medicines for the treatment of hepatitis (Pharmaceutical Benefits Scheme, 2015). The drugs used to treat skin and soft tissue infections were identified through published clinical guidelines (Ramakrishnan et al., 2015). For the treatment of opioid related neonatal abstinence syndrome (NAS), clinical guidelines suggest the use of morphine and/or phenobarbitone in addition to supportive care (Commonwealth of Australia, 2006). We did not have access to the age of the patient receiving medication, therefore, only PBS prescriptions for oral morphine [15] were counted for the cost calculation, as specified in the clinical guidelines. It is also suggested in the literature that methadone and buprenorphine, similar to that used in the treatment of opioid-dependent pregnant women can also be used to treat NAS (Fábio Martins, 2019). The cost of these latter drugs have already been included under treatment for opioid dependence.

In January 2016, the co-payment costs for prescription medications were $6.20 for concessional patients and $38.30 for general patients (Pharmaceutical Benefits Scheme, 2016a). When general patients reach their safety net threshold, they then pay $6.20 per prescription and when concessional patients reach their threshold, they make no co-payment. Co-payments for those covered by the RPBS depend on which Department of Veterans' Affairs concessional card they hold. Gold and Orange card holders receive the concessional rate on all listed medications, while those on the White card can receive the concessional rate on medications for their service related condition(s) (Department of Veterans' Affairs, 2018). The maximum co-payment is $6.20: when safety net thresholds are reached there are no further co-payments. We applied these values to the 'service' (e.g. number of prescriptions) data from the PBS (Pharmaceutical Benefits Scheme, 2016b) to calculate the co-payment costs.

For each medication (PBS item number) listed in Appendix 5.1, government costs in terms of Services (n) and Benefits ($) were extracted from the PBS website and co-payments estimated from the associated patient benefit categories (Pharmaceutical Benefits Scheme, 2016b) (Table 5.5).

There were other health problems that were too broad or generic to be associated with a specific list of medications, especially to narrow it down to only persons who use extra-medical opioids. These include suicide and self-harm, low birthweight, sleep problems, constipation and accidental injuries. Also, we were not able to find specific prescription medicines for treating liver cancer or cirrhosis secondary to HBV and HCV and infective endocarditis. Due to the serious nature of the conditions and high dependence on 'in-hospital' care, we believe that the majority of medicine cost would be covered under the cost of hospital separations.

[15] Other forms of morphine includes injections, tablets, capsules and granules sachets.

Table 5.5: The costs of medications* for key extra-medical opioid-related conditions and opioid attributable costs

Condition	Total cost ($)	Illicit-opioid attributable hospital separation costs (%)	Illicit-opioid attributable PBS/RPBS medicine costs ($)
HIV / AIDS	210,713,408	0.90	1,898,319
Hepatitis C	820,134,599	62.14	509,621,210
Hepatitis B	73,295,743	4.62	3,389,399
Skin and Soft Tissue Infections	82,596,636	0.71	584,304
Neonatal Abstinence Syndrome	2,061,365	96.50	1,989,218
Total	**1,188,801,751**	**-**	**517,482,450**

**For individual items number see Appendix 5.1*

We did not have access to age-group or sex for the PBS costs and so could not apply the extra-medical opioid AF for each condition directly to pharmaceutical costs. Instead we assumed that the proportion of pharmaceutical cost for each condition attributable to extra-medical opioids would be equivalent to the proportion of total hospital separation costs attributable to extra-medical opioids for that condition, which is effectively the age, gender and severity weighted AF for that condition. This gives a total cost of extra-medical opioid attributable PBS/RPBS listed medicine costs for the selected conditions of **$517.5 million** (Table 5.5).

The costs presented in the table above only includes the cost of prescribed medications outside the hospital sector. Therefore, the total estimate does not include 'in-hospital' pharmaceutical costs (these are included in the hospital separation costs reported in Chapter 4) nor does it include pharmaceuticals delivered through outpatient hospital clinics (as is the case with a significant proportion of dialysis and chemotherapy). These latter costs should be captured in the non-admitted hospital costs calculated above.

As an alternative approach, we also calculated pharmaceutical costs using the same approach as for outpatient hospital costs, i.e. allocating a share of total PBS listed pharmaceutical costs equal to the share of extra-medical related inpatient separations. In 2015/16 the total cost of PBS and RPBS medications was $10.4 billion, with a further $1.5 billion in gap payments (total $11.9 billion) (Pharmaceutical Benefits Scheme, 2018b). Assuming that the proportion of PBS listed pharmaceutical costs attributable to extra-medical opioids matched the share of hospital separation costs in 2015/16, it gives an estimate of pharmaceutical costs of $104.7 million.

Since the direct cost of **$517.5 million** (Table 5.6) is higher than the cost of **$104.7 million** based on the alternative method using share of opioid related hospital separations, direct cost is taken as a high bound and hospital separations based cost was taken as a low bound. The mean of the low and high bound values was taken as the central estimate of **$311.1 million.**

5.9 Community mental health services

The number of service contacts and the costs of community mental health expenditure data were sourced from the AIHW web report providing statistics for mental health services in Australia (Australian Institute of Health and Welfare, 2019c). During 2015/16, around 9.4 million community mental health care service contacts were provided to approximately 414,000 patients across Australia. Of these, 102,709 (1.1%) service contacts were for the principal diagnosis 'Mental and behavioural disorders due to use of opioids (F11)'. The total expenditure on community mental health care services in Australia during the same time period was $2,047 million.

We also applied 1.1 percent (for opioid service contacts out of total service contacts) to the total expenditure of $49.1 million on the national suicide prevention program (Australian Institute of Health and Welfare, 2019c) to estimate the cost of suicide prevention for people who use extra-medical opioids ($0.54 million). Applying the proportionate share of opioid related service contacts and adding the cost of suicide prevention gives us an approximate cost of **$22.9 million**.

5.10 Residential and other aged care services

High-level residential care (previously known as nursing home care) is likely to include a proportion of people either dependent on extra-medical opioids or with health conditions attributable to opioids. Notably, many older patients remain in hospital while waiting for access to residential age care: in 2015/16 it was estimated that this period was 11.3 days per 1,000 patient days (Steering Committee for the Review of Government Service Provision, 2018c)[16]. These days in hospital are included with other hospital costs and are reported in Chapter 4. Furthermore, until 2005/06, high-level residential services were classified with health services but were subsequently counted with welfare services, so caution is required in assessing changing expenditure over time within categories (Australian Institute of Health and Welfare, 2017f).

Residential care data (excluding expenditure on high-level residential care for younger people with disability were extracted from the *Community Services* report on aged care (Steering Committee for the Review of Government Service Provision, 2017b)). This item accounted for over two-thirds of the total aged care expenditure ($11.5 of $16.8 billion) with other services such as home care and other support services accounting for the remainder. As only data on ***Government*** expenditure on aged care services is available it is likely that these costs will be underestimated.

Data from the AIHW suggest that 53 percent of nursing home residents suffer from some form of dementia (Australian Institute of Health and Welfare, 2012). We have assumed that those with dementia would be in nursing home care regardless of other conditions and so have excluded them from the calculation of opioid attributed costs. Discounting the expenditure on high level residential care to exclude patients who have dementia gives potentially in scope government costs of $5.5 billion.

Other aged care services have total government expenditures of $5.1 billion. Assuming that a similar proportion of other aged care costs are attributable to dementia, this gives in scope government costs of $2.4 billion. Applying the cost share from the hospital separations data suggests that the extra-medical opioid use attributable cost to government of high level residential care was **$48.1 million** and the attributable cost to government of other aged care services was **$20.8 million.** However, in recognition of the lack of information on the extent of extra-medical opioid dependence and associated health problems within the aged care sector, age care costs have only been included in the high bound estimate.

5.11 Informal carers

The economic contribution of informal carers in reducing government costs by providing health care is an area of growing interest (Oliva-Moreno et al., 2017). In a recent analysis of the contribution in caring for those with chronic conditions, dementia had the highest cost followed by mental illness (Oliva-Moreno et al., 2017). In the UK, the cost of caring for those who had suffered a stroke was estimated at 27 percent of the overall

[16] These data on hospital days come from the 2018 report; costs come from the 2017 report.

cost of stroke care (Saka et al., 2009). However, other than a recent report on the costs associated with tobacco use, where the estimate was $2.0 billion in 2015/16 (Whetton et al., 2019), we have yet to identify any studies estimating the value contributed by informal carers to health conditions caused by alcohol or illicit drugs.

In estimating the cost of informal care for those with ill-health due to extra-medical opioid use, two methods were used to provide the high and low bound, with the mean used as the central estimate. In Australia, the total value of informal care was assessed at $60.3 billion in 2015. This involved 825,000 persons who were primary carers of someone impaired due to disability or ageing: there were an additional 2,032,000 Australians who reported that they were a non-primary carer (Deloitte Access Economics, 2015). The economic contribution of carers will tend to vary with the severity of the condition of the person being cared for. It is likely that those with more severe conditions will require more hours of care per week. In 2015, it was estimated that the average cost across level of severity was $70,362 per person per year (Deloitte Access Economics, 2015).

From confidentialised unit record file data on Disability, Ageing and Carers, the following primary conditions were included in the unit record data in a disaggregated form [17] and were at least partially caused by extra-medical opioid use (Australian Bureau of Statistics, 2017c):

- Other neoplasms - liver cancer (not skin / breast / bowel / prostate);
- Head injury (acquired brain injury);
- Arm/shoulder/hand damage from accident or injury;
- Leg/knee/foot/hip damage from accident or injury; and,
- Other injury / poisoning and consequences.

In each case the number of persons reporting that they received informal assistance for activities was adjusted to opioid attributable cases using the proportion of hospital separation costs for that condition attributable to opioids.

There were 379 persons reporting that they needed informal assistance at least once per week due to an opioid attributable condition, or 0.162 percent of the total persons reporting needing informal assistance at this frequency for any condition. We applied the average cost ($70,362 per person per year (Deloitte Access Economics, 2015)) to obtain the opioid attributed low bound cost of $26.6 million.

To calculate the high bound cost, we multiplied the share needing at least weekly care for opioid conditions (0.162%) by the total value of informal care in Australia ($60.3 billion), which gave a total of $97.9 million. The mean of the low and high bound gave the central value for informal care of **$62.3 million**.

5.12 Conclusions

This chapter presented health costs in primary care and for other health costs for non-admitted treatment. The estimated total healthcare cost attributable to extra-medical opioid use was **$829.4 million** in 2015/16 (Table 5.6). If we exclude the cost of $62.3 million attributed to informal care, the healthcare costs are $767.1 million. These costs are considerably greater than those for inpatient care. The continuing emphasis on reducing length of hospital inpatient stays, given the demand for beds and the costs of inpatient care (Australian Institute of Health and Welfare, 2017b) means that the relative cost of out-of-hospital care is likely to increase in the future. Including an additional valuation for care provided by family members, substantially increases the cost of extra-medical opioid use to society. It should be noted that heroin is the drug of choice

[17] A number of conditions caused by opioids, such as blood borne viruses from IDU, were not reported separately in the data, and therefore could not be included in the calculation.

among opioid dependent persons, as evident from the AODTS where almost 60 percent of opioid related service events were for heroin. Therefore, the majority of extra-medical opioid related cost could be associated with heroin use even though more people report the use of pharmaceutical opioids for extra-medical purposes (Australian Institute of Health and Welfare, 2017g).

About 2.7 million Australians are informal carers, including 856,000 who are primary carers for a person with a health condition or disability (Australian Bureau of Statistics, 2016e). Many of the conditions caused by extra-medical opioid use are either chronic or are likely to involve extended treatment and recovery outside the hospital system, with assistance likely to include help from a partner/relative or significant other. We believe that this is the first attempt to quantify these costs in relation to opioids. From disease-specific assessments, it is clear that the contribution of informal carers makes a significant saving to the health budget. For example, in 2007/08 in the UK, the informal cost of caring for stoke patients has been estimated at 27 percent of the economic cost of stroke or GBP 2.5 billion for 200,000 cases (GBP 125,000 per case[18]) (Saka et al., 2009).

Table 5.6: Summary of other health costs

Cost area	Central estimate ($)	Low bound ($)	High bound ($)
Ambulance costs	18,106,724	3,388,694	32,824,755
Emergency Department costs	22,663,625	3,904,618	41,422,631
Non-admitted patient care costs	30,986,407	14,543,339	47,429,476
Primary healthcare - Total	233,983,558	208,852,090	259,115,026
Primary healthcare - GP Visits	*93,347,208*	*83,321,067*	*103,373,350*
Primary healthcare - Referred Medical services	*140,636,350*	*125,531,024*	*155,741,676*
Specialist healthcare and drug treatment services cost	47,159,806		
Opioid agonist therapy costs	80,260,216		
Pharmaceuticals for opioid related conditions	311,115,913	104,749,376	517,482,450
Community mental health and suicide prevention	22,882,465		
High-level residential care			48,129,349
Aged care			20,752,227
Informal carers	62,299,328	26,649,300	97,949,355
Total	**829,458,043**	**512,389,905**	**1,215,407,757**

Notes: Central estimates have been used to calculate totals where low or high bound costs are not available except for aged / high level care. See Section 11.5 for an alternative method of calculation.
*High bound pharmaceutical costs includes costs for medications for opioid agonist therapy as well.

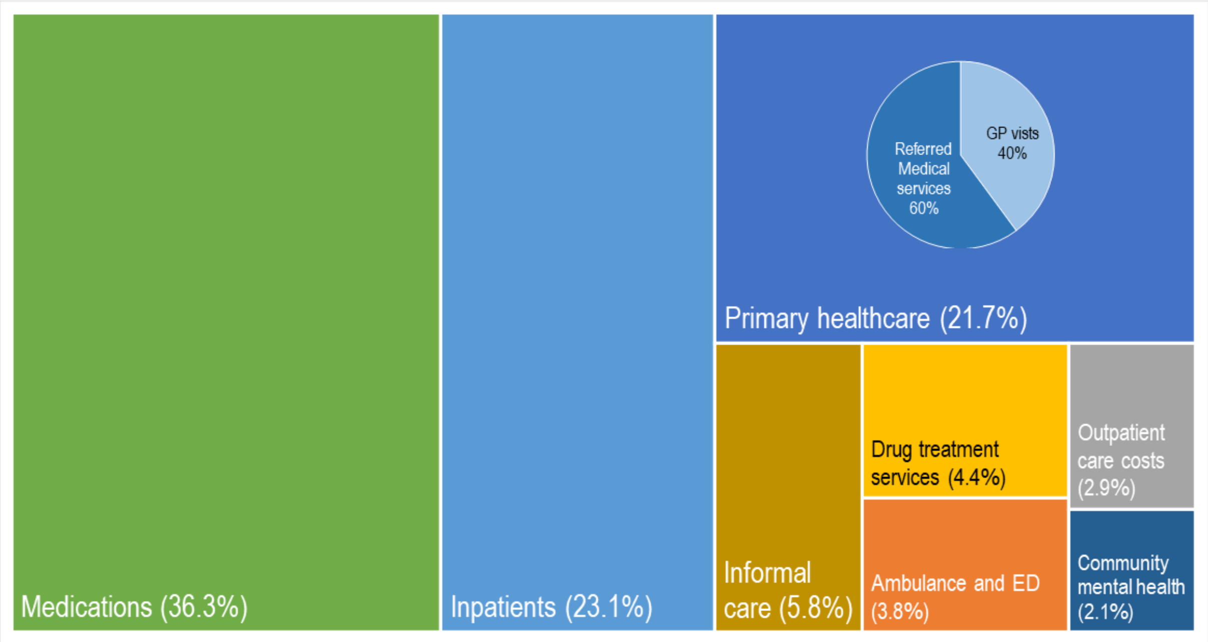
Table 5.7 summarises all the healthcare related costs mentioned in Chapters 4 and 5 and the proportion of cost attributable to opioids. Aged care is not included as its costs are considered for the high bound estimate only. Overall, the total relevant healthcare expenditure during 2015/16 was $154.1 billion. Out of that, $1.1 billion was attributable to opioid-related conditions (0.73 percent of the total). This figure does not include costs of high residential and aged care facilities as they are only part of the high bound cost estimates. Figure 5.1 shows the percentage of costs in each part of the health care system attributable to opioid-related illness.

Table 5.7: Extra-medical opioid attributable cost share of total expenditure for healthcare services

[18] Approximately AU$251,232 in 2007 (Organisation for Economic Cooperation and Development, 2016b)

Item	Opioid Attributable (million $)	Total Health Expenditure (million $)	Opioid Attributable Share (%)
Hospital Separations	249	28,348	0.88
Ambulance and ED	41	8,442	0.48
Outpatient care costs	31	5,392	0.57
Drug treatment services	47	443	10.63
Primary healthcare	234	29,460	0.79
Medications	391	11,909	3.29
Community mental health	23	2,047	1.12
Informal care	62	60,272	0.10
Total healthcare related expenditure	**1,079**	**146,314**	**0.74**

Figure 5.1: Source of extra-medical opioid use attributable costs across the health sector including informal carers



5.13 Limitations

In addition to the medical conditions listed in Table 5.5, other medical conditions such as low birth weight, suicide and self-harm, motor vehicle accidents and interpersonal violence are also associated with extra-medical opioid use. It was not possible to identify specific medicines used to treat these conditions. Therefore, the costs for treating such conditions are not included in our pharmaceutical cost estimates. We note the very high cost of treating HCV (Table 5.5). In 2015/16 Ledipasvir + Sofosbuvir was the most costly drug treatment to the PBS (Pharmaceutical Benefits Scheme, 2016c). The introduction of universal access to direct acting antiviral therapy (Heard et al., 2018) should greatly reduce the prevalence of HCV infection and associated costs in the near future.

The PBS lists various formulations of buprenorphine and methadone for use in the treatment of opioid dependence. However, other pharmaceutical medications are also used for extra-medical purposes. In 2013 there were 10,747 kg of oral morphine equivalent opioids sold in Australia, but the extent to which these were used for extra-medical purposes is unknown (Degenhardt et al., 2016a). Without a basis for allocating a proportion of these to extra-medical use as opposed to being used as prescribed, we have not included other PBS prescription opioids in our analysis and acknowledge that this will under-estimate the extra-medical cost.

Our estimate included a cost for high-level residential care and other aged care services in the high bound estimate. It is currently unclear to what extent these services will be used by the target population, where most will not be in the oldest age groups, even if the average age is increasing (Larney et al., 2015). Nevertheless, we note the growing interest about substance use in older populations as the baby-boomer generation ages (Han et al., 2009). Also, our base cost excluded younger people with disabilities and dementia cases. However, alcohol related dementia and traumatic brain injuries are common causes of dementia (Draper and Withall, 2016). Traumatic and other brain injuries may be prevalent in those with extra-medical opioid dependence, a group that also has high rates of road traffic accidents (Chihuri and Li, 2019) hypoxic brain injuries and cognitive impairments (Darke et al., 2000; O'Brien and Todd, 2009) and thus potentially disability requiring extensive care. Therefore, we have included a cost for this type of high-level care although the exact quantum is uncertain.

Care must be taken in comparing the costs of other health care between recent reports on methamphetamine and tobacco, with slight variations in the methods used and in accessible data. For example, in estimating the costs of primary care for methamphetamine, costs were derived from a single survey in calculating “excess” GP service use (Whetton et al., 2016). In relation to tobacco, a similar approach was taken to the method used here, except due to the greater availability of information on tobacco use, we were able to produce a narrower cost range (Whetton et al., 2019). Overall, the estimates here, more closely align with the methods used in the tobacco report than the methamphetamine report, where there was access to some unique research datasets.

CHAPTER 6: WORKPLACE COSTS

Alice McEntee, Ann Roche & Steve Whetton

6.1 Background

Of the illicit drugs, opioids used for extra-medical purposes are the third most commonly used substance by Australians aged 14 years or older over their lifetime (10.4%) (National Centre for Education and Training on Addiction, 2019). Among all drugs used for illicit purposes in the past 12 months, the extra-medical use of opioids ranks second (3.7%), after cannabis (10.4%). Extra-medical opioid use is higher for men (3.9%) than women (3.6%) and among those aged 18-24 years and 40-49 years (4.7% each) (National Centre for Education and Training on Addiction, 2019). Most Australians who have used opioids for extra-medical purposes in the past 12 months are employed (58.1% vs 9.5% of unemployed, and 32.4% of those not in the labour force) (National Centre for Education and Training on Addiction, 2019). Among workers, prevalence of extra-medical opioid use was similar for males and females (3.8%) and highest for 18-24 year-olds (5.4% vs 2.7%-4.4% for the other age groups) (National Centre for Education and Training on Addiction, 2019).

Extra-medical opioid use can pose a workplace risk. Use can impair psychomotor and cognitive functioning, weaken the immune system, impair driving ability, increase risk of fractures, and dysregulate mood (Chihuri and Li, 2017; Manchikanti et al., 2012). These effects can negatively affect workplace safety, performance and productivity especially if use has occurred shortly before or during work hours. Opioid effects can last two to 72 hours, depending on the type of opioid used, method and quantity of use, and characteristics of the person (e.g. metabolism, hydration, body mass) (Smith, 2009). Although extra-medical opioid use by workers can present a potential risk to the workplace (Australian Safety and Compensation Council, 2007), there is a paucity of research concerning associated workplace safety and productivity costs.

A US study (Ramirez et al., 2013) in Iowa examined toxicology test results of occupational fatalities between 2005-2009 and reported that opiates were detected in five out of 280 (1.8%) deaths (8.2% of all positive toxicology tests). Prior to that, an examination by Li et al. (2011a) of more than one million US post-accident workplace drug tests performed between 1995-2005 found 1.2 percent of results were positive for illicit drugs, with opiates detected in 2.1 percent of positive tests. A social costs study of pharmaceutical opioid misuse in the USA found that work-related costs accounted for USD 25.6 billion (45.9% of total social costs), with premature mortality the largest single factor (43.8%) in workplace costs. Presenteeism [19] (8.0%) and medically related absenteeism (7.8%) also made substantial contributions (Birnbaum et al., 2011).

In Australia, extra-medical opioid use was responsible for 0.9 percent of the total burden of disease and injuries in 2011, equivalent to 31,200 disability-adjusted life years (DALY) in males (1.3% of the total burden for males) and 10,693 in females (0.5% of the total burden for females). Of the total burden of disease and injuries in 2011 attributed to the extra-medical use of opioids, accidental poisoning accounted for 62.8 percent, opioid dependence accounted for 29.1 percent, suicide and self-inflicted injuries 7.8 percent, and road traffic injuries (motor vehicle occupants and motorcyclists) 0.3 percent (Australian Institute of Health and Welfare, 2018b).

To-date, estimates of drug-related absenteeism in Australian workplaces have mostly been limited to alcohol and illicit drugs (undifferentiated by specific illicit drug type) (Pidd et al., 2006; Roche et al., 2008; Roche et al., 2015). The financial impost of workers' use of illicit drugs on workplaces was estimated by Roche et al.

[19] *Presenteeism* can be defined as attending work while unwell or impaired, resulting in reduced quality or quantity of work

(2015) to cost $1,049.6 million in absenteeism specifically attributed to use of illicit drugs, and up to a further $228.7 million in excess illness- and injury-related absenteeism (in addition to the absenteeism incurred by workers who did not use illicit drugs). An analysis of the impact of methamphetamine use on workplace productivity and accidents estimated a cost of $289.4 million in 2013/14 (Whetton et al., 2016). Notably, this estimate excluded work-related traffic accidents and deaths that were costed elsewhere.

It is imperative that all costs specifically attributable to employees' extra-medical opioid use and their associated impact on illness, injury and drug-related absences are quantified.

6.2 Methods

National data were sourced to estimate the cost of occupational injuries (Section 6.2.1) and absenteeism (Section 6.2.2) attributed to extra-medical opioid use. Additional workplace costs due to extra-medical opioid use, where national data were not available, are discussed in Section 6.4.1.

6.2.1 Occupational injury

To establish the cost of occupational injuries, data were sourced from Safe Work Australia. The best available data [20] come from 2012/13 where injury data were reported for different severity levels and for claims which were compensable and non-compensable and that required an absence of at least part of a workday.

Safe Work Australia (2015) reports the overall number and cost of occupational injuries in 2012/13. The method used to determine the number of injuries was based on an incidence approach, rather than a prevalence approach (see Appendix 6.1 for further detail of the method used in Safe Work Australia's incidence approach). The method used to determine the costs incurred from injuries was based on the concept of the 'human cost' of occupational injury. Only costs associated with actual injuries [21] were included (see Appendix 6.2 for the type of costs included).

Due to an overlap in the reporting of Safe Work occupational injuries with other sections of this report (e.g. Section 3.5.1 reports on workplace costs of premature mortality, and Chapter 8 reports on transport accidents), the number and costs associated with occupational injuries were adjusted to prevent double counting. The adjustments involved 1) removing the cost of fatalities from the total costs and 2) reducing all injury severity type costs by 3.9 percent. The latter adjustment was based on traffic accidents having accounted for 3.9 percent of *serious* compensable occupational injuries (≥5 days off work) in 2012/13 (Safe Work Australia, 2014). It was assumed that a similar proportion of traffic accidents occurred for injuries involving a short absence, long absence, partial incapacity or full incapacity.

The cost of non-fatal and non-transport accident occupational injuries attributed specifically to the extra-medical use of opioids was then identified. To determine this, the relative risk (RR) of an occupational injury being incurred by workers affected by the extra-medical use of opioids and the prevalence of workers affected by extra-medical opioid use were estimated.

[20] National data for serious compensable injuries (≥5 days off work) are collated annually. Published data which also includes lower severity level injuries and non-compensable injuries were last collected in 2012/13. Thus 2012/13 data are used in the present report.

[21] Only costs associated with workplace incidents that resulted in an injury were included in the human cost framework. Costs of workplace incidents which do not result in an injury are excluded. Such costs excluded include replacing or repairing damaged machinery and costs associated with damage to corporate image and loss of goodwill.

The RR estimate for extra-medical opioids was determined using findings from Li et al. (2011b) and Grant (2014). In Li et al.'s (2011b) case control study of more than one million post-accident workplace drug tests, an odds ratio (OR) of 3.4 for an occupational injury among employees who tested positive for drug use was reported. To calculate the AF for extra-medical opioids, this odds ratio was converted to a RR. Grant (2014) provided the formula for the conversion as follows:

$$RR = \frac{OR}{1 - p_0 + (p_0 * OR)}$$

Where:

RR = relative risk for the risk factor in question
OR = odds ratio for the risk factor in question
p_0 = the baseline risk.

Applying this formula to the odds ratios from Li and colleagues (2011b) and using a baseline risk of 0.032480486 (based on 374,500 occupational injuries (Safe Work Australia, 2015) among a total workforce 11,530,000 in 2012/13) gives a RR of 3.154.

Data collected by Safework Laboratories indicated an Australian workplace drug testing positivity rate of 2.9 percent for opioids, 1.7 percent for cannabis, 1.6 percent for ATS, and 0.8 percent for benzodiazepines from a sample of 98,599 random workplace drug tests conducted in 2015 (A. Leibie, Safework Laboratories, personal communication, 17th May 2016) [22].

Applying the RR calculation gives an aetiological fraction (AF) of 0.132654387 for all drugs detected and an AF of 0.05879665 for opioids. The AF for opioid use was then used to determine the opioid attributable cost of non-fatal and non-transport accident occupational injuries. The resultant cost was considered the high bound cost as the opioid testing positivity rate may have included both extra-medical and licit opioid use.

A low bound calculation was then undertaken using a positivity rate of 0.8 percent. This value was determined based on the prevalence of weekly extra-medical opioid use among workers from the 2016 NDSHS. It was assumed that most persons who use weekly would return a positive drug test. Applying the RR calculation to the adjusted opioid positivity rate gives an AF of 0.016941062 for extra-medical opioids.

6.2.2 Workplace absenteeism

To estimate the extent and cost of extra-medical opioid related workplace absenteeism, secondary analyses were conducted on 2016 NDSHS data (Australian Institute of Health and Welfare, 2017g, unit record file). Only respondents who were employed and aged ≥ 14 years were included in the analyses.

An illicit drug use status variable comprising four categories was created. The four categories were 1) extra-medical opioid use at least weekly, 2) extra-medical opioid use less often then weekly, 3) other drug use, and 4) no drug use. Frequency of extra medical pain-killer and heroin use were used to estimate extra-medical opioid use on a weekly (every day or once a week) or less than weekly (monthly, every few months, or once or twice a year) basis. The NDSHS does not request frequency of use data from those who used methadone/buprenorphine extra-medically. Thus, such respondents were excluded if they did not also use heroin or pain-killers extra-medically [23].

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[22] National data concerning workplace testing are unavailable prior to 2015.
[23] When those who use extra-medical methadone/buprenorphine, pain-killers and heroin were combined into a past year extra-medical opioid use group, exclusive methadone/buprenorphine respondents comprised 2% of this group.

In relation to absenteeism, two variables were used: absence due to injury and/or illness; and, absence due to drug use. Annual absenteeism due to injury and illness involved summing the total number of days absent from work, school, university or TAFE due to injury or illness in the past three months and then multiplying these days by four to obtain a non-seasonally adjusted annual estimate (with a maximum 240 days absent possible). Annual absenteeism due to drug use was also determined by multiplying by four the number of days absent from work, school, university or TAFE due to their own drug use in the past three months (with a maximum of 240 days absent possible).

Analysis of Variances (ANOVAs) were conducted to establish whether weekly extra-medical use of opioids resulted in more days absent from work due to: a) illness/injury and b) drug use, compared to those who:

- used opioids extra-medically less frequently than weekly;
- used other types of illicit drugs; and,
- did not use drugs (this comparison group was only included in the analysis examining days off due to illness/injury, as it was not applicable for the drug use analysis).

Two Analysis of Covariances (ANCOVAs) were then conducted to determine mean a) illness and injury absenteeism and b) drug-related absenteeism by illicit drug use status while controlling for age, gender, marital status, socio economic status, and occupation. These variables were controlled for as they are known to be associated with workplace absence (Bush and Wooden, 1995; Ekpu and Brown, 2015).

Total absenteeism-related costs for each category of illicit drug use status was then estimated. To accomplish this, the difference in mean number of annual days absent according to illicit drug use status was calculated by subtracting the mean days absent among the group of people who do not use drugs from each of the other three categories. This figure was then multiplied by $373.66 [24] (one day's wage plus 20% employer on-costs, based on the average weekly income in 2015 [25]) (Australian Bureau of Statistics, 2016a) to obtain a cost estimate of extra-medical opioid-related absenteeism (i.e. following a replacement labour cost approach, rather than an economic output per day worked approach).

6.3 Costs due to occupational injury

The results presented below first provide an overview of the number and costs of occupational injuries due to all causes (Section 6.3.1), followed by the costs of non-fatal and non-transport occupational all-cause injuries borne by employers, employees, and the community. The latter results were then used to estimate the cost of occupational injuries (non-fatal and non-transport accidents) attributable to opioids using the RR and AF calculations (Section 6.3.2). The 2015 Consumer Price Index (CPI) (Australian Bureau of Statistics, 2016d) calculator was then applied to the 2012/13 estimates of opioid attributable occupational injury costs.

6.3.1 Number and costs of injuries

In 2012/13 there were 374,500 occupational injuries (Safe Work Australia, 2015). A breakdown by injury severity and compensation status is presented in Table 6.1.

[24] Whetten et al. (2016) included an identical method to determine absenteeism costs attributed to methamphetamine with the exception of the daily wage calculation. The present report determined daily wage using the full-time adult total earnings weekly wage (seasonally adjusted data) for November 2015. The daily wage calculation for the cost of methamphetamine was based on the person's total earnings weekly wage (trend data) for November 2013. Both values were divided by five to determine daily wage and then 20% employer on-costs were added. Appendix 6.3 provides estimated costs of absenteeism attributed to the extra-medical use of opioids using the November 2015 person's total weekly earnings trend data.

[25] Average weekly income data for 2015 was selected in order to maintain consistency across other chapters of this report.

Table 6.1: Compensable and non-compensable occupational injuries by severity 2012/13

Injury category		Short absence [a]	Long absence [b]	Partial incapacity [c]	Full incapacity [d]	Fatality	All
Compensated	%	59	34	7	<1	<1	100
	N	122,500	71,500	14,200	400	200	208,800
Not compensated	%	65	29	6	<1	<1	100
	N	107,200	48,400	9,600	300	200	165,700
All	**%**	**61**	**32**	**6**	**<1**	**<1**	**100**
	N	**229,700**	**119,900**	**23,800**	**700**	**400**	**374,500**

Source: Safe Work Australia, 2015. The Cost of Work-related Injury and Illness for Australian Employers, Workers and the Community: 2012–13. Canberra, Safe Work Australia.
a < 5 days off work.
b ≥5 days off work and return to work on full duties.
c ≥5 days off work and return to work on reduced duties or lower income.
d Permanently incapacitated with no return to work.

The compensable and non-compensable occupational injuries for 2012/13 (Safe Work Australia, 2015) resulted in a total estimated cost of $28,230 million (Table 6.2). After excluding fatalities and transport accidents (costs accounted for in Chapters 3 and 8, respectively), the adjusted cost is $26,284 million (Table 6.2).

Table 6.2: Cost ($000,000) of occupational injuries by severity 2012/13

	Short absence [a]	Long absence [b]	Partial incapacity [c]	Full incapacity [d]	Fatality	Total ($000,000)
Total cost	960	4,340	19,250	2,800	880	28,230
Adjusted total cost [e f]	**923**	**4,171**	**18,499**	**2,691**	**-**	**26,284**

Sources: Safe Work Australia, 2014. Australian Workers' Compensation Statistics 2012–13. Canberra, Safe Work Australia. Safe Work Australia, 2015. The Cost of Work-related Injury and Illness for Australian Employers, Workers and the Community: 2012–13. Canberra, Safe Work Australia.
[a] < 5 days off work.
[b] ≥5 days off work and return to work on full duties.
[c] ≥5 days off work and return to work on reduced duties or lower income.
[d] Permanently incapacitated with no return to work.
[e] Fatalities and transport accidents were excluded as they are reported in Chapter 3 and Chapter 8, respectively.
[f] Safe Work Australia (2014) reported that traffic accidents accounted for 3.9% of serious compensable occupational injuries (≥5 days off work) in 2012/13. It was assumed that a similar proportion of traffic accidents occurred for injuries requiring a short absence, long absence, partial incapacity and full incapacity and thus such associated costs were reduced by 3.9%.

Safe Work Australia (2015) estimates of the proportions of occupational injury costs borne by employers, employees, and the community were then used to calculate apportioned costs for non-fatal and non-transport occupational injuries (Table 6.3).

6.3.2 Costs of injuries due to extra-medical opioid use

The high and low bound attributed costs of opioid use associated with non-fatal and non-transport occupation injuries in 2012/13 were calculated by applying the appropriate AF value. The high bound attributable cost of opioid use in 2012/13 was $1,545.4 million (Table 6.3), based on the positive detection rate of 2.9 percent (AF = 0.059). Of this total cost, $92.7 million is borne by employers, $386.4 million by the community, and

$1,066.3 million by injured employees. Updating the 2012/13 costs to 2015 [26] by the CPI (Australian Bureau of Statistics, 2016d) gives a total cost of $1,598.5 million with $95.9 million borne by employers, $399.6 million by the community, and $1,103.0 million by injured employees (Table 6.3).

Applying the AF for extra-medical opioids based on an adjusted positive detection rate of 0.8% (0.017), the low bound attributable cost of extra-medical opioid use associated with non-fatal and non-transport occupational injuries in 2012/13 was $445.3 million (Table 6.3). Updating the 2012/13 costs of extra-medical opioids to 2015 gives a total low bound cost of $460.6 million with $27.6 million borne by employers, $115.1 million by the community, and $317.8 million by injured employees (Table 6.3).

The mid-point of the high and low bound 2015 costs were used as the central estimate. The resulting total costs was therefore $1,029.5 million, with $61.8 million borne by employers, $257.4 million by the community, and $710.4 million by injured employees (Table 6.3). Costs borne by employees ($710.4 million) are internal costs and thus not included in the total estimate for workplace costs attributable to opioids **($319.1 million**, see Table 6.8).

Given the nature of the available data, it is not possible to identify the extent to which the workplace injuries occurred to the person who used the drug, or to someone else. As such it is very likely that these estimates include some private costs to people who used the drug.

Table 6.3: Costs of non-fatal and non-transport occupational injuries borne by employers, employees, and the wider community 2012/13

			Cost ($000,000)					
			Low bound [a]		Central estimate [b]		High bound [c]	
Bearer of cost	**Cost (%)**	**All causes 2012/13**	**Extra-medical opioids 2012/13**	**Extra-medical opioids 2015 [d]**	**Extra-medical opioids 2012/13**	**Extra-medical opioids 2015 [d]**	**Opioids 2012/13**	**Opioids 2015 [d]**
Employer	6	1,577	26.7	27.6	59.7	61.8	92.7	95.9
Employee	69	18,136	307.2	317.8	686.8	710.4	1,066.3	1,103.0
Community	25	6,571	111.3	115.1	248.8	257.4	386.4	399.6
Total	**100**	**26,284**	**445.3**	**460.6**	**995.3**	**1,029.5**	**1,545.4**	**1,598.5**

[a] 2012/13 all cause occupational injury cost data were multiplied by the aetiological fraction (AF) for extra-medical opioid use (0.016941062) to determine costs borne by the employer, employee and community. The AF was calculated using an adjusted positivity rate of 0.8 percent for extra-medical opioids.
[b] The mid-point of the high and low bound estimates.
[c] 2012/13 all cause occupational injury cost data were multiplied by the aetiological fraction (AF) for opioid use (0.05879665) to determine costs borne by the employer, employee and community. The AF was calculated using a positivity rate of 2.9 percent for opioids (illicit and licit use).
[d] Adjusted using the ABS Consumer Price Index inflation calculator to December 2015 values (Australian Bureau of Statistics, 2016d).

6.4 Costs due to workplace absenteeism

A total of 11,710 (weighted N = 10,368,379) employed Australians aged 14 years or older provided illicit drug status information in the 2016 NDSHS (Australian Institute of Health and Welfare, 2017c, unit record file). Of these, 0.8 percent used opioids extra-medically on a weekly basis, 2.9 percent used opioids extra-medically

[26] The December 2015 quarterly Consumer Price Index calculator was used to adjust the 2012/13 data to align with timeframes used in other Sections of the document.

less than weekly, 14.0 percent used illicit drugs other than opioids, and 82.3 percent were people who did not use drugs.

Results of the ANOVA indicated that there was a statistically significant association between the four drug use groups regarding workplace absenteeism due to illness or injury ($F [3, 10446] = 10.367$, $p < .001$). On closer inspection, workers who used other illicit drugs were significantly more likely to be absent from work than people who did not use drugs ($p < .001$) (Table 6.4) and those who used opioids extra-medically less often than weekly ($p = .005$) (data not shown). Those who used opioids extra-medically at least weekly were also more likely to be absent from work than those who used opioids extra-medically less often than weekly ($p = .019$) (data not shown). Although, workers using extra-medical opioids at least weekly and less than weekly were absent from work 7.6 days more and 1.9 days less, respectively, than workers who did not use drugs, these differences were not statistically significant (Table 6.4).

Table 6.4: Comparison of unadjusted excess workplace absenteeism due to illness/injury among people who use opioids, those who use other drugs and those who do not use drugs (2016 NDSHS data [a])

Drug use status	Annual Illness or Injury Absence		
	Mean Days Absent (95% CI)	Difference [b] (95% CI)	p-value [c]
No drug use	7.754 (7.244 – 8.264)		
Extra-medical opioid use at least weekly	15.333 (6.450 – 24.217)	7.579 (-0.795 – 15.953)	.055
Extra-medical opioid use less often than weekly	5.813 (4.389 – 7.238)	-1.941 (-2.855 – -1.026)	1.000
Other drug use	10.993 (9.568 – 12.418)	3.239 (2.324 – 4.154)	<.001

[a] Australian Institute of Health and Welfare, 2017. National Drug Strategy Household Survey (NDSHS) 2016, Drug Statistics Series. Canberra, Government of Australia.
[b] Mean days absent due to illness/injury for a) extra-medical use of opioids at least weekly, b) extra-medical use of opioids less often than weekly, c) other drug use, minus mean days absent for no drug use.
[c] Significance of mean difference in days absent due to illness/injury for a) extra-medical use of opioids at least weekly, b) extra-medical use of opioids less often than weekly, c) other drug use, compared to no drug use.

Results of the ANCOVA indicated that, after controlling for age, gender, marital status, socio-economic status, and occupation (Bush and Wooden, 1995), there was a significant association between the four drug use groups regarding absenteeism due to injury or illness ($F [3, 6976] = 10.811$, $p < .001$). Marital status was found to be a significant covariate ($F = 7.444$, $p = .006$). Workers who used opioids extra-medically at least weekly were absent due to injury or illness for an additional 972,150 days from work per year compared to workers who did not use drugs, equating to a cost of approximately $363.2 million (Table 6.5).

Table 6.5: Comparison adjusted excess workplace absenteeism due to illness/injury among people who use opioids, those who use other drugs and those who do not use drugs (2016 NDSHS data [a]) with associated costs (2015 ABS data [b]) [c]

Drug use status	Estimated Population	Annual Illness or Injury Absence			
		Mean Days Absent (95% CI)	Difference [d] (95% CI)	Excess Days Absent (95% CI) [e]	Cost $ (95% CI) [f]
No drug use	8,536,278	7.556 (6.909 – 8.203)			
Extra-medical opioid use at least weekly	80,106	19.692 (12.619 – 26.765)	12.136 (5.710 – 18.562)	972,150 (457,378 – 1,486,921)	363,253,507 (170,903,992 – 555,603,040)
Extra-medical opioid use less often than weekly	302,521	4.247 (0.909 – 7.584)	-3.309 (-6.000 – -0.619)	0 (0 – 0) [g]	0 (0 – 0) [g]
Other drug use	1,449,475	11.074 (9.547 – 12.600)	3.518 (2.638 – 4.397)	5,098,715 (3,824,159 – 6,373,271)	1,905,185,957 (1,428,935,406 – 2,381,436,380)

[a] Australian Institute of Health and Welfare, 2017. National Drug Strategy Household Survey (NDSHS) 2016, Drug Statistics Series. Canberra, Government of Australia.
[b] Australian Bureau of Statistics (ABS), 2016. Average Weekly Earnings, Australia, Nov 2015. Cat. no. 6302.0. Canberra, ABS.
[c] Calculations based on estimated absenteeism means adjusted for age, gender, marital status, socio-economic status, and occupation.
[d] Mean days absent due to illness/injury for a) extra-medical use of opioids at least weekly, b) extra-medical use of opioids less often than weekly, or c) other drug use, minus mean days absent for no drug use.
[e] Difference in mean absence multiplied by estimated population.
[f] Excess absence multiplied by $373.66 (2015 average daily wage plus 20% employer on-costs).
[g] To simplify interpretation of results, negative difference values (including 95% confidence intervals) were rounded to 0.

Of those who used illicit drugs, extra-medical opioid use did not significantly predict workplace drug-related absenteeism ($F[2, 1820] = 0.101$, $p = .904$) more than those who used other drugs.

As shown in Table 6.6, after controlling for known confounders (Bush and Wooden, 1995) extra-medical use of opioids at least weekly and less than weekly resulted in 32,240 and 88,902 excess days off work due to drug use per year, respectively. This equated to an annual cost of approximately $45.3 million per year.

Table 6.6: Adjusted excess workplace absenteeism due to illicit drug use by drug use type (2016 NDSHS data [a]) and associated costs (2015 ABS data [b]) [c]

Drug use status	Estimated Population	Annual Absence Due to Drug Use		
		Mean Days Absent (95% CI)	Excess Days Absent (95% CI) [d]	Cost $ (95% CI) [e]
Extra-medical opioid use at least weekly	80,106	0.402 (-0.640 – 1.445)	32,240 (0 – 115,786) [f]	12,046,866 (0 – 43,264,673) [f]
Extra-medical opioid use less often than weekly	302,521	0.262 (-0.248 – 0.772)	88,902 (0 – 233,452) [f]	33,219,290 (0 – 87,231,532) [f]
Other drug use	1,449,475	0.208 (-0.015 – 0.430)	301,024 (0 – 623,604) [f]	112,480,654 (0 – 233,015,746) [f]

[a] Australian Institute of Health and Welfare, 2017. National Drug Strategy Household Survey (NDSHS) 2016, Drug Statistics Series. Canberra, Government of Australia.
[b] Australian Bureau of Statistics (ABS), 2016. Average Weekly Earnings, Australia, Nov 2015. Cat. no. 6302.0. Canberra, ABS.
[c] Calculations based on estimated absenteeism means adjusted for age, gender, marital status, socio-economic status, and occupation.
[d] Days in excess of those who do not use drugs. Mean days absent multiplied by estimated population.
[e] Excess absence multiplied by $373.66 (2015 average daily wage plus 20% employer on-costs).
[f] To simplify interpretation of results, negative difference values (including 95% confidence intervals) were rounded to 0.

Workers who used opioids extra-medically, however, may also use other drugs and it may be the other drugs which account for the worker's absence. Poly-substance use (excluding alcohol and tobacco) occurred in 22 percent of workers who used opioids extra-medically (National Centre for Education and Training on Addiction, 2019). Table 6.7 details the proportion of workers who used other drugs in the same 12 month period that extra-medical opioids were also used.

Table 6.7: Proportion of workers using other drugs in addition to extra-medical opioids in the past 12 months by drug type used [a]

Drug Type	%	Drug Type	%	Drug Type	%
Cannabis	17.4	Tranquillisers	3.7	Inhalants	0.7**
Ecstasy	6.0	Hallucinogens	3.3*	Kava	0.0**
Methamphetamine	5.1	Ketamine	2.7**	Steroids	0.2**
Cocaine	4.7	GBH	0.8**	Other	1.8*

Source: Australian Institute of Health and Welfare, 2017. National Drug Strategy Household Survey.
[a] The NDSHS only asks people who extra-medically used "pain-killers/pain-relievers/opioids" about their poly-substance use. Poly-substance use data is thus missing from 15 persons who use heroin/methadone/buprenorphine (3% of persons who use extra-medical opioids).
* Estimate has a relative standard error of 25% to 50% and should be used with caution.
** Estimate has a relative standard error greater than 50% and is considered too unreliable for general use.

In order to account for drug-related absenteeism (Tables 6.5 and 6.6) due to poly-substance use (Table 6.7), the total cost of extra-medical opioid use was divided by 1.464 (i.e. the summed proportion of persons who use extra-medical opioids who also used other drugs). This resulted in an annual cost of extra-medical opioid attributable absenteeism due to drug use and illness/injury of **$30.9 million** [27] and **$248.1 million** [28], respectively. The cost attributable to *drug use* related absenteeism (**$30.9 million**) is likely to be a conservative estimate as it was obtained from a self-report measure of absenteeism that respondents attributed to drug use and was used as our low bound estimate for absenteeism (Table 6.8). The cost attributed to *injury and illness* absenteeism (**$248.1 million**) however is likely to be an overestimate as higher proportions of people who use opioids also smoke tobacco and/or drink alcohol at risky levels, compared to the general working population (National Centre for Education and Training on Addiction, 2019). Both of these licit drugs have substantial negative impacts on physical health and are unaccounted for in the estimates presented here. The cost attributed to injury and illness absenteeism was used as the high bound estimate, with the mid-point (**$139.5 million**) used as the central estimate (Table 6.8).

Table 6.8: Summary: Workplace costs due to extra-medical opioid use

Cost area	Central estimate ($)	Low bound ($)	High bound ($)
Occupational injury	319,145,000 [a]	142,770,000 [b]	495,520,000 [c]
Absenteeism	139,521,743 [a]	30,919,506	248,123,980
Total	**458,666,743**	**173,689,506**	**743,643,980**

[a] The mid point of the low and high bound estimates.
[b] Cost to employer ($27,630,000) plus cost to community ($115,140,000). Employee costs are an internal cost and thus not included in the total cost estimate for occupational injury (see Table 6.3).
[c] Cost to employer ($95,900,000) plus cost to community ($399,620,000). Employee costs are an internal cost and thus not included in the total cost estimate for occupational injury (see Table 6.3).

[27] The summed cost of absenteeism attributed to extra-medical opioid use at least weekly ($12,046,866) and less often than weekly ($33,219,290) divided by 1.464.
[28] The summed cost of absenteeism attributed to extra-medical opioid use at least weekly ($363,253,507) and less often than weekly ($0) divided by 1.464.

The attributed cost of extra-medical opioid use to workplace absenteeism reported in Tables 6.5 and 6.6 only reflects likely workplace costs directly associated with paid sick leave. There are also likely to be other indirect costs, such as the costs of finding and paying replacement workers to backfill the absent employee's work role and/or the cost of lost productivity if a replacement worker cannot be sourced.

6.5 Conclusions

The total cost of extra-medical opioid use to Australian workplaces is estimated to be **$458.7 million** (**$319.1 million** for costs associated with occupational injury and **$139.5 million** for costs attributed to absenteeism) (Table 6.8). As data were only available to determine workplace costs associated with occupational injury and absenteeism, it is likely that this estimate underestimates the true cost of extra-medical opioids to the workplace. There are additional costs that cannot currently be quantified. These are discussed below.

6.5.1 Other workplace costs

Additional workplace costs associated with the extra-medical use of opioids that cannot be quantified due to lack of data include the following areas.

Presenteeism can be defined as attending work while unwell or impaired, resulting in reduced quality or quantity of work. As extra-medical opioid use can impair psychomotor and cognitive functioning, weaken the immune system, impair driving ability, and dysregulate mood (Chihuri and Li, 2017; Manchikanti et al., 2012), it is likely that extra-medical opioid use contributes to presenteeism. However, there are no current available data concerning drug-related presenteeism in Australian workplaces.

Turnover costs are incurred when employees who leave (either voluntarily or involuntarily) are replaced. Costs are associated with hiring, training, reduced productivity, and lost opportunity. Extra-medical opioid use is likely to contribute to these costs if an employee a) is dismissed for failing a workplace drug test, b) leaves because their use has escalated to severe dependence and restricted their ability to work effectively, or c) is dismissed due to drug-related poor performance. However, there are no current reliable data concerning the costs to Australian workplaces due to drug-related turnover.

Workplace drug testing is becoming more common in Australian workplaces. The costs incurred in implementing workplace testing includes a) the purchase of testing services, b) lost productivity while employees undergo testing, and c) legal and industrial relation costs in the establishment of, and possible defence of, workplace testing procedures. Licit and extra-medical opioid use contributes to these costs, with opioids being detected in 2.1 percent of positive workplace tests (Li et al., 2011a). Across the Australian workforce, the total costs of workplace drug testing are likely to be substantial. Nearly 7 percent of the Australian workforce reports that their workplace conducts drug tests (Pidd et al., 2015), with one of the larger workplace drug testing service providers undertaking nearly 100,000 tests across Australia in 2015 (A. Leibie, Safework Laboratories, personal communication, 17th May 2016). However, precise and accurate data concerning the extent and cost of workplace drug testing across the Australian workforce are not currently available.

Employee wellbeing costs are incurred when employee's mental and physical health is affected by the behaviour of co-workers and traumatic workplace incidents. People who use extra-medical opioids are more likely to have higher levels of psychological distress (21.8%) than those who used other drugs (16.5%) or who do not use drugs (8.3%) (National Centre for Education and Training on Addiction, 2019). Thus, extra-medical opioid use may contribute to employees seeking counselling, other clinical support and/or utilising

Employee Assistance Programs. Additional costs may also be incurred through impacts on employee safety and productivity due to poor worker wellbeing.

The cost to workplaces attributed to extra-medical opioid use are likely to be unevenly distributed across Australian workplaces. Secondary analysis of the 2016 NDSHS indicates that the prevalence of extra-medical opioid and other illicit drug use varies substantially across different occupational and industry groups (National Centre for Education and Training on Addiction, 2019). For example, the extra-medical use of opioids varied from 0.0 percent - 8.6 percent [29] (National Centre for Education and Training on Addiction, 2019). Workplace costs are likely to be higher in industries with higher prevalence of the extra-medical use of opioids. Although prevalence was similar among employed males and females (3.8% each), extra-medical opioid use was highest in employees aged 18-24 years (5.4%) (National Centre for Education and Training on Addiction, 2019). As participation in vocational training is high in this age group, extra-medical opioid use may also contribute to training attrition costs.

6.6 Limitations

6.6.1 Accidents

Extra-medical opioid use can impair memory, concentration, reaction times, dexterity and mood which can contribute to the risk of accidents (Australian Safety and Compensation Council, 2007; Chihuri and Li, 2017). The impacts of this on road crashes and workplace accidents are explored in Chapter 8 and Section 6.3.1, respectively, however there is also the potential for excess rates of other forms of accidental injury, namely vehicle crashes that do not occur on the road, falls, burns and scalds, drowning, and sharp object injuries. Although extra-medical opioid use has been found to increase these risks, no reliable estimates exist concerning the extent to which extra-medical opioid use contributes to excess rates of these forms of injury in Australian workplaces.

6.6.2 Occupational injuries

Data concerning occupational injuries is limited. At present, annual data is reported only for serious (resulting in ≥5 days off) compensable injuries. Data concerning less serious compensable and non-compensable injuries is reported less frequently. Such data are not reported on by drug-type and thus costs attributed to the extra-medical use of opioids were estimated by applying formulas considered reliable. One part of the formula referred to data on the extent of workplace testing and the prevalence of positive tests by drug type. Data of this type are limited and could only be sourced from one large national workplace testing service provider (Safework Laboratories). Due to such limitations, the true cost of occupational injuries attributable to the extra-medical use of opioids may not be accurately reflected.

6.6.3 Absenteeism

Estimates of extra-medical opioid related workplace absenteeism were obtained from a self-report measure. Self-report data may not accurately reflect true absenteeism attributed to illness or injury, and drug use. Furthermore, a proportion of the absenteeism costs calculated may have already been accounted for in the occupational injury estimates if the survey respondent is reporting absenteeism due to an occupational injury.

Absenteeism cost estimates were based on the assumption that people annually worked a five-day working week over 48 weeks, with four weeks annual leave. This may inadequately reflect the work schedule of

[29] Estimates of extra-medical opioid use in some occupation and industry groups had a relative standard error of 25% to 50% and should be used with caution.

employees who work part time, overtime, or longer rosters, and limits assumptions about annual absenteeism rates.

6.6.4 Reduced participation in the workforce

Evidence suggests that regular extra-medical opioid use, and particularly dependent use, is correlated with reduced participation in the workforce (Organisation for Economic Cooperation and Development, 2018). No Australian research quantifies the extent of the impact on employment in terms of its scale, or direction of causation. Direction of causation may be important, as it is unclear whether extra-medical opioid use impacts workforce participation or whether reduced workforce participation impacts extra-medical opioid use. As such these costs cannot currently be quantified.

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CHAPTER 7: COST OF CRIME RELATED TO HEROIN USE

Neil Donnelly & Steve Whetton

7.1 Heroin attributable crime

Note: as explained below, the costs estimated in this chapter relate to heroin only, not to opioids in general.

While studies conducted in the United States, United Kingdom, Canada and Australia have shown a strong association between illicit drug use and levels of different types of crime, the causal pathway of this relationship remains open to debate. In a meta-analysis of 30 studies Bennett et al. (2008) found that while offending was higher among those who use drugs compared with those who do not use drugs, the strength of the relationship varied by drug type. Offending was higher among people who used crack (cocaine), heroin or (powder) cocaine. The causal issue is complex as it appears to not be a simple question of whether initiation of drug use then leads to involvement in crime or vice versa. A cohort study conducted by Pierce et al. (2017) in England found that those who went on to use opiates already had higher levels of involvement in crime. Importantly the use of opiates then further increased their involvement in crime.

In late 2000, when the heroin shortage occurred in Australia, other than an initial spike in incidents of robbery there was a sustained decrease in robbery and burglary. Moffatt et al. (2005) found that rather than the decline in non-fatal heroin overdoses explaining the crime declines alone, they were also explained by re-registrations into methadone treatment by people who used opioids, a decline in unemployed young males and improved general consumer sentiment. The complex relationship between opioid use and crime was examined by Degenhardt et al. (2013a) in a cohort study of entrants into opioid agonist therapy between 1985 and 2010. While almost three quarters of the cohort had appeared before a court during the study period, Degenhardt et al. (2013a) found that only around one-fifth of the cohort accounted for two thirds of the charges.

While understanding the causal issue between opioid use and crime requires more research to be conducted, the opportunity remains to investigate the cost of crime related to opioid use. Examples of this include studies conducted in the United States (Council of Economic Advisers, 2017; Jiang et al., 2017; Mark et al., 2001) and Canada (Canadian Substance Use Costs and Harms Scientific Working Group, 2018; Wall et al., 2000). In Australia a recent study by Whetton et al. (2016) estimated of the costs of methamphetamine use to the criminal justice system in 2013/14. The current investigation applies a similar methodology to examine the costs of crime related to opioid use in Australia in 2015/16.

Criminal justice system data are not generally suited to statistical analyses relating to drug use, as information such as heroin or other opioid use, and its alleged role in the offence, is not routinely recorded. If recorded at all, the information is often located in narrative and is not available for analysis without first going through each file individually and coding the relevant data. Instead, analysis of the role of substance use in crime in Australia usually employs the Drug Use Monitoring in Australia (DUMA) survey as this is the only regular survey of police detainees and substance use in Australia (Patterson et al., 2018). The DUMA survey has several shortcomings; most notably that it only surveys offenders from selected police stations, which may not be representative of the population of offenders for the country as a whole [30]. Given the lack of data on the geographic distribution of dependent heroin use, it is not possible to identify whether the rates of heroin

[30] For the 2015/16 survey, data were collected in the following police stations: Brisbane (Queensland); Bankstown and Surry Hills (New South Wales); Adelaide (South Australia); and Perth (Western Australia) (Patterson et al., 2018).

consumption amongst offenders detained by police at the selected DUMA sites is representative of the country as a whole, or under- or overestimates it.

Other limitations of the DUMA survey are that:

- It can only provide data on those police detainees who were in police custody at the time of the survey (which may over-represent those alleged to have committed more serious offences) and who consent to participate in the research. The long-term participation rate was 87 percent; in 2015/16 it was 60 percent overall but was 82 percent if restricted to those detainees deemed eligible to participate (Patterson et al., 2018);

- Attribution to substance use is based on self-assessment by the detainee. It is not known whether there are any systematic biases in the propensity of offenders to attribute their offending to their use of a substance. These biases include: falsely attributing offending to a substance as a self-exculpatory strategy; failing to attribute offending to the substance use that caused it either through underestimating the extent the substance distorted their reasoning or through a concern of being stigmatised for offending under the influence of the substance;

- Detainees are automatically excluded from the sample frame if they are observed to be intoxicated at the time the researcher attends the station. This may lead the survey to understate the role of substances in offending as those who were intoxicated at the time of the offence are more likely to be excluded than those who were not;

- It is only appropriate as a source of data on the involvement of substances in the offending behaviour of adults, with the sample of juveniles captured in the survey being too small to derive usable attributable fractions (AF). This will tend to understate the impact of substances on crime as at least some juvenile offending is likely to be attributable to substance use;

- The AF for substances calculated from it only relate to crime committed by those who have used the substance in the last 30 days. This means it will not capture that proportion of "systemic" crime where the perpetrators are not, themselves, people who have recently used the substance in question; and,

- It will not necessarily capture the apparent higher rates of crime victimisation of persons who are dependent on methamphetamine or heroin (Torok et al., 2008), except to the extent that the perpetrators themselves use the same substance.

Persons who use drugs extra-medically (particularly with heavier and dependent use) are both more likely to commit crime (acknowledging the complexity of this relationship), but also more likely to be victims of violent crime. Mechanisms for the increased probability of committing crime include economic crime to fund drug consumption (economic/compulsive crime), crime aimed at supporting or protecting systems of drug distribution and use, such as violence used to recover debts from people who use drugs (systemic crime), and criminal behaviour that results from the altered mental state and/or reduced inhibition caused by consumption of many illicit drugs, or withdrawal from them (pharmacological crime) (Darke, 2010; Goldstein, 1985; Torok et al., 2008).

Torok and colleagues (2008) surveyed a group of people who regularly used methamphetamine and heroin, 161 of whom primarily used heroin. Of the primarily heroin using group, 62 percent reported having been charged with a violent crime at some point in their lives (with 58% reporting having been convicted) and 35 percent reported having committed at least one violent crime in the past 12 months, with 72 percent of those committing violent crime having committed multiple offences. Self-reported rates of other offending were also high, with 30 percent of those who primarily used heroin reporting having committed a property crime in the past month (with 6% of the heroin cohort reporting having committed property crime daily), 44 percent reported having sold drugs in the past month, and 14 percent reported having committed fraud. The persons primarily using heroin also reported high rates of being victims of interpersonal violence, with 40 percent having been a victim of violent crime in the past 12 months, 87 percent of whom had been the victim on more than one occasion.

The specific rates of crimes of violence committed by, and suffered by, the cohort included in the Torok study may not be representative of the broader population of persons who use opioids extra-medically. The severity of dependence was high amongst the sample population, with a mean severity of dependence scale score of 9.0 for the sub-sample who primarily used heroin. Instead, for this analysis we have used the estimated AF for violent crime derived from the DUMA survey.

As with concerns over the representativeness of the sites selected for the survey, it is not possible to determine whether the known limitations of the survey will lead to it over- or underestimating the role of substance use in offending. Notwithstanding these limitations, the DUMA survey remains the best available source of data on drug use of offenders in Australia.

For this project, analysis of the DUMA survey data for the 2015/16 financial year was undertaken by the Australian Institute of Criminology (AIC) to identify the proportion of police detainees who attributed their offending to different illicit substances. This method uses the responses to several survey questions to determine the proportion of detainees who attribute their current offending (i.e. offences for which individuals were detained at time of interview), either entirely or partly, to drug use during the past 30 days (Payne and Gaffney, 2012). The detainees were asked to consider the main reason why they had been detained and to indicate via a three-point scale the extent their drug use contributed to their present situation. The questions were asked separately for each different drug type so that attributions could be assigned by drug type. Attributions by offence type were estimated by assigning detainees to a most serious offence (MSO) category on the basis of the charges recorded against them for their current detention. The MSO hierarchy included violence, property, illicit drug, traffic or driving under the influence (DUI), breach, public order and other.

In the DUMA 2015/16 interview, attribution was only asked of those detainees who used heroin in last 30 days and not of those who had used other opioids such as buprenorphine, methadone, oxycodone or morphine. There is some evidence that the proportion of those who use pharmaceutical opioids extra-medically who commit offences, tend to be much lower than for those who use heroin (Krebs et al., 2017). As reported in the introduction, despite the fact that pharmaceutical opioids are killing more people than heroin, more primary drug treatment episodes are for heroin (11,003 *versus* 7,499 (Australian Institute of Health and Welfare, 2017c), Table SD.1). In the 2015/16 DUMA detainee sample, 58 per cent of those who had used heroin in the past 30 days had also used other opioids. Among those who had used other opioids in the past 30 days a much lower percentage had also used heroin (36%). As we do not have data which would justify extrapolating the heroin crime attributions to other opioids it is better to acknowledge this limitation and focus on heroin attributable crime only.

Table 7.1 provides the heroin AF percentages broken down by the most serious offence category of adult detainees. Overall the AF percentages for heroin were very low. In total 3.4 percent of adult detainees attributed their offending to heroin. The highest AF percentages were found for detainees whose MSO was related to property (6.5%), illicit drugs (4.4%) and breach (3.5%) (see Table 7.2 for more information about the types of MSO).

The subsequent sections of this chapter will focus on costs related to: (i) police; (ii) courts; (iii) correction system; and, (iv) victims of crime. In each section national data reported by the ABS will be used and the AF percentages shown in Table 7.1 will be applied to the relevant offence categories. This will include the central estimate cost and also a low bound cost and a high bound cost based on the 95% confidence intervals shown in Table 7.1.

Table 7.1: Self-reported heroin attribution of crime amongst police detainees by most serious offence, DUMA survey July 2015 to June 2016, per cent of total offenders

Attributable fraction	Violent	Property	Illicit drug	Traffic or DUI	Breach	Public order	Other	Total
Central estimate (%)	2.1	6.5	4.4	1.7	3.5	1.5	0	3.4
Confidence Interval (95%)	(1.3, 3.5)	(4.5, 9.4)	(2.3, 8.1)	(0.5, 5.9)	(2.3, 5.3)	(0.4, 5.2)	(0.0, 10.7)	(2.7, 4.3)
Sample size (n)	700	400	205	119	574	136	32	2166

Source: AIC DUMA collection 2015/16 [computer file]; confidence intervals calculated by authors using Wilson estimator; DUI = driving under the influence

The ABS defines most serious offence based on the 16 divisions of the Australian and New Zealand Standard Offence Classification (ANZSOC) (Australian Bureau of Statistics, 2011). Table 7.2 shows how the DUMA most serious offence categories shown in Table 7.1 relate to the ANZSOC divisions. As an example the number of '*Theft*' offenders reported by the ABS would be multiplied by the Property AF shown in Table 7.1 (6.5%) to provide the number of heroin-related theft offenders. These would then be combined with the number of heroin-related '*Unlawful enter with intent*' offenders and heroin-related '*Fraud/deception*' offenders to provide the total number of heroin-related 'Property' offenders.

Table 7.2: Mapping of principal offence in Australian Bureau of Statistics data to DUMA most serious offence by ANZSOC Divisions

Most serious offence (MSO) in DUMA	ANZSOC Principal Offence (Divisions)
Violent	01 Homicide and related offences 02 Acts intended to cause injury 03 Sexual assault and related offences 04 Dangerous/negligent acts 05 Abduction/harassment 06 Robbery/extortion 11 Prohibited/regulated weapons
Property	07 Unlawful entry with intent 08 Theft 09 Fraud/deception
Illicit drug	10 Illicit drug offences
Traffic or DUI	14 Traffic and vehicle regulatory
Breach	15 Offences against justice
Public order	12 Property damage and environmental pollution 13 Public order offences
Other	16 Miscellaneous offences

Source: AIC DUMA collection 2015/16 [computer file]; Patterson et al., (2018); ABS (2011), 2011; ANZSOC = Australian and New Zealand Standard Offence Classification; DUI = driving under the influence.

7.2 Police costs

The real recurrent expenditure on state and territory police services in Australia was approximately $11.0 billion in 2015/16 (costs related to AFP activities outside of general policing in the ACT have not been included in this section). However, only a subset of policing costs should be included in the analysis of heroin attributable crime, as police perform a range of functions unrelated to, or only partially related to, crime, such as protective services, emergency management, policing community events, managing compliance with liquor licensing regulations and traffic management.

Smith et al. (2014) reported that it is reasonable to allocate 80 percent of police costs to crime, based on 2011 data from New South Wales Police. An alternative estimate can be derived from a Western Australian Police report (Western Australian Police, 2014), which allocated expenditure between activity types (with administrative costs allocated based on their share of operational expenditure). For the purposes of this calculation, "Intelligence and protective services"; "Response to, and investigation of, offences"; and "Services to the Judicial Process" are assumed to be crime related activities, with "Crime Prevention and Public Disorder"; "Community Support (non-offence)"; "Emergency Management"; and, "Traffic Law Enforcement and Management" classed as non-crime activities, giving an estimate of 64 percent of police time being crime related. As this is a more conservative estimate, we have used the proportion of crime allocated to crime estimated from Western Australian Police data for this analysis.

Police costs to be used in estimating the costs of heroin attributable crime also need to be adjusted down as our AF are derived from data on adult offenders, and may not be applicable to offenders aged less than 18 years of age. Some 13 percent of offenders processed by police are aged 17 or younger (Australian Bureau of Statistics, 2014), and we use this as an approximation of the share of police time spent on juvenile offenders, with 87 percent on adult offending.

Applying these two proportions (64% and 87%) to overall police costs of $11.0 billion gives an estimate of $6.9 billion in police costs that can be attributed to the response to offences committed by adults. This is the base from which the cost of heroin-related police time is calculated.

To allocate the costs of police time across different offence categories, we obtained data on the total number of offenders processed by police in 2015/16. This was sourced from the ABS publication "Recorded Crime – Offenders" (Australian Bureau of Statistics, 2017g). Unfortunately, this publication does not report the number of offenders processed for driving related offences, so for these offences the number of adult defendants processed in the courts was used as a reasonable proxy in 2015/16 (Australian Bureau of Statistics, 2017e). Simply allocating costs based on the number of offenders processed by police is likely to overestimate the amount of police time spent on frequent, but relatively straightforward, cases such as driving offences, and underestimate the time spent on cases that involve more intensive investigations, such as murder or major fraud. An approach that has been used previously (Moore, 2005) to weighting the raw numbers is to use data on the total police custody hours by offence category. It should be noted this relies on 2002 data (Taylor and Bareja, 2005). However, this also has the potential to be influenced by variations in the time taken to arrange bail or to be transferred to remand. Instead, we use court data on the average length of a trial in 2015/16 (Australian Bureau of Statistics, 2017e) as a reasonable proxy for the average complexity of cases by offence category and, therefore, for the cost of the police investigation.

Table 7.3 provides the heroin attributable police costs by most serious offence for adult offenders in 2015/16. The highest heroin attributable cost was found for property offences ($73.1 million). The next highest heroin attributable costs were for violent offences ($45.0 million) and drug offences ($38.5 million). Allocating police costs between offence categories on this basis, and then applying the AF for offences set out in Table 7.1 gives a central estimate of total heroin attributable police cost of **$202.6 million**, with a low bound of $113.6 million and a high bound of $523.0 million.

Table 7.3: Heroin attributable police costs by most serious offence, 2015/16

	Violent	Property	Drug	Traffic or DUI	Breach	Public Order	Not allocated	Total
Number of offenders	94,253	73,588	77,346	205,817	26,330	71,305	18,924	**567,563**
Weighting for relative complexity (from court data)	1.81	1.24	0.92	0.70	0.68	0.64	0.81	**1.00**
Estimated weighted share of police time on crime (%)	30.0	16.1	12.5	25.5	3.2	8.0	2.7	
Estimated value of police time on adult crime ($'million)	2,100.7	1,125.2	876.2	1,783.5	221.5	562.4	188.6	**6,858.1**
Central estimate of heroin attributable police costs ($'million)	45.0	73.1	38.5	30.0	7.7	8.3	0.0	**202.6**
Low bound of heroin attributable police ($'million)	27.4	50.3	20.4	8.2	5.0	2.3	0.0	**113.6**
High bound of heroin attributable police ($'million)	92.4	132.0	89.4	132.5	14.8	36.7	25.4	**523.0**

Source: ABS (2017e); Steering Committee for the Review of Government Service Provision, (2017a); AIC DUMA collection 2015/16 [computer file]; calculations by the authors. Costs relating to juvenile offenders are excluded.

7.3 Court costs

Total recurrent expenditure on criminal courts in Australia was $853.5 million in 2015/16 (Steering Committee for the Review of Government Service Provision, 2017a). However, that includes Children's Court costs for which we do not have reliable AF for heroin. Deducting Children's Court costs leaves $821.4 million in court costs that are in-scope. These court costs include the cost of operating such specialist courts as drug courts but do not include the cost of Federal courts (which process Commonwealth offences such as customs offences). Thus, with the exclusion of Children's Court and the Federal courts, the court costs are likely to understate costs attributable to heroin.

Offender based AF calculated by the AIC from the DUMA survey in 2015/16 were used to assess the court costs attributable to heroin. As with police costs, these court costs need to be allocated between offence categories (based on the alleged perpetrator's most MSO) so that the relevant AF can be applied to them. This allocation was made on the basis of the proportion of total defendant weeks for that level of court.

Table 7.4 displays the findings from both Higher courts (Supreme and District courts) and Magistrates courts. Applying the relevant AF gives a central estimate of total court costs attributable to heroin in 2015/16 of **$12.4 million** for Higher courts. The low bound of heroin-related costs was $7.4 million and the high bound costs was 21.1 million. In Magistrates Courts applying the relevant AF gives a central estimate of total court costs attributable to heroin in 2015/16 of **$12.1 million**. The low bound of heroin-related costs in Magistrates courts was $6.6 million and the high bound costs was $25.5 million.

Combining Higher and Magistrates court costs the central estimate of total heroin attributable court costs in 2015/16 was **$24.5 million**. The low bound of total heroin-related court costs was **$14.0 million** and the high bound was **$46.6 million**.

Table 7.4: Heroin attributable court costs by most serious offence and level of court, 2015/16

	Violence	Property	Drugs	Traffic or DUI	Breach	Disorder	Not allocated	Total
Higher Courts								
Number of defendants finalised	7,506	1,689	3,827	7	259	342	62	13,692
Total defendant weeks	335,788	71,789	158,821	188	11,215	14,434	3,212	595,445
Assumed court costs ($million)	214.0	45.7	101.2	0.1	7.1	9.2	2.0	379.4
Central estimate of heroin attributable court costs ($million)	4.6	3.0	4.4	0.0	0.2	0.1	0.0	**12.4**
Low bound of heroin attributable court costs ($million)	2.8	2.0	2.4	0.0	0.2	0.0	0.0	**7.4**
High bound of heroin attributable court costs ($million)	7.5	4.3	8.2	0.0	0.4	0.5	0.2	**21.1**
Magistrates Courts								
Number of defendants finalised	94,859	53,509	51,898	205,810	39,331	41,628	10,647	497,697
Total defendant weeks	1,007,171	425,048	212,782	1,049,631	184,856	180,408	59,623	3,119,519
Assumed court costs ($million)	142.7	60.2	30.1	148.7	26.2	25.6	8.4	442.0
Central estimate of heroin attributable court costs ($million)	3.1	3.9	1.3	2.5	0.9	0.4	0.0	**12.1**
Low bound of heroin attributable court costs ($million)	1.9	2.7	0.7	0.7	0.6	0.1	0.0	**6.6**
High bound of heroin attributable court costs ($million)	5.0	5.6	2.5	8.8	1.4	1.3	0.9	**25.5**

Source: ABS (2017e); Steering Committee for the Review of Government Service Provision, (2017a); AIC DUMA collection 2015/16 [computer file]; calculations by the authors.

In addition to the direct costs of the court system, there are also social costs imposed through the costs of public prosecutors (where cases are not prosecuted by police) and legal aid costs, where that is provided to defendants. The costs of counsel funded by defendants themselves are out-of-scope of this report as they are a purely private cost.

State and territory governments have legal aid commissions that provide legal support in criminal, civil and family law matters. Both Moore (2005) and Ritter et al. (2013) used a top-down approach to allocate a proportion of these costs to substance use, which we replicated. First, we estimated the average proportion of court activity considered attributable to heroin use (e.g. our estimated heroin attributable court costs divided by the total Higher Court and Magistrate's courts estimates, but excluding Children's Court costs; see Table 7.4 for the source data). This proportion was estimated to be 3.0 percent.

Expenditure figures were sourced from the annual reports of each of the Legal Aid Commissions across Australia for 2015/16 (Justice and Community Safety Directorate, 2016b; Legal Aid Commission New South Wales, 2016; Legal Aid Queensland, 2016; Legal Services Commission of South Australia, 2016; Northern Territory Legal Aid Commission, 2016; The Treasurer, 2015; Victoria Legal Aid, 2016). It was not possible to identify the spending on criminal matters from the ACT and NT data and so these jurisdictions are excluded from the calculation. Legal aid organisations for which data are available are estimated to have spent $306.8 million on criminal matters. Assuming the share of legal aid costs on Children's court matters matches the share of Children's court costs in total court costs, we estimate legal aid costs on adult criminal court matters at $295.3 million, with a central estimate of heroin attributable costs of **$8.8 million**, with a low bound of $5.0 million and a high bound of $16.8 million (see summary Table 7.18).

State and territory government spending on Department of Public Prosecution (DPP) services was $408.4 million in 2015/16 (Commonwealth Director of Public Prosecutions, 2016; Director of Public Prosecutions, 2016; Director of Public Prosecutions Northern Territory, 2016; Justice and Community Safety Directorate, 2016a; Office of the Director of Public Prosecutions, 2016; The Treasurer, 2016, 2017). As was done for Legal Aid Commission expenditure, we applied a multiplier to this total expenditure to derive a heroin specific public prosecution expenditure. We estimated this multiplier from the average of Higher and Magistrates' court activity figures, weighted by expenditure (as described earlier) as 2.9 percent.

As with legal aid costs, it has been assumed the DPP costs on Children's court matters matches their share of direct court costs (3.8%) giving $392.9 million in DPP costs related to adult criminal court matters, with a central estimate of heroin attributable costs of **$11.7 million**, with a low bound estimate of $6.7 million and an high bound of $22.3 million (see summary Table 7.18).

7.4 Correction system costs

Conceptually there are two ways that the correction costs attributable to heroin could be calculated. The first is to calculate the net present value of all future corrections related costs arising from heroin attributable crime committed in 2015/16. The second approach is to calculate the corrections system related costs attributable to heroin incurred due to imprisonment in 2015/16, regardless of when the offence itself occurred.

The former approach has the advantage of being based on crime committed in the study year (or at least criminal proceedings finalised in the study year) reflecting the pattern of heroin use and crime in the study year. The latter has the advantage of being based on known costs and known prison populations.

7.4.1 Estimating the unit costs of imprisonment

The on-going net recurrent costs (including depreciation of capital items) of corrections facilities cost society a total of $3.9 billion in 2015/16, $2.9 billion in capital costs and $1.0 billion in operating costs (Steering Committee for the Review of Government Service Provision, 2017a). As at 30 June 2016 there were 38,845 individuals detained in the adult corrections system including prisoners on remand (Australian Bureau of Statistics, 2017f). This gives an annual correction system cost per prisoner of $99,769. We have used this average in calculating the cost per heroin attributable prisoner although this is likely to underestimate the true per prisoner costs, as it excludes some of the costs associated with in-prison drug and alcohol services. We do not have data that would allow us to isolate the cost of these services from the overall prison costs.

There are other less direct costs and offsetting benefits associated with imprisonment, with researchers at the AIC identifying the following additional forms of cost and offsetting savings (Morgan and Althorpe, 2014):

Costs

- Lost productivity of prisoners (paid and unpaid work);
- Workplace disruption and costs of recruiting replacement employees;
- Lost potential lifetime economic output as ex-prisoners have a lower employment participation rate post release;
- Increased risk of homelessness post release;
- Prison assaults (on both staff and prisoners);

- Additional government payments as a result of household income falling due to imprisonment of a member of the household who was in work;
- Health impacts of imprisonment such as transmission of BBV;
- Cost of out of home care for children whose custodial parent is imprisoned and who cannot be placed with another member of the immediate family; and,
- Childcare and parenting support costs.

Offsetting savings

- Reduced government payments;
- Incapacitation effect of imprisonment (e.g. it is more difficult for imprisoned offenders to commit additional crime (excluding prison assaults));
- Value of work completed in prison;
- Reduction in illicit drug use by prisoners (although it should be noted that although rates of drug use are likely to fall during imprisonment, the harms per person arising from use may actually increase, for example through increased sharing of needles);
- Reduction in alcohol use (and therefore associated harms) by prisoners; and,
- Reduction in access to welfare services by prisoners.

Unfortunately, many of these costs cannot be accurately quantified from the available data. Our estimate of the net costs of imprisonment was therefore restricted to the following areas (with the method used to quantify the amount set out in the discussion that follows):

- Recurrent costs of corrections facilities: **$99,769** / prisoner (calculation set out above);
- Lost productivity of prisoners in paid work: **$23,843** / male prisoner and **$10,684** / female prisoner;
- Workplace disruption and costs of recruiting replacement employees **$3,017** / male prisoner and **$1,352** / female prisoner;
- Lost productivity of prisoners in unpaid household work: **$19,685** / male prisoner and **$35,146 /** female prisoner;
- Prison assaults (on both staff and prisoners): **$489**; and,
- Reduced government payments (offsetting saving): **-$2,848** / male prisoner and **-$3,363** / female prisoner.

7.4.1.1: Lost productivity of prisoners in paid work

A proportion of offenders were in paid work at the time that they were arrested. For these individuals there is a social cost from the loss of the economic output that would have been produced had they remained in the labour force. Gross domestic product per employee was calculated from current price estimates of GDP for the year to June 2016 from the ABS national accounts and average employment over 2015/16 (Australian Bureau of Statistics, 2019a, d) and is $139,697 in 2015/16 [31].

Unlike the mortality data, this calculation excluded the estimated portion of income flowing to the person using heroin themselves. This is partially because criminal behaviours are not as directly linked to dependence in the way that medical harms are linked, and partially because if they were included, then income would need to be offset against any savings in living expenses for the imprisoned persons, for which

[31] This GDP per worker is slightly different than that used in the recently released report into the social cost of smoking as the ABS has made minor revisions to their estimates of current prices, GDP and employment for 2015/16 since the smoking analysis was completed.

data is not available. The average labour share of GDP over the past 20 years has been 54 percent, and so only 46 percent ($63,933) of the per employee GDP has been included as a cost in this corrections cost calculations.

Data from the 2013/14 Victorian crime statistics (Victoria Police, 2014) indicates that 37 percent of male adult alleged offenders and 17 percent of female adult alleged offenders were in employment when they were arrested (more up to date data on the employment status of alleged offenders does not appear to be available). We have assumed that these employment rates are representative of those arrested for heroin attributable offences. These parameters give an estimated annual loss to economic output of **$23,843** per male prisoner and **$10,684** per female prisoner.

7.4.1.2: Workplace disruption and costs of recruiting replacement employees

Employers face one-off costs to recruit new employees to replace imprisoned workers, and to train those new workers. We have assumed that these costs match the costs estimated by the Bureau of Infrastructure, Transport and Regional Economics for replacing deceased employees, namely $6,422 in 2006 values (Bureau of Infrastructure Transport and Regional Economics, 2009). Converting to 2015/16 values using the change in the CPI (Australian Bureau of Statistics, 2019c) gives a cost per imprisoned employee of $8,119. Applying the employment shares for alleged offenders (37% for males and 17% for females) (Victoria Police, 2014) gives an estimated average cost to employers of replacing imprisoned workers of **$3,017** per male prisoner and **$1,352** per female prisoner.

7.4.1.3: Lost productivity of prisoners in unpaid household work

The estimated value of labour in the household lost due to imprisonment is calculated on the same basis as that lost due to premature mortality (see Chapter 3). Following Collins and Lapsley, production losses in the household sector are valued on an individual function replacement basis using data from the ABS publication Unpaid Work and the Australian Economy 1997 (Australian Bureau of Statistics, 1997; Collins and Lapsley, 2008). The total value of male unpaid labour in the household is estimated at $82 billion in 2007 values and female unpaid labour is valued at $154 billion. Converting these figures to per adult estimates using the population data used in the ABS estimates of the value of unpaid household labour (Australian Bureau of Statistics, 1997) and to 2015/16 values using the CPI (Australian Bureau of Statistics, 2019c) gives values of unpaid household work of **$19,613** per adult male and **$35,016** per adult female.

7.4.1.4: Prison assaults

Data from the Review of Government Services Provision (Steering Committee for the Review of Government Service Provision, 2017a) estimates that in 2015/16, 1.1 percent of prisoners were the victim of a serious assault and 13.6 percent were the victim of an assault, with 0.04 percent of prisoners having committed a serious assault on a prison guard and 1.4 percent having committed an assault on a prison guard.

The estimated cost per assault was taken from Smith et al.'s (2014) estimates of the costs of crime in Australia (see Table 7.10). Serious assaults were assumed to be equivalent to assaults requiring hospitalisation. Other assaults were costed at the average cost of the other assault categories reported in Smith et al. (2014) and weighted based on their relative frequency amongst assaults. For assaults on prisoners, the productivity costs were not included. Medical costs outside of hospital have been excluded for prisoners as it has been assumed that they are included in the overall recurrent costs of prisons.

It is less obvious whether productivity costs should be included for prison guards; to the extent to which these costs are borne directly by the corrections system then they will be included in the overall recurrent operating costs and should not be included in this calculation. However, to the extent they are borne by the employee through unpaid time off, or by workers compensation funds they will not be included in the recurrent costs and should be included in our costing.[32] The estimated cost per assault on prisoners was $26,882 for serious assaults and $1,054 for other assaults, and the costs per assault on a prison guard were $61,852 and $1,751 respectively if productivity costs are included. Applying the relative frequencies to these unit costs, the estimated annual cost per prisoner from prison assaults (both on other prisoners and on prison guards) is **$489**.

7.4.1.5: Reduced government payments (offsetting saving)

Prisoners are not eligible for government income support payments whilst in detention so, to the extent that detainees were unemployed and on benefits at the time of their offence, there will be a cost saving for the Australian Government. We have not been able to identify data on the proportion of offenders who were in receipt of income support benefits at the time of their imprisonment, however the 2013/14 Victorian crime statistics (Victoria Police, 2014) reports that 21 percent of male alleged offenders and 25 percent of female alleged offenders were unemployed at the time of their arrest (with those neither employed nor unemployed being not in the labour force). The annual value of Newstart allowance for singles in 2015/16 was $14,606 (Centrelink, 2015). Assuming that these rates of unemployment are representative of prisoners detained for a heroin attributable offence at the time of their arrest, and that all unemployed alleged offenders were in receipt of Newstart allowance at the time of their offence this gives average offsetting savings of **-$3,082**/male prisoner and **-$3,639**/female prisoner. These estimates are likely to overstate the potential cost savings, as not all of those who are unemployed are eligible for Newstart allowance (in which case there would be no offsetting benefit) and of those eligible some would have a partner who was also in receipt of income support benefits (in which case the cost saving would be the difference between two persons in receipt of the couples Newstart allowance and one person in receipt of the single Newstart allowance which is $9,771). On the other hand at least some unemployed prisoners would have been in receipt of a more generous benefit such as the Disability Support Pension, or be in receipt of other payments such as rent assistance or family tax benefit, and for those individuals the offsetting saving will be underestimated.

7.4.1.6: Aggregated net costs per prisoner

Combining the six sources of cost and offsetting benefit from imprisonment that were able to be quantified gives a total estimated net average annual cost of imprisonment in 2015/16 of $143,721 for male prisoners and $143,801 for female prisoners. It is not known whether the net costs would be higher or lower if all of the unquantifiable costs were able to be quantified.

7.4.2 Estimating the total costs of heroin attributable imprisonment

The estimated total cost of heroin attributable imprisonment in 2015/16 can be estimated from the total number of persons sentenced to custody in 2015/16, the expected duration of their sentences, and the proportion of imprisoned persons whose offending was attributable to heroin (Table 7.5).

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[32] The costs of opioid attributable prison assaults on prison guards should be additional to any workplace costs reported in chapter 6. This is because the attribution of workplace injuries to opioids in chapter 6 is based on the prevalence of opioid use of employees as it is reporting the estimated cost of injuries caused by the opioid use of an employee (whether the injury is to the person who had used the opioid or to one of their colleagues) . The estimate in section 7.4.1.4 is calculating the expected increase in assaults of prison guards due the higher prison population that results from opioid attributable crime, no assumption is made as to whether opioid use has continued in prison.

Data on the number of persons sentenced to custody was taken from the ABS publication 'Criminal Courts, 2015/16' (2017e) using the data on number of persons found guilty and sentenced to 'custody in a correctional institution'. The duration that will be served by those sentenced in 2015/16 cannot be known at this point in time; as a proxy we used the mean time served by offence category for persons who have completed their sentence from the ABS publication 'Prisoners in Australia' (2016f) Heroin attributable persons imprisoned were calculated using the AF derived from the DUMA survey.

Table 7.5: Adult prisoners sentenced in 2015/16, total and heroin attributable by most serious offence category

Most serious offence category	Total persons sentenced to custody	Mean duration of time served (years)	Persons sentenced to custody for a heroin attributable offence		
			Central estimate	low bound	High bound
01 Homicide and related offences	251	15	5.4	3.3	8.8
02 Acts intended to cause injury	11,816	2.0	253.2	153.9	414.2
03 Sexual assault and related offences	1,678	5.8	36.0	21.9	58.8
04 Dangerous or negligent acts endangering persons	2,747	1.5	58.9	35.8	96.3
05 Abduction, harassment and other offences against the person	600	3.6	12.9	7.8	21.0
06 Robbery, extortion and related offences	1,392	3.6	29.8	18.1	48.8
07 Unlawful entry with intent/burglary, break and enter	3,769	2.1	245.0	168.6	352.5
08 Theft and related offences	3,783	1.1	245.9	169.3	353.8
09 Fraud, deception and related offences	1,671	1.9	108.6	74.8	156.3
10 Illicit drug offences	4,451	3.8	195.4	103.6	361.9
11 Prohibited and regulated weapons and explosives offences	1,601	1.9	34.3	20.9	56.1
12 Property damage and environmental pollution	996	2.0	14.6	4.0	51.8
13 Public order offences	654	1.5	14.4	4.0	51.0
14 Traffic and vehicle regulatory offences	2,123	0.6	21.4	5.9	75.4
15 Offences against justice procedures, government security and government operations	3,282	1.2	114.4	74.4	174.6
16 Miscellaneous offences	139	4.5	0.0	0.0	14.9
Total	**40,953**		**1,390.1**	**866.1**	**2,296.5**

Source: ABS, (2016f); AIC DUMA collection 2015/16 [computer file]; calculations by the authors.

The unit cost of imprisonment used was that calculated in Section 7.4.1. This was applied for each year (or fractional year) that a person convicted of that offence would be expected to remain in custody. For instance, each person convicted of homicide the annual costs are incurred for 15 years, for each person convicted of assault the costs are incurred for two years, and so on. Costs arising from lost economic output, and the costs of assaults in prison, increase at the expected nominal rate of growth in GDP per capita, other costs are expected to grow in line with the CPI. This series of future costs are converted to a present value using a real discount rate of 7 percent.

The total estimated cost of heroin attributable imprisonment is **$422.2** million, with a low bound of $257.7 million and a high bound of $710.7 million (Table 7.6). The majority of the costs arise from the costs of operating and maintaining prisons.

Table 7.6: Expected total cost of imprisonment for persons sentenced in 2015/16 for heroin attributable crime, present values

Cost items	Present value of cost, central estimate ($)	Present value of cost, low bound ($)	Present value of cost, high bound ($)
Cost of imprisonment	295,706,745	180,492,981	497,799,909
Value of lost economic output	66,341,635	40,476,448	111,726,086
Additional recruitment costs	8,066,690	4,923,732	13,579,661
Value of lost labour in household	58,860,149	35,926,958	99,086,603
Cost of prison assault	1,414,507	863,021	2,382,174
Offsetting saving in reduced benefit payments	-8,233,492	-5,025,545	-13,860,460
Total net costs	422,156,234	257,657,595	710,713,973

7.4.3 Community based correction costs

The cost of community corrections arising from heroin attributable offences, where the sentence was imposed in 2015/16, was estimated from ABS data on the number of persons sentenced to community service orders (and the average length of the orders) by broad offence type (Australian Bureau of Statistics, 2017e)[33] and data on the total cost of the community corrections system (Steering Committee for the Review of Government Service Provision, 2017a). It was assumed that the cost of a given order was directly proportional to the length of the order, with the average cost per order converted to a per hour cost ($80.99) using the mean number of hours for all orders. The data on the mean duration of community service orders does not include those orders where the most serious offence was 'homicide'. For the purposes of the calculation we have assumed that the mean duration for these orders was the same as for 'Acts intended to cause injury'. This is likely to understate the mean duration of community service orders for persons sentenced for homicide. Data on mean duration is also not available for the most serious offence category 'Miscellaneous offences'. Absent any comparable offence category we have excluded these offences from the cost calculations.

The mean duration data are also based on a smaller sample for orders issued where the most serious offence is 'Acts intended to cause injury'. The ABS records 7,987 persons as having been sentenced to a community service order where this was their most serious offence, however in calculating the mean duration data the ABS only had duration information for 4,130 persons sentenced for this offence category (Australian Bureau of Statistics, 2017e). For the cost calculations we have assumed that community service orders where the duration is not known by the ABS have the same median duration as those whose duration is known. All other most serious offence categories have the same sample size

Attribution to heroin was based on the AF calculated from the DUMA survey with a central estimate of 128,451 hours of community supervision attributable to heroin (Table 7.7). This equates to a cost of **$10.4 million** for heroin attributable community supervision orders in 2015/16 under the central estimate of heroin attribution, with a low bound of $6.3 million and a high bound of $18.0 million.

[33] Note that not all forms of non-custodial orders are included in the ABS statistics. Home detention, probation, good behaviour bonds and suspended sentences are not included. These types of orders generally require minimal administration and supervision, however, so the impact of their omission is reduced.

Table 7.7: Community supervision orders, total and heroin attributable, 2015/16

Most serious offence category	Number of community supervision orders	Mean duration (hours)	Heroin attributable hours central estimate	Heroin attributable hours low bound	Heroin attributable hours high bound
01 Homicide and related offences	15	114.4 [a]	36.8	22.4	60.2
02 Acts intended to cause injury	7,987	114.4 [b]	19,579.6	11,904.1	32,028.2
03 Sexual assault and related offences	562	147.1	1,771.5	1,077.0	2,897.8
04 Dangerous or negligent acts endangering persons	2,352	118.7	5,982.5	3,637.3	9,786.1
05 Abduction, harassment and other offences against the person	680	108.9	1,586.8	964.8	2,595.7
06 Robbery, extortion and related offences	459	178.5	1,755.7	1,067.4	2,871.9
07 Unlawful entry with intent/burglary, break and enter	2,742	110.6	19,712.2	13,568.2	28,366.0
08 Theft and related offences	3,942	84.3	21,600.2	14,867.7	31,082.7
09 Fraud, deception and related offences	1,959	122.3	15,573.1	10,719.2	22,409.7
10 Illicit drug offences	4,023	114.6	20,240.6	10,726.7	37,490.3
11 Prohibited and regulated weapons and explosives offences	1,421	102.6	3,124.2	1,899.5	5,110.5
12 Property damage and environmental pollution	1,724	73.9	1,873.6	515.0	6,629.0
13 Public order offences	1,504	75.2	1,663.2	457.2	5,884.8
14 Traffic and vehicle regulatory offences	3,713	108.3	6,758.3	1,858.3	23,810.5
15 Offences against justice procedures, government security & government operations	2,859	72.2	7,192.3	4,678.9	10,982.4
16 Miscellaneous offences	169	c-	n/a	n/a	n/a
Total hours of community supervision orders	**3,741,100**	**103.6**	**128,451**	**77,964**	**222,006**
Total cost of community supervision orders			**$10,403,815**	**$6,314,640**	**$17,981,308**

Source: RoGS 2017, (ABS 2017b), calculations by the authors.

[a] Duration data is not available for community supervision orders where the most serious offence was homicide; mean duration for 'Acts intended to cause injury' has been used to calculate the cost of this offence category.

[b] Mean duration is for the 4,130 orders where the ABS was able to identify the duration of the order.

[c] Duration data was not available for the most serious offence category 'Miscellaneous offences' and it was excluded from the cost calculations.

7.5 Costs to victims of crime

As well as the costs arising from the investigation of crime, the administration of justice and the corrections system, there are also substantial costs incurred by the victims of crime. Administrative data from police and courts authorities are generally poor guides as to the extent of crime victimisation, as many victims do not report the offence to the police. Nationally, reporting rates in 2015/16 for selected crimes varied widely, ranging from 30 percent for sexual assault to 93 percent for motor vehicle theft (Australian Bureau of Statistics, 2017d).

The most comprehensive assessment of the prevalence of crime victimisation in Australia is provided by the ABS's survey 'Crime Victimisation, Australia' (2017d). The number of persons reporting that they had been a victim of crime (or that their household had been a victim of crime for property offences), by offence type, is set out in Table 7.8. It should be noted that the totals cannot be summed to provide an overall number of persons who have been a victim of crime in the reference year as not all crimes are in scope, and some individuals would have been the victim of more than one type of crime. It is also important to note that not all crimes are included in the survey of crime victimisation and for those types of crime costs to victims cannot be calculated.

Table 7.8: Number of victims of selected crimes, 2015/16

Offence	Number of victims of crime – reported latest incident to police ('000)	Number of victims of crime – did not report latest incident to police ('000)	Total number of victims of selected crimes ('000)
Personal Crimes			
Physical assault	253.6	207.8	462.2
Face-to-face threatened assault	200.9	294.7	492.0
Non face-to-face threatened assault	67.7	116.8	182.3
Robbery	36.5	29.7	70.6
Sexual assault victims aged 18 years or older	23.5	53.0	77.4
Household crimes			
Break and enter	173.3	52.7	225.7
Attempted break and enter	80.9	105.0	185.9
Motor vehicle theft	45.2	4.1	48.6
Theft from a motor vehicle	142.9	120.4	264.4
Malicious property damage	234.3	199.3	434.0
Other theft	99.5	140.3	238.9

Source: ABS, (2017d)

Note: Number of victims of crime, not the number of offences. As some victims of crime will have had more than one occasion in the year in which they were the victim of a particular crime type, these data understate the cost of crime to victims.

Applying the relevant AF to the total number of victims of crime gives the numbers where the crime was attributable to heroin, see Table 7.9. Overall, we estimate that there were 38,600 victims of at least one heroin attributable violent crime in 2015/16, and 69,100 households that were victims of some form of heroin attributable property crime.

Table 7.9: Number of victims of selected heroin attributable crimes, 2015/16

Offence	Number of victims of heroin attributable crime – central estimate ('000)	Number of victims of heroin attributable crime – low bound ('000)	Number of victims of heroin attributable crime – high bound ('000)
Personal Crimes			
Physical assault	9.9	6.0	16.2
Threatened assault	11.6	6.4	17.2
Robbery	1.5	0.9	2.5
Sexual assault victims aged 18 years or older	1.7	1.0	2.7
Household crimes			
Break and enter	14.7	10.1	21.1
Attempted break and enter	12.1	8.3	17.4
Motor vehicle theft	3.2	2.2	4.5
Theft from a motor vehicle	17.2	11.8	24.7
Malicious property damage	6.4	1.8	22.6
Other theft	15.5	10.7	22.3

Source: ABS (2017d)AIC DUMA collection 2015/16 [computer file]; calculations by the authors

Note: Number of victims of crime, not the number of offences. As some victims of crime will have had more than one occasion in the year in which they were the victim of a particular crime type, these data understate the cost of crime to victims

The most comprehensive set of estimates of the costs of crime have been compiled by researchers at the AIC (Smith et al., 2014). Drawing together information from a range of Australian and international sources on the costs of various types of personal and household crime, they distinguish between medical costs, lost output, property loss, property damage, and intangible cost (e.g. pain and suffering). Although not all forms of crime are in scope, the analysis covers the majority of the crime types included in the ABS victims of crime survey.

Costs of the various forms of personal crime are subdivided by the severity of medical impact on the victim, and the number of victims of heroin attributable crime estimated. Table 7.10 has been apportioned between severity categories based on the proportions reported in Smith et al. (2014)

In almost all cases, the parameter values chosen by Smith et al. are consistent with the ranges adopted in comparable international exercises, however the intangible cost estimate adopted for sexual assault is at the lower end of comparable studies (Smith et al., 2014). Smith et al. did not derive a specific estimate for the intangible cost of sexual assault but rather based it on the intangible cost used for assault where the victim was injured, with treatment other than hospitalisation for sexual assault where the victim sustained physical injuries, and assault where the victim was injured and no treatment was required for sexual assault where the victim did not sustain physical injuries (Smith et al., 2014). In contrast, Dolan and colleagues (2005) derive estimates of intangible costs from estimates of the quality of life impact of sexual assault, expressed in terms of disability adjusted life years (DALY) using a value of 0.56 lost DALY for rape and 0.16 lost DALY for other sexual assault. This compared to a lost DALY of 0.19 for assault resulting in serious injury (roughly equivalent to the assault – hospitalised category used by Smith and colleagues (2014)).

As it is more closely aligned to the approach taken to intangible costs in other areas of this report we have used the Dolan et al. (2005) estimates of the intangible costs of sexual assault in place of those derived by Smith et al.(2014).

Unit costs for each cost category were converted to 2015/16 values using the change in current price Gross State Product (GSP) per capita (Australian Bureau of Statistics, 2019a) from June 2011 to June 2016 for intangible costs and lost output, and the CPI for medical costs, property loss and property damage (Australian Bureau of Statistics, 2019c). Table 7.10 sets out the unit costs to victims of personal crime while Table 7.11 reports the unit costs for household crime.

Table 7.10: Unit costs to victims of personal crime converted to 2015/16 values

Personal crime offence	Medical costs ($)	Lost output ($)	Intangible costs ($)
Assault			
Hospitalised	12,699	34,970	14,183
Injured, treatment other than hospital	755	2,923	3,031
Injured no treatment	-	725	725
No injury	-	43	433
Sexual assault			
Injury	1,040	6,929	41,658
No injury	0	57	10,974
Robbery			
Hospitalised	12,699	34,970	13,988
Injured, treatment other than hospital	755	2,923	3,069
Injured no treatment	-	731	725
No injury	-	43	433

Sources: ABS (2019a, c); Smith et al., 2014, Dolan et al. 2005, calculations by the authors

Table 7.11: Unit costs to victims of property crime from Smith et al. converted to 2015/16 values

Personal crime offence	Property loss & property damage ($)	Lost output ($)	Intangible costs ($)
Burglary [a]			
Completed	1,911	87	1,135
Attempted	234	57	756
Motor vehicle theft	4,345	174	2,472
Theft from a vehicle [b]	1,135	63	822
Malicious property damage	621	47	1,346
Other theft	559	10	250

Sources: ABS, (2019a, c); Smith et al., (2014), calculations by the authors

[a] The unit cost used for burglary is that for burglaries of private residences, as we do not have an estimate for the number of victims of burglaries of commercial properties.

[b] These costs are the average for thefts from private and from commercial vehicles.

Applying the unit costs outlined in Tables 7.10 to the central estimate of the number of victims of heroin attributable crime in 2015/16 gives a total estimated cost to victims of personal crime of **$115.0 million** (Table 7.12). Assaults account for 55 percent of the victims of crime costs, with sexual assault accounting for a further 40 percent. The costs of premature deaths due to heroin attributable homicide are not included in these victim of crime cost estimates as they are included in the calculation of heroin attributable mortality (see Chapter 3).

Table 7.12: Central estimate of total costs to victims of heroin attributable personal crimes by offence type and severity, 2015/16

Offence	No. of heroin attributable victims	Medical costs ($)	Lost output ($)	Intangible costs ($)	Total costs ($)
Assault					
Hospitalised	404	5,130,871	14,129,206	5,730,421	24,990,499
Injured, treatment other than hospital	3,493	2,638,382	10,210,204	10,588,359	23,436,944
Injured no treatment	6,007	0	4,357,802	4,357,802	8,715,604
No injury	11,646	0	504,374	5,043,744	5,548,118
Total	21,551	7,769,253	29,201,586	25,720,326	62,691,165
Sexual assault	.	.	.	.	.
Injury	737	766,703	5,108,176	30,710,483	36,585,362
No injury	921	0	52,870	10,110,961	10,163,831
Total	1,659	766,703	5,161,046	40,821,444	46,749,193
Robbery	.	.	.	.	.
Hospitalised	53	672,422	1,851,692	740,677	3,264,791
Injured, treatment other than hospital	207	155,990	603,663	633,846	1,393,500
Injured no treatment	270	0	197,351	195,890	393,241
No injury	983	0	42,586	425,865	468,451
Total	1,513	828,413	2,695,293	1,996,277	5,519,983
All Personal Crime	.	.	.	.	.
Total	**24,722**	**9,364,369**	**37,057,925**	**68,538,047**	**114,960,341**

Sources: ABS (2019a, c); Smith et al., (2014), Dolan et al. (2005),, AIC DUMA collection 2015/16 [computer file]; calculations by the authors.

The costs of heroin attributable property crime shown in Table 7.13 are of a similar order of magnitude, with the central estimate of the total cost $141.0 million. Burglaries (completed and attempted) are the most significant driver of the cost accounting for 42 percent of the total.

Table 7.13: Central estimate of total costs to victims of heroin household crimes in Australia by offence type and severity, 2015/16

Offence	No. of heroin attributable cases	Costs of property loss & property damage ($)	Cost of lost output ($)	Intangible costs ($)	Total costs ($)
Burglary	26,754	30,872,793	1,964,053	25,777,501	58,614,347
Completed	*14,671*	*28,041,892*	*1,270,677*	*16,645,869*	*45,958,437*
Attempted	*12,084*	*2,830,901*	*693,376*	*9,131,633*	*12,655,910*
Motor vehicle theft	3,159	13,726,154	550,650	7,808,288	22,085,092
Theft from a vehicle	17,186	19,510,649	1,079,203	14,122,671	34,712,523
Malicious property damage	6,382	3,960,307	297,132	8,593,336	12,850,775
Other theft	15,529	8,686,975	151,312	3,883,665	12,721,951
Total	**69,010**	**76,756,877**	**4,042,350**	**60,185,461**	**140,984,688**

Sources: ABS (2019a, c); Smith et al., (2014), Dolan et al. (2005), AIC DUMA collection 2015/16 [computer file]; calculations by the authors

Note: values may not sum due to rounding

Tables 7.14 and 7.15 set out the estimated cost of heroin attributable crime if the low bound estimate of the share of crime attributable to heroin is used, and Tables 7.16 and 7.17 show the estimated cost of crime if the high bound estimate for the AF is used.

The plausible range of the costs to victims of heroin attributable violent crime ranges from a low bound of $69.9 million to a high bound of $188.1 million.

Similarly, the plausible range of the costs of heroin attributable property crime ranges from a low bound of $91.7 million to a high bound of $229.9 million.

Table 7.14: Low bound estimate of total costs to victims of heroin attributable personal crimes by offence type and severity, 2015/16

Offence	No. of heroin attributable victims	Medical costs ($)	Cost of lost output ($)	Intangible costs ($)	Total costs ($)
Assault					
Hospitalised	246	3,119,498	8,590,359	3,484,016	15,193,873
Injured, treatment other than hospital	2,124	1,604,099	6,207,661	6,437,574	14,249,334
Injured no treatment	3,652	0	2,649,483	2,649,483	5,298,965
No injury	7,081	0	306,653	3,066,526	3,373,178
Total	**13,103**	**4,723,597**	**17,754,155**	**15,637,598**	**38,115,350**
Sexual assault					
Injury	448	466,145	3,105,699	18,671,543	22,243,387
No injury	560	0	32,144	6,147,323	6,179,467
Total	**1,008**	**466,145**	**3,137,844**	**24,818,866**	**28,422,854**
Robbery					
Hospitalised	32	408,823	1,125,803	450,321	1,984,947
Injured, treatment other than hospital	126	94,840	367,019	385,370	847,228
Injured no treatment	164	0	119,987	119,098	239,085
No injury	598	0	25,892	258,920	284,812
Total	**920**	**503,663**	**1,638,700**	**1,213,709**	**3,356,072**
All Personal Crimes	**15,031**	**5,693,405**	**22,530,699**	**41,670,172**	**69,894,276**

Sources: ABS (2019a, c); Smith et al., (2014), Dolan et al. (2005),; AIC DUMA collection 2015/16 [computer file]; calculations by the authors

Table 7.15: Low bound estimate of total costs to victims of heroin household crimes in Australia by offence type and severity, 2015/16

Offence	No. of heroin attributable cases	Costs of property loss & property damage ($)	Cost of lost output ($)	Intangible costs ($)	Total costs ($)
Burglary	18,415	21,250,210	1,351,887	17,743,044	40,345,141
Completed	*10,098*	*19,301,658*	*874,626*	*11,457,603*	*31,633,887*
Attempted	*8,317*	*1,948,552*	*477,261*	*6,285,441*	*8,711,254*
Motor vehicle theft	2,174	9,447,919	379,021	5,374,562	15,201,503
Theft from a vehicle	11,829	13,429,474	742,832	9,720,848	23,893,154
Malicious property damage	1,754	1,088,566	81,672	2,362,042	3,532,280
Other theft	10,689	5,979,376	104,150	2,673,185	8,756,711
Total	**44,861.8**	**51,195,545**	**2,659,562**	**37,873,681**	**91,728,788**

Sources: ABS (2019a, c); Smith et al., (2014), Dolan et al. (2005); AIC DUMA collection 2015/16 [computer file]; calculations by the authors

Table 7.16: High bound estimate of total costs to victims of heroin attributable personal crimes by offence type and severity, 2015/16

Offence	No. of heroin attributable victims	Medical costs ($)	Cost of lost output ($)	Intangible costs ($)	Total costs ($)
Assault					
Hospitalised	661	8,393,068	23,112,525	9,373,811	40,879,404
Injured, treatment other than hospital	5,713	4,315,859	16,701,829	17,320,415	38,338,103
Injured no treatment	9,827	0	7,128,483	7,128,483	14,256,966
No injury	19,051	0	825,055	8,250,545	9,075,600
Total	**35,253**	**12,708,927**	**47,767,892**	**42,073,254**	**102,550,073**
Sexual assault	.	.	.	.	.
Injury	1,206	1,254,172	8,355,943	50,236,141	59,846,256
No injury	1,507	0	86,485	16,539,488	16,625,973
Total	**2,713**	**1,254,172**	**8,442,428**	**66,775,630**	**76,472,229**
Robbery					.
Hospitalised	87	1,099,947	3,028,994	1,211,598	5,340,538
Injured, treatment other than hospital	338	255,169	987,471	1,036,844	2,279,484
Injured no treatment	442	0	322,827	320,436	643,263
No injury	1,609	0	69,663	696,628	766,291
Total	**2,475**	**1,355,116**	**4,408,954**	**3,265,506**	**9,029,576**
All Personal Crimes	**40,440**	**15,318,215**	**60,619,274**	**112,114,390**	**188,051,878**

Sources: ABS (2019a, c); Smith et al., (2014), Dolan et al. (2005), AIC DUMA collection 2015/16 [computer file]; calculations by the authors

Table 7.17: High bound estimate of total costs to victims of heroin household crimes in Australia by offence type and severity, 2015/16

Offence	No. of heroin attributable cases	Costs of property loss & property damage ($)	Cost of lost output ($)	Intangible costs ($)	Total costs ($)
Burglary	38,499	44,426,050	2,826,279	37,093,909	84,346,239
Completed	*21,111*	*40,352,375*	*1,828,508*	*23,953,460*	*66,134,343*
Attempted	*17,388*	*4,073,676*	*997,771*	*13,140,450*	*18,211,896*
Motor vehicle theft	4,546	19,751,981	792,387	11,236,152	31,780,520
Theft from a vehicle	24,731	28,075,888	1,552,976	20,322,570	49,951,435
Malicious property damage	22,582	14,012,189	1,051,300	30,404,577	45,468,066
Other theft	22,346	12,500,585	217,738	5,588,607	18,306,930
Total	**112,703**	**118,766,694**	**6,440,681**	**104,645,815**	**229,853,190**

Sources: ABS (2019a, c); Smith et al., (2014), Dolan et al. (2005), AIC DUMA collection 2015/16 [computer file]; calculations by the authors

7.6 Conclusions

This investigation has provided estimates of heroin attributable crime costs among adults in Australia during the 2015/16 financial year. The cost estimates are summarised in Table 7.18. A feature of this research was that it used the DUMA survey conducted in several police commands in Australia to obtain estimates of the extent to which inmates arrested for different offence types attributed their arrest to having used heroin recently. Overall, the heroin attributable percentages were very low, with only 3.4% of all detainees attributing their arrest to heroin. This heroin attribution did vary by the most serious offence, and was higher for those with property offences (4.4%) and illicit drug offences (4.4%). These heroin attributions were then applied to range of different national crime statistics reported by the Australian Bureau of Statistics for 2015/16 (2017d, e, f, g)

Table 7.18: Summary of heroin attributable crime costs, 2015/16

Cost area	Central estimate ($)	Low bound ($)	High bound ($)
Police (Table 7.3)	202,586,394	113,634,904	523,024,002
Court (Table 7.4)	24,471,841	14,027,982	46,615,535
Legal Aid	8,796,892	5,042,639	16,756,886
Public Prosecutors	11,710,075	6,712,561	22,306,103
Prisoners sentenced (Table 7.6)	422,156,234	257,657,595	710,713,973
Community correction (Table 7.7)	10,403,815	6,314,640	17,981,308
Personal crime victim (Tables 7.12, 7.14, 7.16)	114,960,341	69,894,276	188,051,878
Household crime victim (Tables 7.13, 7.15, 7.17)	140,984,688	91,728,788	229,853,190
Total	**936,070,281**	**565,013,385**	**1,755,302,874**

The heroin attributable cost of police dealing with adult offenders was $202.6 million. This attributable cost was particularly high for property offenders ($73.1 million). For adult offender matters finalised in Higher and Magistrates courts the total heroin attributable court costs was $24.5 million. The effect of heroin attribution was also examined for legal aid costs and the costs of public prosecutors. For legal aid the heroin attributable cost was $8.6 million and for public prosecutors it was $11.7 million. Correction system costs were examined by firstly looking at costs of prisoners sentenced during 2015/16 and secondly looking at community based correction costs. The heroin attributable costs of prisoners sentenced during 2015/16 was $422.2 million. The heroin attributable community correction costs was $10.4 million during the same 12-month period.

Costs related to victims of personal crime and of household crime were also examined for 2015/16. Heroin-attributable personal crimes were $115.0 million while heroin attributable household crimes were $141.0 million. Summing across the eight cost areas shown in Table 7.18 the central estimate of heroin attributable crime was $936.1 million. The low bound costs for this was $565.0 million and the high bound cost was $1,755.3 million.

7.7 Limitations

The findings of this analysis are markedly different from those of Moore (2007) who reported the cost of heroin attributable crime as $1.74 billion in 2004 (without adjusting for inflation). The main driver for this difference is in the allocation of costs. Moore drew on the analysis by Mayhew (2003) where the cost of crimes included the value of property loss from economic crime, which are typically excluded from economic studies, as they represent a transfer (these are about 1/3 of the costs of crime in Moore). This different approach more than offsets the lower costs of violent crime in Mayhew compared with a combination of medical costs increasing at a rate greater than inflation and the wider range (and higher value) of intangible costs in our current study. This is amplified by the fact that in 2005, a greater proportion of crime was for property offences, representing 22.2 percent of offences (Moore, 2007, Table A2.2), whereas in the current analysis it was 18.5 percent (Australian Institute of Criminology, 2019). Almost all of the cost of heroin attributable crime was from property crime, which accounted for $1.579 billion out of $1.743 billion (90.6%) (Moore, 2007). In the current analysis, property crime accounted for approximately $387.0 million[34] out of $923.4 million (41.9%).

There have also been changes to attribution in the DUMA data, but these seem likely to only be a minor factor. Allocation between drugs was based on a the proportion of drug consumption episodes for each substance summed across the sample, but with cannabis weighted at half for economic crime and excluded from non-economic crime e.g. if the 3,500 respondents had taken drugs other than cannabis an average of 10 times each over the sample period (e.g. denominator = 35,000) and there were a total of 3,500 episodes of heroin consumption then heroin would be allocated 10 percent of the costs of drug attributable non-economic crime.

There are important limitations to the current investigation. Firstly, it relied on the DUMA surveys of detainees to obtain estimates of the attributable role of heroin across different types of crime. The DUMA survey is currently only conducted in five police commands across Australia and as discussed above, the detainees' survey may be quite different in terms of their illicit substance use and involvement in incidents of crime to other people in Australia. The second limitation is that the DUMA survey did not obtain attribution information from detainees who had used other opioids, such as buprenorphine, methadone, oxycodone or morphine extra medically. A third limitation is that costs associated with drug court were not separately investigated, but were included in total court costs.

[34] Not reported in the results: calculated from tables 7.3, 7.4, 7.5, 7.7, 7.12, 7.13 plus Legal aid and DPP fraction

It should be noted that the costs associated with the administration of juvenile justice (e.g. police time, the Children's court, juvenile detention) have not been included, as detailed earlier. Similarly, we have not included costs arising from prosecutions occurring in the Federal courts. Although, this would likely entail few cases, prosecutions involving the international importation of drugs could be complex and time consuming. In common with other sections of this report, the issue of poly-substance use is problematic in attempting to assign costs specifically to heroin, although the approach used by the AIC attempts to attribute offending to individual substances based on the offender's self-assessment.

As detailed in section 7.4.1, a number of the potential costs of imprisonment arising from heroin attributable crime, and a number of the potentially offsetting cost savings of imprisonment, cannot be reliably quantified or costed.

Costs that were not able to be included in the cost of imprisonment calculation include:

- Lost potential lifetime economic output as ex-prisoners have a lower employment participation rate post release;
- Increased risk of homelessness post release;
- Additional government payments as a result of household income falling due to imprisonment of a member of the household who was in work;
- Health impacts of imprisonment such as transmission of BBV;
- Cost of out of home care for children whose custodial parent is imprisoned and who cannot be placed with another member of the immediate family; and,
- Childcare and parenting support costs.

Potential offsetting savings arising from imprisonment for heroin attributable offences that were not able to quantify in the cost calculation were:

- Incapacitation effect of imprisonment (e.g. it is more difficult for imprisoned offenders to commit additional crime (excluding prison assaults));
- Value of work completed in prison;
- Reduction in illicit drug use by prisoners (this is potentially ambiguous as although the prevalence of heroin use would be expected to fall for persons imprisoned for a heroin attributable offence, the harm per person using heroin may well be higher, for example through increased sharing of needles);
- Reduction in alcohol use (and therefore associated harms) by prisoners; and,
- Reduction in access to welfare services by prisoners.

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CHAPTER 8: ROAD TRAFFIC ACCIDENTS

Steve Whetton & Tania Dey

8.1 Opioid use and road crashes

There are numerous licit and illicit substances that can impair driving ability and as such are likely to increase the rate at which road traffic accidents occur. The increase in risk arises from: impairment to the cognitive and psychomotor skills necessary to drive safely for example reductions in attentiveness; poor judgement and increased impulsiveness; reduced lane control, increased reaction times; and, other impairments to fine and gross motor skills (Drummer et al., 2004; Verstraete and Legrand, 2014). Evidence from crash studies suggests that alcohol and cannabis are the substances that contribute to the greatest number of road crash fatalities and hospitalisations, due to their greater population prevalence and also to the nature of their effect on cognitive and psychomotor skills (Ch'ng et al., 2007; Drummer et al., 2003; Verstraete and Legrand, 2014).

In the case of opioids, the evidence on road crash risk is somewhat mixed. Controlled task analysis (i.e. driving simulations and similar tests) of the acute effects of opioids suggest no, or only small impacts, on most of the relevant cognitive and psychomotor skills at the doses administered in the tests (typically between 2.5 mg and 17.5 mg morphine per 70 kg body weight; (Verstraete and Legrand, 2014). At dosages above 10 mg morphine per 70 kg of body weight, impairments have been observed and typically follow a dose response relationship (Hill and Zacny, 2000).

Epidemiological studies do generally identify an increased risk of fatal and non-fatal crash where opioid metabolites are detected in the blood, but these increases in risk are in many cases not statistically significant at the conventional level of 95% confidence intervals. Studies identifying a statistically significant increase in risk include: Chihuri and Li (2019) (odds ratio (OR) 2.18, 95% CI 1.91 – 2.48) and Martin et al. (2017) (OR 2.2, 95% CI 1.06 – 4.61). Studies that identified an increase in risk as their central estimate, but where the increase in risk was not statistically significant, include: Drummer and colleagues (2003), (OR 1.41, 95% CI 0.7 – 2.9); Movig and colleagues (2004) (OR 2.35, 95% CI 0.87 – 6.32); and, Palamara and colleagues (2014) (OR 1.18, 95% CI 0.70 – 1.98). Drummer and colleagues (2003) note that the wide confidence intervals of the OR estimates frequently result in the lack of statistical significance for opioid intoxication as a causal factor for road crashes. This is most likely an effect of the small samples of opioid only cases (most of the epidemiological studies exclude polysubstance cases from their analysis) rather than an actual lack of an increase in risk (Drummer et al., 2003). The risk may also vary depending on the level of physiological tolerance that the person has to the drug.

The evidence for persistent impacts from heroin dependence is much stronger. Persons with heroin dependence exhibit a range of cognitive and psychomotor deficits that can increase the risk of road crashes (e.g., impaired executive function, reaction times, time perception, special working memory, pattern recognition memory, and right-left discrimination with some of the impairments persisting up to a year after the last use of heroin) (Aleksandrov, 2004; Bryun et al., 2001; Liu et al., 2005; Liu et al., 2006; Lyvers and Yakimoff, 2003; Ornstein et al., 2000; Pau et al., 2002; Verdejo et al., 2004). Larney et al. (2019) found that the RR for fatal accidents for persons with extra-medical opioid dependence was 7.35 (95% CI 4.69 – 11.51).

As the evidence of a role for opioid dependence in road crash risks is more robust than that for acute use, this analysis focuses on road crashes attributable to persons with opioid dependence. This may well understate the role of opioids in road crashes, given that acute opioid exposure appears to increase risk, but the evidence for the role of acute exposure is not yet sufficiently robust to include in the analysis.

In road crashes, it is the substance use status of the culpable road users that is of most interest. There will be some occasions when intoxication by pedestrians or others road uses can increase the risk of death or injury, but by focusing on the substance use status of the culpable driver, the potential for error in attribution is reduced. Age group and gender specific AF were calculated from the RR estimate from Larney et al. (2019). The estimated prevalence of persons who are dependent on opioids by age group was obtained from the GBD study (Global Burden of Disease Collaborative Network, 2018). These were then weighted by the proportion of accidents where a person in that age group was culpable, as assessed by Drummer and colleagues (2003). This population AF (Table 8.1) has also been used to calculate the opioid attributable premature deaths and hospital separations arising from road crashes, see sections 3.3.2 and 4.3.4.

Table 8.1: Opioid attributable fractions for road crashes

Factor	0-17 years	18-25 years	26-29 years	30-39 years	40-59 years	60+ years	All ages [a]
AF, central estimate	0.048	0.048	0.048	0.048	0.018	0.009	0.037
AF, low bound	0.024	0.024	0.024	0.024	0.009	0.004	0.018
AF, high bound	0.089	0.089	0.089	0.089	0.036	0.019	0.070
Share of accidents where a road used of this age group was culpable (%)	3.5	33.6	11.8	18.5	18.7	13.8	99.9 [b]

[a] The attributable fraction is weighted for all ages.

[b] The percentage does not tally to 100% due to rounding.

8.2 Road crash frequency, 2015/16

The frequency of road crashes can be difficult to quantify, as lower severity crashes are underreported because they do not have to be reported to police. There are also differences in the way in which transport crashes are classified between different jurisdictions, even for serious accidents Australian states and territories use varied definitions of what constitutes a serious accident. The two reliable and consistent forms of data on road crash frequency (and transport accidents more broadly) are deaths arising from road crashes and hospital separations caused by road crashes.

The most recent comprehensive assessment of road crash frequency and costs, including quantification of accident frequency by severity, was undertaken by the Bureau of Infrastructure, Transport and Regional Economics (BITRE) in 2009 with a reference year of 2006 (Bureau of Infrastructure Transport and Regional Economics, 2009). BITRE estimated the total number of crashes in the reference year by applying estimates of the proportion of unreported crashes by severity to data provided by state and territory governments on the number of reported road crashes.

There were 1,602 deaths as a result of road crashes in 2006, with a further 31,204 persons admitted to hospital, 216,500 persons who were injured but did not need to be admitted to hospital, and 438,700 crashes in which no persons were injured (Bureau of Infrastructure Transport and Regional Economics, 2009).

Table 8.2: Estimated number of road crashes resulting in injury by severity of injury, 2006

Severity level	Number of crashes	Number of persons injured by severity	Number of vehicles involved
Fatalities	1,455	1,602	1,886
Hospitalised	25,498	31,204	n/a[a]
Not hospitalised injury	188,200	216,500	n/a
All crashes resulting in injury			428,643[a]
Non-injury crash	438,700	-	715,862
Total	**653,853**	**249,306**	**1,146,391**

Source: (Bureau of Infrastructure Transport and Regional Economics, 2009), pp. 10, 13, 14.
[a] Data on the number of vehicles involved crashes resulting in injuries do not disaggregate crashed resulting in hospitalised injuries and those which resulting in injuries that did not require hospitalisation.

Data on the number of fatal road crashes in 2015/16 were taken from the national road fatalities database (Bureau of Infrastructure Transport and Regional Economics, 2019). Data on hospital separations attributable to road crashes were sourced from an analysis of the AIHW NHMD (Chrzanowska, 2019, *personal communication*) (Table 8.2). More recent estimates are not available for the number of road crash accidents whose consequences are less severe than hospitalisation. We have assumed that the number of other accidents have increased by 17.5 percent, the same rate as land transport accident hospital separations over the period, which increased from 52,286 in 2005/06 (Pointer, 2018) to 61,454 in 2015/16 (Pointer, 2019). This rate of increase roughly reflects the increase in population over this period (Table 8.3).[35]

Table 8.3: Estimated road crash frequency by severity, 2015/16

Severity level	Injuries by severity	Estimated opioid attributable
Fatalities [a]	1,269	46.9
Hospitalised injuries [a]	44,017	1,628.0
Not hospitalised injuries [a]	254,476	9,411.8
Non-injury crashes [b]	515,653	19,071.5

Sources: (Bureau of Infrastructure Transport and Regional Economics, 2009) pp. 10, 13, 14, Chrzanowska, 2019, *personal communication.* [a] Number of injuries: [b] Number of crashes

Applying the population opioid AF for road crashes to the severity categories suggests that there were 47 premature deaths, and 1,628 hospital separations caused by opioid attributable road crashes in 2015/16.

8.3 Costs of road crash accidents

There is a range of harms and costs that can arise from transport accidents including:

- Premature mortality;
- Hospital separations;
- Permanent disability;
- Non-hospitalised injuries;
- Damage to property; and,
- Costs of insurance administration.

[35] Over the same period ***road crash*** hospitalisations increased from 31,204 to 44,007; an increase of 44%. It is not clear why road crash hospitalisations increased at a much faster rate than overall transport accident hospitalisations; however as we cannot rule out changes in coding practices we have used the more conservative change in transport accidents rather than the change in road crashes.

The tangible and intangible costs of premature mortality due to opioid attributable transport accidents are included in the broader estimates of premature mortality costs (see Chapter 3). The impact on hospital separations and other medical costs arising from opioid attributable road crashes are included in Chapters 4 and 5 respectively. Quantification of the costs of other road crash related harms is undertaken in this chapter.

There are two broad approaches that could be taken to estimating the impacts of long-term injuries and medical treatment resulting from road crashes: (1) calculating the costs of each specific form of harm individually (e.g. outpatient medical care, and where the injury was severe enough to result in long-term impairment, lost lifetime output in the workplace, lifetime value of lost household labour, modifications to dwellings and vehicles to adjust for impairment, and long-term care costs over the lifetime); or, (2) using compensation payments for injuries where long-term costs are 'capitalised' into a single lump sum payment in the study year.

The former approach will result in estimates that are consistent with the valuation of other forms of cost in this study (e.g. consistent valuation of workplace and household labour, of QALY) and as such has much to recommend it. However, using the value of compensation payments has the advantages of avoiding any uncertainty of the expected years of life remaining after a road crash resulting in a severe impairment and giving a cost that is incurred entirely in the study year. This approach may, however, understate the intangible costs relative to society's willingness to pay to avoid them. Therefore, we will use the compensation payments approach to calculate the low bound of costs (Section 8.3.2.1), and the specific costs based approach to calculate the high bound (Section 8.3.2.2) and use the average of the two approaches as the central estimate.

8.3.1 Property damage caused by opioid attributable road crashes

The BITRE (2009) estimated that property damage resulting from road crashes cost Australia $3.9 billion in 2006. Converting this to 2015/16 values using the CPI (Australian Bureau of Statistics, 2019c) and dividing by the estimated number of road crashes in 2006, gives an estimated average property damage per road crash of $4,269.90 in 2015/16 .

Our central estimate is that there were 28,626 opioid attributable road crashes in 2015/16 (low bound 11,908, high bound 45,532), giving an estimated cost of property damage of **$122.2 million** ($50.8 million to $194.4 million) (see summary Table 8.6).

The costs of insurance administration for claims related to road accidents were estimated by BITRE to be $257.5 million in 2006, with legal actions costing a further $231.3 million (Bureau of Infrastructure Transport and Regional Economics, 2009). Combining these two cost items, converting them to 2015/16 values using the CPI (Australian Bureau of Statistics, 2019c), and dividing by the estimated number of road crashes in 2006 gives a per crash estimate of $945. Multiplying by the estimated number of opioid attributable road crashes gives a central estimate of insurance administration and legal costs of **$27.1 million** (low bound $11.3 million, high bound $43.0 million).

Finally, BITRE (2009) estimated that road crash injuries created workplace disruption costs (including temporary replacement costs for temporarily impaired workers, and the costs of recruitment and training to replace those unable to return to their previous employment) to employers of $77.7 million in 2006. Converting this to 2015/16 values using the change in the CPI (Australian Bureau of Statistics, 2019c), and dividing by the estimated number of road crashes in 2006, gives an estimated average property damage per road crash of $88 in 2015/16. Multiplying by the estimated number of opioid attributable road crashes gives a central estimate of the cost of workplace disruption to employers of **$2.4 million** (low bound $1.0 million, high bound $3.9 million).

8.3.2 Long-term costs of road crash injuries

We used two approaches in estimating the long-term costs of road crash injuries. These formed the low and high bounds of our estimate, with the mean of the two approaches being our central estimate of long-term costs.

8.3.2.1 Compensation paid approach (low bound estimate)

The low bound approach to estimating the Long-term costs of road crash injuries makes use of compensation payments made by third party insurance providers.

The Transport Accident Commission (the Victorian provider of third party injury insurance) paid out $1.2 billion in compensation in 2015/16 (Transport Accident Commission, 2016). Victoria on average accounted for 22 percent of road crash fatalities in 2015 and 2016 (Bureau of Infrastructure Transport and Regional Economics, 2017), which implies national costs of $5.6 billion.

Applying our central estimate of the proportion of road crashes attributable to opioids gives an estimate of compensation awarded for long-term injuries arising from opioid attributbale road crash costs of **$207.2 million** (low bound $102.0 million, high bound $390.1 million).

8.3.2.2 Long-term care costs approach (high bound estimate)

The BITRE (2009) estimated that serious injury road crashes will lead to some degree of permanent impairment in around 15 percent of cases, with the degree of permanent impairment varying significantly from 'profound limitations' (2.2% of serious injury accidents) to 'mild limitations' (4.9% of serious injury accidents).

Applying these frequencies to the estimated 44,017 road crash hospital separations in 2015/16 suggests just over 6,500 persons would be expected to have an on-going impairment due to road crashes injuries.

Average unit costs of disability by severity are taken from BITRE (2009) and these, updated to 2015/16 values using the CPI (Australian Bureau of Statistics, 2019c) are shown in Table 8.4.

Table 8.4: Estimated unit costs of equipment and care costs due to permanent impairment from road crash injuries, 2015/16

Severity of impairment	Equipment purchase & dwelling modification (one-off) $	Care costs (annual) $	Equipment maintenance (annual) $	On-going medical (annual) $
Profound limitations	49,966.1	271,591.2	1,169.4	7,136.8
Severe limitations	49,966.1	72,185.7	1,169.4	7,136.8
Moderate limitations	18,129.5	22,795.5	424.3	4,282.1
Mild limitations	9,064.7	0.0	212.2	2,569.2

Source: Bureau of Infrastructure Transport and Regional Economics, (2009), Australian Bureau of Statistics, 2019c.

These unit cost estimates were multiplied by the estimated number of impairments of the relevant severity from opioid attributable road crashes and, where costs extend into the future, discounted back to 2015/16 terms using the Australian Government's recommended discount rate of 7 percent. This gives a present value of equipment and care costs of **$239.1 million** (low bound $118.5 million, high bound $448.9 million). Table 8.5 includes the costs for each of these components: equipment, support workers and medical costs.

In addition to these costs relating to dealing specifically with the impairment arising from road crashes, disabilities also impact on the probability of employment. The extent of the impact on employment will vary depending on the severity of the impairment, and the extent to which the injured individual's form of employment (or skill set and aptitudes) are amenable to modification to adjust for the impairment. Estimates presented by BITRE suggest that the reduction in employment probability ranges from 95 percent for those with profound limitations to a 30 percent reduction in the probability of employment for those with mild limitations (Bureau of Infrastructure Transport and Regional Economics, 2019).

Data on the estimated age at the point of injury, expected years of working life for that age group and gender, and the estimated reduction in the probability of employment were used to develop estimates of the (discounted) years of working life lost due to impairment resulting from opioid attributable road crashes. The central estimate was a (discounted) loss of 1,293 years of expected working life (low bound 451, high bound 1,726). Using the same approach as in the premature mortality calculations, each discounted year of working life lost was valued at $139,697, giving a total impact of years of life lost to impairment of **$180.6 million** (low bound $63.1 million, high bound $241.1 million).

Permanent impairment also reduces the potential for individuals to contribute to unpaid household labour. It was assumed that the impact of impairment on the ability to contribute (unadjusted for labour force status) was used as the basis for the calculation, giving an estimated (discounted) number of years of household labour lost due to opioid attributable impairment of 1,297 (low bound 453, high bound 1,731). This was valued following the same approach as was used for the premature mortality calculation, valuing each year of household chores at $19,685 for males and $35,146 for females. Applying this to the estimated (discounted) number of years of chores lost gives an estimated cost of **$30.9 million** (low bound $10.8 million, high bound $41.2 million).

As shown in Table 8.5, the central estimate for the lifetime care costs approach for estimating the long-term costs arising from opioid attributable road crashes is **$450.6** million (low bound $192.3 million, high bound $731.3 million).

Table 8.5: Estimated total long-term costs, lifetime care approach

Cost domains	Central estimate ($'million)	Low bound ($'million)	High bound ($'million)
Equipment costs	7.2	4.3	12.3
On-going support worker costs	217.5	107.1	409.6
On-going medical costs	14.4	7.1	27.1
Lost economic output from reduced employment	180.6	63.1	241.1
Lost value of household labour	30.9	10.8	41.2
Total	**450.6**	**192.3**	**731.3**

Central estimate of long-term costs

The compensation paid approach gives a low bound estimate of these costs of $207.2 million (the central estimate of that approach). The calculation approach based on the disaggregated lifetime are costs gives an upper bound of $450.6 million (the central estimate of that approach). Taking the mean of the two approaches gives a central estimate of long-term care costs of **$328.9** million.

8.4 Conclusion

Opioid use has a small, but meaningful impact on road crash risk. The evidence is strongest for opioid dependence, which is estimated to cause around 3.7 percent of road crashes (low bound 1.8%, high bound 7.0%). There is evidence that opioid use by persons who are not dependent also increase road crash risks, in which case these are underestimated, however at this point in time the evidence is insufficient to justify the inclusion of opioid use more broadly.

The costs arising from premature deaths, and hospital separations, from road crashes attributable to opioid dependence are set out in Chapters 3 and 4 respectively. The other costs of opioid attributable road crashes are estimated to have cost society $480.6 million in 2015/16 (low bound $270.3 million, high bound $692.0 million). The most significant contribution to these costs comes from the long-term costs of impairment resulting from road crashes ($328.9 million) followed by the cost of property damage $122.2 million (Table 8.6).

Table 8.6: Opioid attributable road crash cost summary

Cost domains	Central estimate ($)	Low bound ($)	High bound ($)
Premature mortality	a	a	a
Hospital separations	b	b	b
Costs of property damage	122,230,669	50,847,847	194,416,161
Costs of insurance administration and legal costs	27,053,502	11,254,232	43,030,428
Costs of workplace disruption	2,429,842	1,010,812	3,864,829
Long-term costs (average of approaches)	328,910,711	207,181,126	450,640,296
Total road crash costs not included elsewhere	**480,624,725**	**270,294,018**	**691,951,715**

[a] Estimated in Chapter 3: [b] Estimated in Chapter 4.

Note: In the text we also report the low and high bound estimates associated with the items that contribute to the long-term estimate. These are not included in Table 8.5

8.5 Limitations

Due to data limitations the impact of extra-medical opioid use on road crash risk was calculated based on a meta-analysis of the excess rate of road crashes amongst persons dependent on extra-medical opioids (Larney et al., 2019). Ideally the analysis would instead make use of RR for road crash accidents (either for persons dependent on opioids or persons who had consumed extra-medical opioids prior to driving) and population specific data on the prevalence of driving amongst persons depending on opioids or persons who had recently used extra-medical opioids.

There is also a significant data limitation with respect to the impact on road crash risk of those who consume extra-medical opioids, but who are not dependent on them, as the sample sizes of persons testing positive to metabolites of opioids in road crash studies to date have been too small to make statistically significant conclusions as to whether road crash risks are higher. For example, Drummer and colleagues (2003b) had only 59 cases in their sample of culpable drivers who tested positive to opioids and did not test positive to another substance of interest. As such, although they found an odds ratio of 1.41 for drivers who tested positive to opioids only, the confidence interval for this estimate was 0.7 to 2.9 and it is not possible to say with confidence given the small sample size whether there was a genuine increase in risk or whether it was random variation in the sample.

CHAPTER 9: TENTATIVE ESTIMATE OF HARMS TO RESIDENT OTHERS

Robert J. Tait & Steve Whetton

9.1 Background

Depending on the perspective that they adopt, social cost studies can include costs incurred by anyone affected by another person's actions, such as substance use. While there is growing research on the harms to other people from alcohol use (Callinan et al., 2016; Laslett et al., 2011; Nayak et al., 2019), there has been less research on the impacts of illicit drugs. Affected family members, especially parents, partners and children living with a person with extra-medical opioid dependence may experience intangible costs through reduced quality of life and may also incur tangible costs. Many of the issues impacting quality of life can be similar across different drug use disorders and may include: violence; emotional abuse; impaired mental wellbeing; increased ill-health; diminished family relationships; and, alienation from friends and the wider community (Orford, 2015; Orford et al., 2013). There may also be costs through lost wages in caring for the person with drug dependence and, in some cases theft from the household. Among those with illicit drug use disorders, there are also potential family concerns about criminal activity and exposure to criminal networks and legal repercussions.

While drug use disorders *per se* are not causal or always predictive of child neglect, (influenced, for example, by quality of care), drug use disorders and dependence are associated with increased risk of neglect and abuse after controlling for other social and demographic characteristics, with the potential for long-term consequences (Chaffin et al., 1996; Leijdesdorff et al., 2017). In 2007, the cost of child abuse and neglect in Australia was estimated range from \$10.7 billion to \$30.1 billion, with the incident cost of those first abused in 2007 for their lifetime being \$13.7 billion to \$38.7 billion (Taylor et al., 2008). While the experience of children living with a substance using parent has similarities to those of an adult in terms of increased risk of distress and mental and physical health consequences, there may be further unique harms in terms of hurt, shame and embarrassment, early caring responsibilities, and in more severe cases, through family break-down (Arria et al., 2012; Orford, 2015). Child protection system costs are explored in chapter 11, with this chapter focussed on intangible costs.

As previously reported, the attempt to quantify the harms and costs to other people from illicit drug use are still in their formative stage, and there do not yet appear to be an agreed set of parameters to be used in their estimation (Whetton et al., 2016). Further, even determining the number of partners, other adults or children living with a person dependent on illicit drugs is subject to considerable uncertainly, without considering the broader range of people affected outside the household (Whetton et al., 2016). Finally, some of the intangible costs to those resident with a person who is dependent on opioids may be included in other cost calculations in this report, such as the estimated intangible cost to victims of crime. This creates the potential for a degree of double counting if harms to others are included in the core cost calculations.

9.2 Number of people resident with a person dependent on extra medical opioids

The best estimate of the number of persons dependent on illicit opioids in Australia is provided in the GBD study (Global Burden of Disease Collaborative Network, 2018) with a central estimate of 104,026 and range of 89,484 to 120,196. These latter figures were used in calculating the low and high bound costs. However, these data do not include information on the household of the person dependent on opioids. The NDSHS (Australian Institute of Health and Welfare, 2017i) does include data on the household situation of its respondents, including resident dependent children, but does not directly capture the number of persons dependent on opioids. What it does collect is the frequency of use, which we used as a proxy measure for dependence. Whilst using opioids 'daily' or 'at least weekly' is not the same as dependence, the two populations overlap substantially, but notably the estimate of frequent use is almost twice as high as the GBD estimate of persons who are dependent on opioids (see Section 2.4.1). Therefore, in assessing the number of children and other residents living with a person who was dependent on opioids, we had to draw on the NDSHS data for estimates of household structure, but the estimated population of persons who are dependent on opioids is from the GBD.

We used these two datasets to estimate the number of persons living with an individual who was dependent on opioids in a two-stage process. First, ten-year age-group and gender specific estimates of the average number of dependent children[36], the average number of resident partners, and the average total number of persons resident with a person who uses extra-medical opioids 'at least weekly' were calculated from the NDSHS. These 'per person who uses extra-medical opioids frequently' averages were then applied to the gender and ten-year age-group estimates of the total number of persons dependent on opioids from the GBD. The number of children resident may be underestimated using this approach as the NDSHS records the number of children as 0, 1, 2, or 3+; we coded the latter category as 3 children.

These estimated numbers of co-residents are shown in Table 9.1. Based on the central estimate of the number of persons who are dependent on opioids, we estimate that there are about 70,000 children, 41,000 partners and 160,000 others who are living with a person dependent on opioids.

Table 9.1: Estimated number of persons co-resident with a person who is dependent on opioids

Estimate of persons dependent on opioids	Dependent children	Partners	Other co-residents
Central estimate	69,969	41,274	160,166
Low bound	53,956	31,742	122,953
High bound	88,435	52,488	203,182

9.3 Quantifying the impact on household members

While it is generally agreed that there are potentially substantial impacts from living with a substance dependent person, there is less consensus on how to quantify those harms and costs. One method is to assess the reduced quality of life in that situation either as Disability Adjusted Life Years (DALY) or Quality Adjusted Life Years (QALY). On the surface, these two measures appear to be the inverse of one another, with DALY measuring the number of healthy years of life lost due to disability (e.g. with a year of perfect health having a DALY of 0, while a year with a condition that reduces the quality of life by 20% having a DALY of 0.2). In comparison, QALY is used to measure the quality adjusted life years lived (e.g. one year of perfect health has a QALY of 1, while a year lived with a condition that reduces the quality of life by 20% has a QALY of 0.8). However, even though they are attempting to measure the same concept, the assumptions underpinning their calculation means that they are likely to arrive at different estimates of the impact on quality of life. In the current study we followed the GBD approach and opted to use DALY (e.g. (World Health Organization, 2016)).

[36] The NDSHS questionnaire defines dependent children as: "children aged 0 – 14, or older children who are still financially dependent, such as full-time students" (Australian Institute of Health and Welfare, 2017h, p3)

Estimates have been made of the DALY lost due to substance use disorders, but we are not aware of any specific estimates of the quality of life impact on partners or dependent children. The best estimate of the DALY by a person dependent on extra-medical opioids is 0.641 (0.459-0.803): this is then adjusted to account for asymptomatic dependence, to give a value of 0.501 (0.330-0.689) (Degenhardt et al., 2013b). A review of the benefits gained from the treatment of alcohol disorders suggests that the benefits for family members are of a similar magnitude to the gains for the treated individual (Mortimer and Segal, 2006). However, an alternative estimate reported that the impact on a co-resident adult from the successful treatment of another's alcohol disorder was 0.108 QALY gained (Salize et al., 2013). An approximate conversion formula for QALY to DALY (Sassi 2006), gives a value of 0.154 DALY for a 35-year-old family member, which is approximately half the DALY arising from moderate alcohol dependence (0.388 DALY). Therefore, we constructed a low and high range of the quality of life impact for a co-resident of a person with extra-medical opioid dependence with values of 0.251 – 0.501 DALY.

9.4 Intangible costs to family members

Having estimated the number of DALY lost by co-residents, these then need to be monetarised: a process that is subject to critical debate (Baker et al., 2010; Dolan, 2010; Donaldson et al., 2011; Miller and Hendrie, 2011). In some cases, the value of a year lived with disability has just been equated to the value of a statistical life year (e.g. Moore (2007), Nicosia et al., (2009)) an approach that has also been recommened for use in governmental cost-benefit analyses (Abelson, 2008). In calculating the value of a statistical life year (VoSLY), the same approach is used as in calculating the annual payment for an annuity of a given value and is based on the expected average years of life for the individual (typically 40 years). The formula used is,

$$VoSLY_{\mathrm{t=1}} = VoSL \times \frac{(1-(1+g)/(1+r))}{(1-(\frac{1+g}{1+r})^{years})}$$

Where:

- VoSL = estimated value of a statistical life
- g = annual escalation factor for VoSLY, typically the long-run real growth rate in per capita GDP
- r = the discount rate being used, in Australian studies this is usually a real annual rate of 7%
- years = assumed average years of life remaining at the time of the study for the sample used to derive the VoSL estimate.

However, this simple approach has been criticised in that the value of a life-year varies depending on many factors including: age; health state; expected years of life remaining; the ability to pay; and, the person's preference on the distribution of resources over their lifetime (Baker et al., 2010; Dolan, 2010; Donaldson et al., 2011). It is also not clear if the prospective expressed willingness to accept less years of life to avoid a particular health condition is accurate given the degree of adaption shown by those people with the health condition (Dolan, 2010).

An alternative approach to the estimation of DALY is via specific studies on the preferences of the population of interest. The disadvantages of this approach is that preference studies are costly and time consuming to conduct and they may result in 'bespoke' values largely driven by variations in the sample selected rather than the 'true' value of averting death or ill health. Therefore, we adopted an estimate based on the VoSLY.

As detailed in Section 3.7, our preferred value for a statistical life in 2015/16 was $4.6 million (Abelson, 2008). From this we calculated the value of a *single year* of life and hence a VoSLY in 2015/16 of

$286,553. Plausible bounds were then placed around that value using the implicit threshold value per DALY from PBS approvals of $45,000 as the low bound (Community Affairs References Committee, 2015; Harris et al., 2008). We then calculated the high bound using the VoSLY derived from the value of a statistical life used by the US Department of Transport (2015) which equated to $841,393.

As the exact relationship between the other persons co-resident with the person dependent on opioids is likely to impact on the extent to which their quality of life is reduced (for example, parents would arguably be more affected than house mates), and as the nature of this relationship cannot be identified from the NDSHS data, we have excluded the other co-residents from our preferred estimate. These costs, using the low DALY value are included in Table 9.2 for completeness but not added to the estimated cost.

Table 9.2: Tentative estimate of harms to resident others

Relationship to person dependent on opioids	**DALY lost estimate**	**Central Estimate** Abelson (2008) VoSLY **($)**	**Low bound** Implicit PBS value of VoSLY**($)**	**High Bound** US DoT value of VoSLY **($)**
		286,553	45,000	841,393
Resident Children	Low DALY	5,022,497,842	788,728,099	14,747,340,027
	High DALY	10,044,995,684	1,577,456,198	29,494,680,054
	Mean	7,533,746,763	1,183,092,148	22,121,010,040
Resident partners	Low DALY	2,962,687,644	465,257,540	8,699,209,726
	High DALY	5,925,375,287	930,515,081	17,398,419,452
	Mean	4,444,031,466	697,886,311	13,048,814,589
Total cost partners and children	**Sum of means**	**11,977,778,228**	**1,880,978,459**	**35,169,824,629**
Other persons resident	Low DALY	14,459,636,577	2,270,727,042	42,457,196,396
Total cost including other co-residents		26,437,414,805	4,151,705,501	77,627,021,025

GBD = Global Burden of Disease: NDSHS = National Drug Strategy Household Survey: VoSLY = value of statistical life year

Our estimate of the lost quality of life for dependent children and partners resident with a person dependent on extra-medical opioids, was the sum of the two central values, **$12.0 billion** with a range of $1.9 billion to $35.2 billion.

9.5 Conclusions

There is growing interest in the impacts of substance use on others, although to date the literature is dominated by investigation of the harms arising from involuntary tobacco smoking (US Department of Health and Human Services, 2006) and alcohol use by others (Callinan et al., 2016; Laslett et al., 2011; Nayak et al., 2019). In relation to methamphetamine, there has been an estimate of one aspect of harms to others, with the cost of child maltreatment and foster care being quantified at USD 904.6 million in 2005 (Nicosia et al., 2009). We are not aware of previous attempts to estimate the cost of these harms for extra-medical opioid use. *Therefore, although these costs have been estimated, we have not included them in the overall total attributed to extra-medical opioid dependence*.

Although we were unable to provide separate estimates of the extent of quality of life lost by parents and other adults resident with a person dependent on opioids, we provided an estimate for the number of children and partners likely to be impacted. In particular, it should be noted that more than one-third of the co-resident people were children, a group where the harms would be expected to be the most substantial and persistent. We estimated that between 54,000 and 88,000 dependent [37] children are living with a parent or guardian who is dependent on extra-medical opioids: there may be further children living with an adult who is dependent on opioids but who are not financially dependent on that adult. A further 32,000 to 52,000 people were partners of the person with extra-medical opioid dependence, who could be expected to have greater lost quality of life than other adults in the household.

9.6 Limitations

In estimating the DALY lost, we assumed that children and partners would suffer the same level of lost quality of life, and given the formative stage of the field further adjustment for potential differences seemed unwarranted. Also given the formative stage of research, we have provided an initial estimate of harms to other resident adults, but not included this in the total. We note that we were not able to identify any studies that directly estimated the DALY lost as a result of living with a person dependent on a substance; instead we drew on studies that estimated the quality of life impact relative to the DALY lost for the substance using person themselves. It is also possible that some of the DALY lost through residing with a person dependent on a substance is captured in other costs reported in this study, such as the intangible costs to victims of crime.

We were unable to quantify the tangible costs of living with someone dependent on extra-medical opioids, for example, theft from the household. In addition, from the literature, informal care makes a substantial contribution to health care and hence savings to health budgets (Deloitte Access Economics, 2015; Saka et al., 2009). The value of informal care is estimated in Section 5.11, however this relates to informal care provided for impairment resulting from an illness or disability attributable to extra-medical opioids, rather than care provided for the acute and chronic impacts of opioid use itself.

As noted above, as no information on the household structure of persons dependent on opioids was available from the GBD study, we used data on the household structure of those persons who used opioids frequently ('at least weekly') as a proxy. This rests on the assumption that the characteristics of the two populations, once controlled for age and gender, are similar. If the household characteristics of those who have been classified as dependent in the GDB data differ systematically from those of the most frequent users of opioids in the NDSHS then our estimates of affected partners and dependent children will be biased. Whether this would lead to a lower or a higher estimate is not known.

Finally, if opioid dependent persons tend to cohabit with other opioid dependent persons, rather than individuals who do not use drugs, the estimate of the number of DALY lost may be inaccurate. We were unable to determine if this would be likely to increase or decrease the DALY lost.

[37] Note the survey asks "Are there any dependent children in this household? (Dependent children are defined as children aged 0 – 14, or older children who are still financially dependent, such as full-time students)" This refers to financial rather than clinical dependence.

CHAPTER 10: INTERNALITIES

Steve Whetton & Robert J. Tait

10.1 Background

As previously noted in Section 2.2.1, the estimation of the cost of harms in social cost studies does not typically include the harms arising to the consumer. This is predicated on the assumption that any harms from consumption will be factored into the purchasing decision along with the purchase price, so that the overall benefits outweigh the overall costs (and harms) of consumption(Becker and Murphy, 1988).

This model of rational consumption appears to be less well suited to the explanation of the consumption of substances with dependence potential, or more specifically in people who are identified as severely dependent on a substance (US National Cancer Institute and World Health Organization, 2016). In addition, the fact that the 'benefits' of consumption are likely to be immediate and the harms potentially distant, undermines the plausibility that the consumer with a substance dependence is maximising their lifetime utility at their current level of consumption (Angeletos et al., 2001; Gruber and Köszegi, 2001; Laibson, 2001; Akerlof, 1991; Suranovic et al., 1999).

On this basis it is justifiable to include the consumption costs from drug dependence within public policy responses to reduce consumption to its 'optimal' level, whether by decreasing availability, increasing price, or providing information to people who use and to those who will potentially use in the future. As the costs to a person with substance dependence are not strictly social costs, they are often termed "internalities" or "private costs" – these represent the sum of costs that were not factored into the original consumption decision. In some analyses, for example the Productivity Commission's inquiry into the social costs of gambling, an attempt is made to assess what level of consumption and associated harms would occur if these consumers were not dependent (Productivity Commission, 1991). In other analyses, all costs borne by people who are dependent are treated as internalities. The costs of drug use arising to those who are classified as non-dependent are excluded from the internalities estimate, as it is less certain that these people depart from the assumptions underpinning the rational model.

It is unclear precisely what negative impacts underpin the evaluation of DALY lost by people with drug dependence (see, for example, (Degenhardt et al., 2013c; Pyne et al., 2008)) so we cannot be certain that any harms that occur to the consumer and captured as internalities are excluded from DALY. Therefore, we adopted a conservative approach and recommend the use of ***either*** the quality of life impact ***or*** the estimated internalities, plus the expenditure by people who are dependent on extra-medical opioids. However, we acknowledge that the use of a single approach may underestimate the true extent of the internalities.

In the current study, we decided that all costs to who are dependent were potentially in-scope as internalities and we preferred to assess these via the quality of life impact plus the cost of extra-medical opioid purchases.

10.2 Estimated quality of life impact of dependent extra-medical opioid use

The quality of life lost from dependence on extra-medical opioids can be quantified via the DALY lost. As noted earlier, DALY assess the departure from a year in full health, such that a condition with a DALY of

0.2 equates to an average person with that condition having a quality of life equal to 80% of a person in full health.

The GBD provides the best available estimate of the DALY lost from opioid dependence at 0.641 (Degenhardt et al., 2013b; Degenhardt et al., 2013c). However, in recognition that the level of severity is likely to vary over the course of a year, we adjusted this value down by 16 percent as recommended by the GBD to reflect these periods of reduced severity, giving a final adjusted estimate of 0.501 DALY (Degenhardt et al., 2013b; Degenhardt et al., 2013c). Given the use of GBD data elsewhere in this analysis, the DALY estimate was our selected measure of reduced quality of life.

Applying the adjusted DALY of 0.501 to the estimated 104,026 people dependent on extra-medical opioids in 2015/16 (Global Burden of Disease Collaborative Network, 2018), gives an estimate of years of life lost to disability (YLD) due to extra-medical opioid dependence of 52,117 (see Table 10.1).

Table 10.1: Estimated total years of life lost to disability due to extra-medical opioid dependence, 2015/16

Basis for estimate	YLD
Based on Degenhardt estimate of a lost DALY of 0.501 for dependent extra-medical opioid use and dependent cases = 104,026	52,117

Sources: (Degenhardt et al., 2013b; Degenhardt et al., 2013c; Global Burden of Disease Collaborative Network, 2018)

In monetising the YLD, we repeated the methods and used the same assumptions as described in Section 9.4. Our central cost estimate was based on the VoSL (Abelson, 2008) that we converted from the 2007 values to 2015/16 values using the change in the average nominal national per capita income over that period. The rate at which a value of statistical life should increase over time as national incomes increase is determined by the income elasticity of demand for reductions in the risk of premature death, with the elasticity representing the proportionate increase in the VoSL for a given increase in per capita incomes. For example, an income elasticity of 0.5 implies that for a 1% increase in per capita income, the VoSL would increase by 0.5%. These income elasticities have been variously estimated at 0.5 to 0.6 (Viscusi and Aldy, 2003), 1.32 (with a range from 1.16 to 2.06) (Kniesner et al., 2010)) and 1.5 to 1.6 (Costa and Kahn, 2004). We followed the US Department of Transportation (US Department of Transportation, 2015) in adopting a relatively conservative assumption of an income elasticity of 1 [38], slightly below the average of the three studies which was 1.16.

This gave a 2015/16 value of a statistical life of $4.6 million. This figure was then annualised to give the VoSLY at $286,553 and hence the value for each DALY lost. As before, we estimated plausible low and high bounds per DALY lost from the implied threshold value used for PBS approval of $45,000 (Community Affairs References Committee, 2015; Harris et al., 2008) and the VoSLY derived from the annualised value of the VoSL used by the US Department of Transport (2015), which equated to $841,393.

These values were then applied to the estimated YLD due to extra-medical opioid dependence (Table 10.2). Our central estimate based on the value calculated using the Abelson (2008) VoLSY was, **$14.9 billion**.

[38] This is likely to be an underestimate, as empirical analysis suggests that on average people are risk averse (and in particular loss averse) which would imply a price elasticity of averting loss of >1 (Kniesner et al., 2010)

Table 10.2: Estimated cost of DALY lost due to the quality of life impact of extra-medical opioid dependence, 2015/16

Basis of VoSLY estimate	Abelson 2008 ($)	Implied PBS threshold ($)	US DoT ($)
Based on Degenhardt estimate of a lost DALY for extra-medical opioid dependence (0.501)	14,934,290,151	2,345,266,170	43,850,900,857

Source: (Degenhardt et al., 2013b; Degenhardt et al., 2013c): US DoT = United States Department of Transport

10.3 Cost of heroin and other extra-medical opioids

As noted in Section 2.2.1, in the current study we are only considering internalities for those who are dependent on extra-medical opioids, defined as the 104,026 cases enumerated via the GBD tool (Global Burden of Disease Collaborative Network, 2018). The cost of heroin was obtained from the IDRS surveys. The estimated average national price for a gram of heroin was $300 in 2015 and $350 in 2016, with the median amount used being 0.5 g per day of use (Stafford and Breen, 2016). The median days of use was 75 out of the last 180 days, or 41.7 percent of days. Combining this information for the 104,026 people who were dependent, equates to 0.076 kg per person per year (at a cost of $24,700) or 7,922 kg overall for the dependent cohort, with an estimated overall cost of $2.6 billion. We used this as our high bound estimate (Table 10.3).

By way of comparison, the National Waste Water Monitoring Program estimated that in 2016/17 about 765kg of heroin was consumed in Australia (Australian Criminal Intelligence Commission, 2018) [39]. At an average cost of $325 per gram (Stafford and Breen, 2016) that equates to $248.6 million. It has been estimated that those dependent on heroin consume 85% of the total heroin used in Australia (Moore, 2007), so this total was reduced by 15 percent to account for use by non-dependent persons. We used this ($211.3 million) as the low bound estimate with the mean of the two values our central estimate, **$1.4 billion.**

In relation to other opioids, although the IDRS reports typical prices for pharmaceutical opioids obtained through 'illicit' purchases (e.g. methadone $1 per 1 ml; buprenorphine $25 per 8 mg tablet: buprenorphine-naloxone $20 per 8 mg 'film': generic oxycodone $50 per 80 mg tablet) (Stafford and Breen, 2016), typical frequency and quantity consumed are not reported. However, median days of use (in the last 180 days) was reported. For illicit methadone liquid, the median was 5.5 days out of 180 days, for illicit buprenorphine it was 7 days, for buprenorphine-naloxone, 11 days, and for oxycodone it was 7 days. Based on a single 8mg dose per occasion, this corresponds to $350 per illicit buprenorphine using individual per year and $440 per person using illicit buprenorphine-naloxone per year. Based on a single 80mg tablet of oxycodone the cost would be $700 per year. The volume of methadone used was not reported so no estimate of the cost has been made.

Among those we defined as dependent (e.g. frequency of use reported as 'daily + once a week or more') on extra-medical opioids in the NDSHS there were 175,787 (92.3%) people who we defined as dependent on other opioids (but not on heroin) and 14,739 (7.7%) who we defined as dependent on heroin ± other opioid dependence. If the same ratio applied to the GBD (n = 104,026), there would be 96,016 dependent on other opioids and 8,010 dependent on heroin ± other opioid dependence.

[39] Test results for heroin were first included in the November 2017 report: the cited report is the first to include an estimate of the total heroin consumed.

If all those dependent on other opioids (96,016) used just buprenorphine, the annual cost would be $33.6 million and if all used oxycodone the cost would be $67.2 million. In addition, we note that if this method is applied to the cost of heroin, then if the 8,100 people dependent on heroin ± other opioid dependence consumed the average amount of heroin (0.076 kg at $24,700 per person per year), expenditure on heroin would equate to $200.1 million, a value that is close to that obtained via the waste water estimate.

Although waste water analysis collects and reports data on oxycodone and fentanyl, no estimate is made of the proportion that is used extra-medically compared with as prescribed. Thus, this information cannot be used in estimating the amount and cost of this aspect of extra-medical use (Australian Criminal Intelligence Commission, 2018).

Table 10.3: Extra-medical opioid purchases by those with dependence

Opioid class	Central estimate ($)	Low bound estimate ($)	High bound estimate ($)
Heroin	1,393,000,541	211,331,250	2,574,669,832
Other opioid	50,408,400	33,605,600	67,211,200
Total	**1,443,408,941**	**244,936,850**	**2,641,881,032**

10.4 Conclusions

Internal costs are seldom included in social cost studies, even for those investigating substances with potential for problematic use. In reviewing the literature on social cost studies for extra-medical opioids, we only identified two studies that included the cost of drug purchases (Jiang et al., 2017; Lin et al., 2013) and one that included the intangible costs of premature mortality (Council of Economic Advisers, 2017). No study included an estimate of the intangible costs of dependence. However, as discussed previously, in the case of people who are dependent on a drug, the notion of fully rational consumption decisions are undermined. *On this basis we decided to estimate and report these internal costs, but not include them in the overall figure attributed to extra-medical opioid dependence.* Our estimate of the overall internal costs arising from drug purchases and the reduced quality of life for persons dependent on extra-medical opioids was **$16.4 billion** (Table 10.4).

Table 10.4: Summary of internalities

Component	Central estimate ($)	Low bound estimate ($)	High bound estimate ($)
Value of DALY lost	14,934,290,151	2,345,266,170	43,850,900,857
Extra-medical opioid purchases	1,443,408,941	244,936,850	2,641,881,032
Total	**16,377,699,092**	**2,590,203,020**	**46,492,781,889**

10.5 Limitations

In estimating the costs of purchasing heroin, the initial estimate was based on all those meeting the criteria for opioid dependence being people who primarily used *heroin*. When the population was divided into the components reported in the NDSHS, the large majority used opioids excluding heroin, with only 7.7 percent defined as dependent on heroin ± other opioid dependence. In this situation, the cost for heroin purchases was dramatically reduced and the approximate concordance of this estimate with that based on wastewater analysis, suggests that this approach provides a better estimate of the true cost of heroin purchases.

There were limited data on the cost, amount consumed and the frequency of use of non-heroin opioid drugs. Our estimates are also likely to include some 'double counting' where purchases are of pharmaceuticals included in the PBS. Therefore, the costs assigned here are speculative. We also note that the source document (Stafford and Breen, 2016) emphasises the limited sample reporting on the price of illicit buprenorphine and combined buprenorphine-naloxone and the need to interpret these values with caution. The IDRS also collects data on other opioids. Medium days of use of oxycodone was reported as the combined values for licit and illicit oxycodone. The cost of licit oxycodone purchases will also be included in the high bound estimate of pharmaceuticals, meaning that any 'licit purchases' of this drug will be double counted. Costs for illicit fentanyl and other opioids (including at the time available over-the–counter codeine products) were not reported (Stafford and Breen, 2016). Therefore, we were unable to estimate the cost of purchasing these other forms of opioids. However, any pharmaceutical opioids that were obtained by "doctor shopping" and then bought at a pharmacy, will be included in the high bound estimate of PBS medications.

The GBD study provides a disability weight for 'opioid dependence' (Degenhardt et al., 2013b) and in estimating the intangible costs of extra-medical opioid dependence, we have assumed that the DALY lost are the same whether this involves heroin or other forms of opioids. In addition, we assumed that the ratio of people dependent on heroin compared with other forms of opioids was the same in the NDSHS and GBD data. Any deviation from our assumption that the ratios were the same could markedly impact on the estimated cost of drug purchases.

CHAPTER 11: MISCELLANEOUS COSTS

Steve Whetton, Robert J. Tait & Steve Allsop

11.1 Child maltreatment and protection

11.1.1 Background

In estimating the social cost in the USA of methamphetamine use, methamphetamine-related child endangerment emerged as one of the major components, accounting for USD 904.6 million, the third largest area (Nicosia et al., 2009). Further, infants and children exposed to a neglectful upbringing have ongoing impaired quality of life (Nicosia et al., 2009). Research commissioned by the US Department of Health and Human Service suggested that there is a robust correlation between changes in extra-medical opioid use at a county level (as measured by opioid-related hospital separations) and changes in child protection substantiation; with a 10 percent increase in hospitalisations associated with a 2.1 percent increase in substantiations, a similar order of magnitude impact to that found for stimulants such as methamphetamine (Ghertner et al., 2018). In Australia, it has been calculated that child maltreatment contributes 1.4 percent of all DALY lost by males and 2.4 percent lost for females when just considering key mental health conditions (depression, anxiety and self-harm) (Moore et al., 2015). However, there is only limited evidence of the specific contribution of extra-medical opioid use to adverse child outcomes in Australia.

The costs associated with premature death and hospital episodes are addressed in Chapters 3 and 4 with reduced quality of life reported in Chapter 9. The cost of child protection represents a discrete component of childhood neglect that can be evaluated. Although, there are marked variations in the legal definitions and the child protection systems across Australia, there remain similarities in the stages between initial notification to child protection and outcomes such as court orders (Bromfield and Higgins, 2005). However, in estimating these costs, it is important to recognise the multifactorial nature of the cases: removal of a single factor, such as drug use, would not necessarily prevent the death or harm of an individual child (Field, 2016).

11.1.2 Number of child protection cases

In Australia, there are limited public data available on the underlying cause(s) for substantiated protection cases beyond the broad categories of "physical", "sexual", "emotional" and "neglect" categories (Australian Institute of Health and Welfare, 2016b). However, an analysis of cases in Victoria over the period 2001-2005 reported that, substantiated cases represented 20.5 percent (n=38,511) of the 188,063 notifications to child protection. Of these, 35.3 percent (n=13,579) had a parental history of "substance abuse", comprising 15.9 percent (n=6,119) drug use only and 19.4 percent (n=7462) with alcohol and drug use (Laslett et al., 2013).

Nationally, in 2015/16 there were 45,714 children (aged 0-17 years) with substantiated cases (Steering Committee for the Review of Government Service Provision, 2017b). Applying the above proportions (15.9% and 19.4%) to the substantiated 2015/16 cases resulted in 7,269 "drug use" cases and 8,869 "drug and alcohol" cases for the period. To attribute a proportion of these cases to extra-medical opioid use, we used the proportion of people receiving treatment for opioid use (Australian Institute of Health and Welfare, 2017d). For heroin use, there were 11,003 episodes of care where it was the primary drug of concern, with a further 4,801 episodes where it was an additional drug of concern. For other opioids [40] the respective figures were 7,499 and 7,462 episodes of care (Australian Institute of Health and Welfare, 2017d). In total, there were 18,502 extra-medical opioid cases as the primary drug of concern and 12,263 episodes as an additional drug of concern. Of the total episodes of care for their own drug use (198,747) in 2015/16, 9.3 percent were primarily for extra-medical opioid use: of the 153,271 episodes that involved additional drugs of concern, 8.0 percent involved opioids. On this basis we allocated 676.7 instances of the substantiated "drug use only" cases to extra-medical opioid use and 709.6 instances of the "drugs and alcohol" substantiated cases. From the total of 45,714 substantiated cases, extra-medical opioid use was projected to account for 1,386 (3.03%) instances.

An alternative estimate of the role of extra-medical opioid use in child protection cases can be derived from a detailed review of 467 cases representing children's first entry into care in South Australia (Jeffreys et al., 2009). The study's findings suggest that about 70.2 percent (n=328) involved parental substance use. A detailed case series of 99 randomly selected out of the original sample revealed that 75 (75.8%) involved substance use, with 12.0 percent primarily involving heroin and 2.7 percent primarily involving methadone (n = 11 cases). There were also 10.7 percent involving pharmaceutical drugs. From national treatment data (Australian Institute of Health and Welfare, 2017d), opioid drugs make up 73 percent of the episodes where pharmaceutical drugs are the principal drug of concern. On this basis we allocated a further 6 cases due to pharmaceutical opioids, with 17 cases overall.

The case review identified all factors mentioned in the case file as having contributed to the decision to place the child in care for both those with and without substance use factors (Jeffreys et al., 2009). No weighting or precedence of the factors could be identified. If it is assumed that each of the factors contributed an equal weight to the decision to take the child into care, and that none of the factors were caused by another factor [41], then the share of total factors can be used to identify the role of extra-medical opioids in care decisions.

Weighted up to the whole sample, there were an estimated 74 cases in which extra-medical opioid use was one of the factors contributing to the removal of a child into care for the first time, out of a total of 2,285.4 factors identified in the case review. Thus, extra-medical opioid use accounted for 3.2 percent of all factors identified in the care decision (see Table 11.1 below). On the assumption that each factor in the decision carried an equal weight, this suggests that 3.2 percent of the decisions to take a child into care could be attributed to extra-medical opioid use.

11.1.3 Child protection costs

In 2015/16, the total cost of child protection services in Australia was $4.8 billion (Steering Committee for the Review of Government Service Provision, 2017b). Using the substance use treatment data to allocate a share of "drug use only" and "drug and alcohol" substantiated cases to extra-medical opioid use (3.03%) equates to $144.3 million. The alternative approach of identifying extra-medical opioid's total share of factors identified in the South Australian case review suggested an extra-medical opioid share of 3.2 percent or $153.7 million. For the purpose of this report, we use the mid-point as our main estimate: **$149.0 million** (see Table 11.4).

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[40] Codeine, morphine, buprenorphine, methadone, oxycodone, other opioids

[41] Without a basis for weighting the factors, these were the assumptions that underpinned the estimate. We note, that we do not know in which direction any difference from the assumptions is likely to skew the estimates.

Table 11.1: Factors influencing decision to take a child into care in South Australia for the first time by whether substance use was noted in the case file, 2006

Factor influencing decision to take into care	Substance use: No [a] % with factor	Substance use: Yes [b] % with factor	Substance use: No [a] # of times with factor	Substance use: Yes [b] # of times with factor	All cases # of times with factor	All cases % of total factors
Alcohol use	-	77.3	-	253.5	253.5	11.1
Cannabis use	-	53.3	-	174.8	174.8	7.6
Amphetamine use	-	50.7	-	166.3	166.3	7.3
Heroin use	-	12.0	-	39.4	39.4	1.7
Prescription drug use	-	10.7	-	35.1	35.1	1.5
Intravenous substance use	-	4.0	-	13.1	13.1	0.6
Methadone use	-	2.7	-	8.9	8.9	0.4
Ecstasy use	-	1.3	-	4.3	4.3	0.2
Inhalant use	-	1.3	-	4.3	4.3	0.2
Parental mental health	54.2	65.3	75.3	214.2	289.5	12.7
Domestic violence	16.7	69.3	23.2	227.3	250.5	11.0
Homelessness	8.3	28.0	11.5	91.8	103.4	4.5
Financial difficulties	0.0	29.3	0.0	96.1	96.1	4.2
Parental incarceration	4.2	25.3	5.8	83.0	88.8	3.9
Housing instability	8.3	24.0	11.5	78.7	90.3	3.9
Transience	0.0	22.7	0.0	74.5	74.5	3.3
Criminal activity	0.0	20.0	0.0	65.6	65.6	2.9
Abandonment	4.2	17.3	5.8	56.7	62.6	2.7
Social isolation	20.8	12.0	28.9	39.4	68.3	3.0
Parent abused as a child	0.0	13.3	0.0	43.6	43.6	1.9
Family breakdown	12.5	13.3	17.4	43.6	61.0	2.7
Parental intellectual disability	25.0	2.7	34.8	8.9	43.6	1.9
Child behaviours	16.7	4.0	23.2	13.1	36.3	1.6
Parent/child conflict	16.7	4.0	23.2	13.1	36.3	1.6
Parent hospitalisation	12.5	4.0	17.4	13.1	30.5	1.3
Other jurisdiction CP involvement	4.2	4.0	5.8	13.1	19.0	0.8
Parent ex-GOM	12.5	1.3	17.4	4.3	21.6	0.9
Young parents	8.3	2.7	11.5	8.9	20.4	0.9
Parental death	0.0	4.0	0.0	13.1	13.1	0.6
Adolescent at risk	4.2	1.3	5.8	4.3	10.1	0.4
New arrivals	4.2	1.3	5.8	4.3	10.1	0.4
Support to relative carers	4.2	1.3	5.8	4.3	10.1	0.4
Unaccompanied minor, refugee program	8.0	0.0	11.1	0.0	11.1	0.5
Child disability	4.2	1.3	5.8	4.3	10.1	0.4
Child mental health	0.0	1.3	0.0	4.3	4.3	0.2
Child intellectual disability	0.0	1.0	0.0	3.3	3.3	0.1
Previous CP history	4.2	0.0	5.8	0.0	5.8	0.3
Recovery order	4.2	0.0	5.8	0.0	5.8	0.3
Total number of factors					**2,285.4**	**100.0**

Note: [a] 139 cases; [b] 328 cases. CP = child protection: GOM = Guardianship of the Minister
Source: (Jeffreys et al., 2009), calculations by the authors

11.2 Child Death Reviews

The major costs of child premature mortality are addressed in Chapter 3. However, there are additional specific costs associated with assessing some childhood deaths. The Western Australian Ombudsman provides an estimate of the cost of conducting an investigation into those deaths that fulfil the criteria from the relevant legislation: the Ombudsman does not investigate all child deaths [42]. In 2015/16, the Ombudsman reviewed 41 deaths at a cost of $18,597 per review. While not asserting causality, the long-term average is that 33 percent of cases involve drug use as a contributory factor although no specific drug categories were identified, and alcohol was listed as a separate factor (Field, 2016). (The identification of drug use maybe by the victim, the perpetrator or both). As a proxy for the potential involvement of extra-medical opioid use, we used the proportion of episodes where these drugs were the principal drug of concern (14.1%) in illicit drug treatment episodes [43] (Australian Institute of Health and Welfare, 2017d. Table SD1). Assuming that this figure translates to Western Australia, then 14.1 percent of cases equates to 6 deaths where opioids were potentially a contributory factor.

Child death reviews are investigated by relevant state or territory authorities and so there are variations in which deaths are subject to detailed examination. While reports from other jurisdictions identify drug use as a contributory factor, such as in unintentional overdoses, suicides, vehicle accidents and neglect (McMillan, 2017), the proportion of deaths where drug use was a contributory factor were not reported. Therefore, we used the estimate from Western Australia (33%) in projecting the number of deaths possibly involving drug use and the treatment data in attributing a fraction of these to opioids (14.1%) (Australian Institute of Health and Welfare, 2017d. Table SD1).

There were 226 deaths in the target year or the most recent available year that were either explicitly subject to detailed review (New South Wales, Western Australia) or known to the child protection system and thus likely to be reviewed (Table 11.2). Based on the Western Australia cost, this equates to $4.2 million in review costs in addition to any coronial or police investigations that were required. Using the 14.1 percent from the paragraph above as the proportion involving opioids, the cost of conducting these child death reviews was **$0.6 million.** As discussed in the limitations (Section 11.7), we did not add any further 'cases' to the number of deaths reported in Chapter 3 from this section of the analysis.

Table 11.2: Child protection deaths

State or Territory	Source	Reviewable deaths	Year(s)
New South Wales	1	[a] 47.5	2015
Queensland	2	[b] 46.0	2015/16
South Australia	3	[b, c] 24.6	2014-16
Tasmania	4	[d] 16.0	2015/16
Victoria	5	[b] 38.0	2015/16
Western Australia	6	41.0	2015/16
Australian Capital Territory	7	[e] 0.0	2014/15
Northern Territory	8	[b] 12.4	2015
Total		**225.5**	

[42] All 'reportable' deaths are reviewed (e.g. where the in the last two years the child's or a child relative's safety has been raised with the Department for Child Protection and Family Support, or the child or child relative is in their care). The Ombudsman can review any other notified death (Field, 2016).

[43] Primary drug of concern, excluding alcohol (63,270) and nicotine (4,688) episodes.

[a] 95 deaths in 2014 to 2015: [b] Known to the child protection system: [c] mean of 2014 to 2016: [d] mean paediatric mortality 2015 to 2016; [e] None of the deaths was known to ACT Children and Youth Protection Services
1 = (McMillan, 2017); 2 = (Vardon, 2016); 3 = (Eszenyi, 2017); 4 = (Council of Obstetric and Paediatric Mortality and Morbidity, 2017, 2018); 5 = (Victorian Government, 2016); 6 = (Field, 2016); 7 = (Gregory, 2015) 8 = (Gwynne, 2016)

11.3 Needle, syringe and related programs

Needle and syringe programs (NSP) have been active in Australia since 1986 and stand at the forefront of harm prevention and efforts to prevent the spread of BBV (Iversen et al., 2017). In addition, the programs provide a range of health and education services and assist clients in accessing treatment programs (Australian National Council on Drugs, 2013). In 2015, there were more than 3500 NSP outlets including those in pharmacies and vending machines, with nearly 50 million syringes distributed in 2015/16 (Iversen et al., 2017).

NSP have been extensively evaluated in Australia (Australian Government Department of Health and Ageing, 2002, 2009) and elsewhere (Fernandes et al., 2017; National Institute for Health and Clinical Excellence, 2009). It is estimated that between 2000 and 2009 NSP prevented 32,050 new HIV infections and 96,667 HCV infections (Australian Government Department of Health and Ageing, 2009).

Among people who use heroin, 81 percent report injecting as the most commonly used route of administration, while for those who use pharmaceuticals, including opioids, injecting was less common, with 31 percent of clients reporting that they had injected in the last three months. (Australian Institute of Health and Welfare, 2017c, d). However, among NSP clients on the audit day, opioids where the most commonly reported drug last or about to be injected, representing 41 percent of clients (Iversen et al., 2017). Despite the prevalence of injecting, the prevalence of HIV infection has remained low, at 1.5 to 1.6 percent in those who inject heroin and 0.2 to 0.0 percent in those who inject other opioids in 2015 and 2016 (Heard et al., 2018). In contrast, the prevalence of HCV infection was markedly higher, with the respective figures being 73-66 percent and 67-59 percent (Heard et al., 2018). The introduction of universal access to direct acting antiviral therapy for HCV in March 2016 is likely to make a dramatic impact on the prevalence of HCV (Heard et al., 2018) and the reduction in antibody prevalence noted above between 2015 and 2016 is potentially an early indication of this change.

Identifying the budget for NSP has become more difficult in the last decade as it has been included in the federal budget as part of the Healthcare Specific Purpose Payment (Ritter et al., 2013). The last time the NSP budget was reported as a separate item was in 2007/08, when the NSP received $26.4 million. Increasing, this by CPI since that time, gives a cost of $32.1 million in 2015/16 (Australian Bureau of Statistics, 2016c). Of this, we allocated 41 percent to the cost of supplying services to people who inject opioids, **$13.2 million.**

In 2015/16, Australia had one Medically Supervised Injecting Centre (MSIC), which was based in Sydney. As with the NSP, the international evidence suggests that supervised injecting or drug consumption facilities are cost-effective in reducing the harms from drug use (Schatz and Nougier, 2012). In 2013/14 the budget for the Sydney MSIC was $3.5 million (personal communication manager MSIC). Increasing this by CPI to 2015/16 values, gives a total of $3.62 million, from which we allocated 41 percent (**$1.5 million)** to extra-medical opioid related services (see Table 11.4).

11.4 Prevention programs

11.4.1 Cost of school prevention programs

Prevention programs can be sub-divided into primary prevention which attempts to prevent the uptake of drug use and secondary prevention which attempts to prevent the transition to more serious drug use. Generally, primary programs are delivered through schools, while secondary prevention can be delivered through schools or the broader community. Earlier estimates suggest that Australia spent $156.8 million in 2009/10 on preventing illicit drug use, with $79.2 million (50.5%) spent on school based programs (Ritter et al., 2013).

It was estimated that hours of *illicit* drug education represented 25 percent of drug education for year 8 and below and 50 percent for later years (Ritter et al., 2013). These represent 0.2 percent of school hours and thus were extrapolated to be 0.2 percent of the recurrent expenditure or $79.2 million for 2009/10.Using the fraction identified above (0.2%), this equated to $113.3 million for illicit drug education. However, in order to update these estimates we have retained the approach used by Ritter and colleagues (Ritter et al., 2013) which calculated the fraction of time that students spent on drug misuse prevention education and applied that to total government spending on school education. In 2015/16 Federal and other government recurrent expenditure on schools was approximately $55.7 billion (Steering Committee for the Review of Government Service Provision, 2018a). In primary schools illicit drug education focuses mainly on cannabis and steroids with secondary schools covering a broad range of illicit drugs (Auditor General Victoria, 2003). Therefore, these estimates only include the costs incurred in secondary school prevention.

Table 11.3: Estimated hours of illicit drug education and costs for secondary students in 2015/16

	Total student time spent on drug education (hours)	Share of student time on drug education (%)	Implied government spending on drug education ($)	Drug education spending related to opioids ($)
Central estimate	8,041,121	0.42	$101,615,987	$20,323,197.32
Low bound	5,680,792	0.30	$71,788,408	$14,357,681.69
High bound	10,401,450	0.54	$131,443,565	$26,288,712.95

In 2015/16 there were 1.5 million (full time equivalent) secondary students in government and non-government schools (Australian Bureau of Statistics, 2017h), with total annual government spending of $24.3 billion (Steering Committee for the Review of Government Service Provision, 2018a). The total school hours based on a 6 hour day and 40 weeks per year was 1.92 million hours. Drug education hours per year (mid-point 10.05 hours per student, range 7.1 to 13.0 hours) were obtained from the Auditor General's report (Auditor General Victoria, 2003) and multiplied by the number of students per year (Australian Bureau of Statistics, 2017h) and reduced by 50 percent reflecting the time allocated to illicit drug education. The 8.0 million hours on illicit drugs equate to 0.42 percent of total hours (low bound 0.30 percent, high bound 0.54 percent), giving a total cost for secondary illicit drug education of $101.6 million ($71.79 million to $131.44 million).

If "ecstasy" is regarded as a separate class of drugs to amphetamine, the Auditor General's report identified five classes of drugs usually included in secondary school programs, with the remainder being heroin, cocaine and hallucinogens (Auditor General Victoria, 2003). We were unable to locate the time allocated to each drug and have thus assumed that these are approximately equal. On this basis, the cost of heroin and the extra medical use of opioid prevention activities in schools was estimated at **$20.3 million** (range $14.4-$26.3 million).

11.4.2 Cost of general population prevention programs

In 2009/10, an estimated $77.6 million was spent on general illicit drug programs (Ritter et al., 2013), including direct costs of prevention programs, staff salaries and overheads. Of this, $53.7 million was from state or territory governments and at the federal level, $18.9 million was spent on prevention via the National Illicit Drug Strategy with a further $5.0 million spent on specific Indigenous programs under the Closing the Gap strategy (Ritter et al., 2013).

In 2015/16, Western Australia spent $4.67 per head of population aged 14 and above on prevention programs, (Mental Health Commission, 2016). With a population of 2.08 million people aged 14 or older in 2015/16 (Australian Bureau of Statistics, 2018a), this totalled to $9.7 million. There were no data available on the split between alcohol and other drugs or on the proportion spent on heroin or other opioids. We were unable to find similar costings for other states or territories. Therefore, we extrapolated this figure to the Australian population aged 14 or older in 2015/16 (19,749,225) giving a total cost on alcohol and other drug prevention activities of $92.2 million. Based on the assumptions of Ritter et al., we allocated 50 percent to illicit drug prevention ($46.1 million) and of this we allocated one fifth to heroin and other opioid prevention programs: **$9.2 million**.

11.4.3 Cost of opioid overdose prevention programs

In February 2016, injectable naloxone became available in Australia for over-the-counter purchase with the aim of enabling lay administration to reduce the number of fatal opioid overdoses: subsequently an intra-nasal formulation has been released (Jauncey and Nielsen, 2017; Johnson, 2019). The cost of prescribed naloxone for 2015/16 was $62,279 (Pharmaceutical Benefits Scheme, 2018b). In addition, there were training programs, typically run by specialist treatment services or community groups, for potential overdose witnesses and the kits provided (minijets of naloxone, plus intramuscular needles, swabs, gloves and instructional materials) (Lenton et al., 2016). In 2014, it was estimated that training, including resources, cost $237 per trainee (Olsen et al., 2015) [44]. By October 2017, at least 2,858 people had been trained (Lenton and Dietze, 2017). On the assumption that 500 people were trained in 2015/16, the cost would be $118,500. Therefore, we estimated that the total cost in 2015/16 was **$180,799.**

11.5 Commonwealth government programs

The Commonwealth government has provided about 31 percent of all funding for alcohol and other drug treatment in Australia, with the states and territory governments providing a further 49 percent with the remainder (20%) privately funded by individuals or philanthropy (Ritter et al., 2014). Much of the Commonwealth funding is addressed elsewhere in this report (e.g. public hospitals, PBS, Medicare) however, the Commonwealth also funds non-government organisations to provide services. In 2012/13 these totalled $129 million and were funded through the Non-Government Organisation Treatment Grants Program (NGOTPP) and the Substance Misuse Service Delivery Grants Fund (SMSDGF) (Ritter et al., 2014).

The *New Horizons* review noted the difficulty in identifying the amount spent on treatment services from publicly available documents, including from budget statements (Ritter et al., 2014). Therefore, our main estimate uses a bottom up approach and is reported in Section 5.6 and Table 5.2. However, we note two Commonwealth Government announcements in the target year of funding for the treatment sector. There

[44] We note that less intensive (shorter) courses are now provided, so this cost may fall in future estimates.

was $87 million allocated in early 2015 for the 2015/16 financial year to non-government treatment agencies (Nash, 2015). These funds were allocated under the SMSDGF and the NGOTGP. Subsequently, funding allocation through the SMSDGF and NGOTGP has now been amalgamated into the Drug and Alcohol Program (personal communication Prevention and Treatment Section, Alcohol, Tobacco and Other Drugs Branch, September 2019). In late 2015, $300 million was announced for a four-year period (Turnbull et al., 2015). The funding was in response to the National Ice Taskforce's Final Report, with $298.2 million committed for treatment, workforce support, prevention and education and community engagement. The funding was allocated through the Primary Health Networks (PHN) in the planning and commissioning of drug and alcohol treatment services (personal communication Prevention and Treatment Section, Alcohol, Tobacco and Other Drugs Branch, September 2019). However, as this commenced from 1 July 2016 it is outside the target year of this report.

Table 11.4: Summary Chapter 11 costs

Cost area	Central estimate ($)	Low bound ($)	High bound ($)
Child protection cases	149,000,856	144,284,776	153,716,936
Child death reviews	591,301	[a]	[b]
Needle and syringe programs	13,161,000	[a]	[b]
Supervised Injecting Centre	1,484,200	[a]	[b]
School prevention programs	20,323,197	14,357,682	26,288,713
General prevention programs	9,222,888	[a]	[b]
Opioid overdose prevention	180,799		
Federal government programs [c]	-	-	-
Total	**193,964,241**	**183,282,646**	**204,645,837**

[a] Low bound estimate – duplicated central estimate: [b] High bound estimate – duplicated central estimate: [c] See Section 5.6 for bottom-up cost estimate.

11.6 Intangible costs of opioid attributable ill-health

11.6.1 Background

In addition to the tangible costs, many of the health problems attributable to opioids, and the long-term consequences of opioid attributable injuries also reduce the quality of life of those experiencing them.

The intangible impacts of road crash injuries are included in the cost calculations for opioid attributable road crash accidents set out in Chapter 8. The intangible costs to victims of crime, including the intangible costs of violent crime, are included in the cost calculations set out in Chapter 7. As such, the intangible costs of road crashes and interpersonal violence are excluded from these calculations. Finally, the intangible cost of arising from opioid dependence itself is assessed in section 10.2 and, as such, is excluded from these calculations.

As discussed in section 9.3, quality of life impacts due to ill-health are typically quantified through one of two measures of the number of health adjusted years of life lost to a condition, either a Disability Adjusted Life Year (DALY) or a Quality Adjusted Life Year (QALY). Consistent with the other sections of this report, the intangible impacts of ill-health have been measured in DALY, and specifically, as we are measuring reduced quality of life rather than reduced length of life, the intangible impact is years of life lost due to disability (YLD).

11.6.2 Method

There is considerable debate as to the best approach to expressing YLD (and DALY more generally) in monetary terms. Some authors recommend a straightforward conversion of a value of statistical life (VoSL) to a value of a life year (VoSLY) by annualising it from an assumed average number of years of life to live (Abelson, 2008; Moore, 2007; Nicosia et al., 2009). Others recommend either a context specific adaption from a VoSL taking into account current health states and expected future health state, or to calculate a VoSLY specific to the context of the particular study through a discrete choice survey of the relevant population (Baker et al., 2010; Dolan, 2010; Donaldson et al., 2011; Miller and Hendrie, 2011): see section 9.2 for a more extensive discussion.

Again, following the approach used elsewhere in this study we have used a value for a DALY based on the VoSLY derived from a VoSL. Our central estimate is based on the Abelson estimate of the value of a statistical life ($3-4 million in 2007 values, Abelson (2008), converted to 2015/16 values using the change in the average nominal national per capita income over that period, and then converted to a value of a life year (again see section 9.2 for the approach taken to the annualisation). Our high bound estimate of the VoSLY was derived from the value of a statistical life used by the US Department of Transport (US Department of Transportation, 2015). As a lower bound for the value per DALY lost we have used the implicit threshold value per DALY used for PBS approval, of $45,000 in 2014/15 values as the low bound: this latter value is implied rather than explicitly stated (Community Affairs References Committee, 2015; Harris et al., 2008).

The number of years of life lost due to disability for each partially opioid attributable condition was sourced from the Global Burden of Disease Study 2017 (Institute for Health Metrics and Evaluation, 2019). Data were extracted by condition, gender and broad age groups for persons aged 15 years and older. The data is provided by calendar year and an average was taken of the 2015 and 2016 estimates. In contrast to the approach taken elsewhere in this report, data on YLD is only available based on the total burden experienced in the year in question (e.g. as a stock measure). It is not possible to identify the extent to which these harms were first experienced in the study, or whether they represent long-term quality of life loss from harms that occurred in previous years.

The source of the relative risk estimates used to identify what proportion of the intangible cost should be attributed to opioids is the same as for the mortality and hospital separation calculations, see Table 2.1 for a summary.

Not all conditions identified as at least partially caused or prevented by opioids were individually identifiable in the GBD data, largely due to aggregation issues. The following conditions that are included in our hospital separations cost calculation were **excluded** from the YLD calculation due to data unavailability:

- Mental and behavioural disorders due to use of opioids or opioid poisoning (including overdoses, treatment of withdrawal and treatment of opioid use and dependence);
- Injecting-related infection attributable to opioids,
- Brain injury caused by mental and behavioural disorder due to use of opioids or opioid poisoning;
- Infective endocarditis; and
- Neonatal abstinence syndrome

As noted above, intangible costs arising from interpersonal violence and road crash injuries were excluded from this calculation as they have already been quantified in their respective sections, as was the cost of opioid dependence, which is assessed in Chapter 10.

11.6.3 Results

Estimates of the impact on quality of life of opioid attributable ill-health and injury where it can be quantified are set out in Table 11.5, expressed in total years of life lost to disability attributable to opioids by gender and broad age group.

Amongst those conditions that could be quantified, the total impact of opioid attributable ill-health is 10,131 years of life lost to disability (low bound: 3,682 YLD, high bound: 26,416 YLD). Seventy four percent of the intangible cost is borne by males, and 70 percent is borne by those aged 15 to 49.

Amongst the specific causes of ill-health, accidental injuries contribute a clear majority of the intangible cost, with a substantial cost also arising from illnesses secondary to injecting drug use.

Table 11.5 Quality of life impact of opioid attributable ill-health, 2015/16

Condition	Age group	Female			Male		
		Central estimate	Low bound	High bound	Central estimate	Low bound	High bound
Acute hepatitis B	*15-49 years*	*3.1*	*0.8*	*7.6*	*6.1*	*1.6*	*15.5*
	50-69 years	*1.5*	*0.3*	*4.2*	*2.7*	*0.7*	*7.3*
	70+ years	*0.4*	*0.1*	*1.2*	*0.5*	*0.1*	*1.6*
Acute hepatitis C	*15-49 years*	*1.1*	*0.4*	*2.5*	*1.4*	*0.5*	*3.0*
	50-69 years	*0.7*	*0.2*	*1.5*	*0.6*	*0.2*	*1.3*
	70+ years	*0.7*	*0.3*	*1.4*	*0.3*	*0.1*	*0.7*
HIV/AIDS and its complications	*15-49 years*	*3.2*	*1.3*	*6.8*	*15.4*	*6.8*	*30.7*
	50-69 years	*0.9*	*0.3*	*2.1*	*8.0*	*3.8*	*15.1*
	70+ years	*0.1*	*0.0*	*0.3*	*0.5*	*0.2*	*1.0*
Cirrhosis and other chronic liver diseases due to hepatitis B	*15-49 years*	*4.6*	*1.0*	*12.1*	*14.1*	*3.8*	*34.6*
	50-69 years	*3.8*	*0.8*	*10.6*	*14.5*	*4.0*	*35.4*
	70+ years	*1.4*	*0.3*	*4.1*	*3.8*	*1.0*	*9.7*
Cirrhosis and other chronic liver diseases due to hepatitis C	*15-49 years*	*93.9*	*49.8*	*151.9*	*136.8*	*78.9*	*213.3*
	50-69 years	*113.4*	*65.5*	*175.2*	*203.0*	*126.3*	*307.9*
	70+ years	*50.2*	*27.1*	*79.6*	*70.1*	*43.0*	*106.7*
Liver cancer due to hepatitis B	*15-49 years*	*0.1*	*0.0*	*0.3*	*0.6*	*0.4*	*0.6*
	50-69 years	*0.2*	*0.1*	*0.5*	*1.4*	*0.9*	*1.4*
	70+ years	*0.1*	*0.0*	*0.3*	*0.3*	*0.2*	*0.3*
Liver cancer due to hepatitis C	*15-49 years*	*0.6*	*0.3*	*0.9*	*3.8*	*5.5*	*2.4*
	50-69 years	*4.4*	*3.0*	*6.1*	*39.5*	*56.9*	*25.4*
	70+ years	*7.0*	*4.5*	*9.8*	*30.4*	*43.0*	*20.1*
Total illnesses secondary to injecting drug use	15-49 years	106.7	53.8	182.2	178.1	97.5	300.1
	50-69 years	124.9	70.3	200.2	269.7	192.7	393.9
	70+ years	59.9	32.4	96.6	105.9	87.5	140.1
Complications of low birthweight & pre-term birth	15-49 years	145.6	64.4	307.8	132.7	59.0	284.2
	50-69 years	56.8	25.0	121.0	42.3	18.6	91.0
	70+ years	8.9	3.9	19.0	4.2	1.9	8.8
Accidental injury (excluding transport accidents)	15-49 years	1,290.1	418.4	3,592.8	4,768.2	1,635.4	12,682.4
	50-69 years	425.7	136.0	1,231.3	1,385.0	448.8	3,942.1
	70+ years	350.2	112.5	994.6	529.4	169.5	1,476.3
Self-harm	15-49 years	54.7	19.5	134.1	52.4	20.4	119.7
	50-69 years	15.7	5.7	39.1	16.5	6.1	40.5
	70+ years	3.9	1.4	9.9	3.2	1.2	7.9
Total opioid attributable ill-health	**15-49 years**	**1,597.1**	**556.0**	**4,216.9**	**5,131.5**	**1,812.3**	**13,386.4**
	50-69 years	**623.0**	**237.0**	**1,591.6**	**1,713.5**	**666.2**	**4,467.5**
	70+ years	**422.9**	**150.2**	**1,120.1**	**642.7**	**260.1**	**1,633.0**
	All aged 15+	**2,643.0**	**943.2**	**6,928.6**	**7,487.7**	**2,738.5**	**19,486.9**

Source: YLD data, [Institute for Health Metrics and Evaluation (2019), Global Burden of Disease 2017, GBD Compare Tool, https://vizhub.healthdata.org/gbd-compare/, data extracted 9 April 2019. Share of harm attributable to opioid calculated from relative risks set out in Table 2.1.

Converting these YLD estimates to monetary values gives an estimate of the intangible cost of opioid attributable illness of $2.9 billion using the Abelson (2008) values of a statistical life year (low bound: $1.1 billion; high bound $7.6 billion) (Table 11.6).

Alternatively, if the value of a statistical life year implied by PBS decision criteria is used, the cost of opioid attributable ill-health is $471 million (low bound: $171 million, high bound $1.2 billion) (Community Affairs References Committee, 2015; Harris et al., 2008). Using the value of a statistical life year from the US Department of Transport (2015) gives an estimated cost of $8.6 billion (low bound $3.1 billion; high bound: $22.4 billion).

Table 11.6: Value of quality of life lost to opioid attributable ill-health and injury, 2015/16

Condition	Value of a Statistical Life Year from Abelson 2008			Value of a statistical life year derived from PBS criteria			Value of a statistical Life Year from US Department of Transportation		
	Central estimate $	Low bound $	High bound $	Central estimate $	Low bound $	High bound $	Central estimate $	Low bound $	High bound $
Acute hepatitis B	4,103,281	1,036,980	10,698,720	665,302	168,135	1,734,680	12,157,534	3,072,447	31,699,039
Acute hepatitis C	1,354,391	502,879	3,004,135	219,600	81,536	487,088	4,012,900	1,489,970	8,900,897
HIV/AIDS and its complications	8,038,393	3,546,285	16,037,657	1,303,337	574,991	2,600,330	23,816,804	10,507,220	47,517,676
Cirrhosis and other chronic liver diseases due to hepatitis B	12,072,820	3,149,492	30,504,793	1,957,475	510,656	4,946,017	35,770,333	9,331,571	90,382,082
Cirrhosis and other chronic liver diseases due to hepatitis C	191,264,701	111,947,681	296,478,178	31,011,471	18,151,087	48,070,681	566,694,618	331,687,697	878,429,665
Liver cancer due to hepatitis B	790,623	457,153	1,012,547	128,191	74,122	164,173	2,342,523	1,354,491	3,000,056
Liver cancer due to hepatitis C	24,572,885	32,440,892	18,517,871	3,984,224	5,259,934	3,002,469	72,806,543	96,118,515	54,866,255
Total illness secondary to injecting drug use	242,197,094	153,081,361	376,253,901	39,269,599	24,820,462	61,005,439	717,601,255	453,561,912	1,114,795,668
Complications of low birthweight & pre-term birth	111,907,959	49,499,934	238,356,457	18,144,647	8,025,871	38,646,882	331,570,007	146,662,430	706,221,902
Accidental injury (excluding transport accidents)	2,506,916,813	836,888,231	6,854,174,779	406,469,035	135,692,237	1,111,329,180	7,427,697,087	2,479,600,537	20,308,106,664
Self-harm	41,947,127	15,555,109	100,658,956	6,801,266	2,522,090	16,320,744	124,284,361	46,087,944	298,240,544
Total intangible costs of opioid attributable ill-health	**2,902,968,994**	**1,055,024,636**	**7,569,444,093**	**470,684,547**	**171,060,660**	**1,227,302,245**	**8,601,152,710**	**3,125,912,823**	**22,427,364,778**

Source: YLD data, [Institute for Health Metrics and Evaluation (2019), Global Burden of Disease 2017, GBD Compare Tool, https://vizhub.healthdata.org/gbd-compare/, data extracted 9 April 2019. The proportion of harms attributed to opioids is the same as for the mortality and hospital separation calculations: see Table 2.1 for a summary of the relative risks.

11.7 Conclusions

This chapter assembles costs from a diverse range of areas and has at times made speculative assumptions in attributing costs to extra-medical opioid use (Table 11.4). While in each case there is a clear argument that there will be costs, the quantum is different to determine. For example, ascribing childhood maltreatment, harms and deaths to a specific type of drug use is likely to be associated with a high level of uncertainty even though, by definition, there are links between maltreatment and harms (Radford et al., 2011). Using substantiated child protection cases is likely to identify the most severe instances of harm, but not all cases of harm or even all the cases of severe harm will be included in child protection data.

The intangible costs of ill-health were not included in the last national estimate of drug-related costs (Collins and Lapsley, 2008) and, at $2.9 billion represents a significant source of substance attributable costs, despite the fact that the DALY lost from a number of sources of opioid attributable ill-health could not be quantified. Therefore, improved availability of data may well increase the estimate of intangible costs in future analyses. In reviewing the literature, few studies include intangible costs either for the opioid consumer or for others impacted by people who use opioids.

11.8 Limitations

The costs due to premature mortality are reported in Chapter 3, but deaths resulting from childhood neglect associated with parental drug use may not be detected using our search strategy, as whilst deaths resulting from interpersonal violence and road crashes include those aged <15 years, other accidental injuries do not. Similarly, cases of childhood neglect or harm requiring hospital care should be addressed in Chapter 4, but again whilst separations for interpersonal violence and road crashes cover all ages other forms of accidental injury only include those aged 15 and older. While the data from child protection and child death reviews highlight these potential gaps, with the data that are publicly available, we have not been able to the estimate the number of additional deaths or hospital episodes that should be added to those sections of the report.

The issue of poly-substance use in child maltreatment, as with other sections of this report, also complicated the allocation of cases to a specific drug. Indeed, there is the additional difficulty in that the drug use is likely to be by a parent or guardian rather that the person incurring the harm. It is also more difficult to assert that extra-medical opioid use by a parent or guardian caused the harm and not some other characteristic of the person. Given the multifactorial nature of child neglect and harm (Field, 2016) even when case file based studies identify substance use, it is not a definitive assertion of causality between substance use and the maltreatment.

Both NSP and MSIC have track records of reducing the harms and associated costs of drug use, but we were only able to report the gross cost of these programs, rather than the net outcomes. There are also many community and other organisations working in the harm reduction field either directly relating to drug use or associated conditions (e.g. AIDS Councils and Hepatitis Australia). All these organisations would incur costs arising from people who use extra-medial opioids. We were unable to determine an appropriate method for allocating a proportion of their budgets against these costs.

In estimating the cost of school prevention programs and state-based prevention programs, we had to extrapolate from a single state (respectively Victoria and Western Australia) to national costs: these states may not be representative of the spending across jurisdictions. Clearly this is not ideal. Furthermore, although prevention activities were included in our previous report on the costs of methamphetamine use (Whetton et al., 2016), the expert advisory panel on tobacco recommended that, by convention, prevention activities are not included in assessing the costs of smoking in Australia (Whetton et al., 2019). Therefore, in this respect, the figure reported here is not directly comparable to the costs of tobacco use.

As shown by the wide range of estimated costs ($0.2 billion to $22.4 billion) this aspect of the analysis is at a formative stage. There are also disagreements in the literature around the preferred approach to valuing DALY and changes in the accepted practice could increase or decrease the estimates. Finally, a number of conditions with potentially significant impacts on quality of life, such as brain injuries, could not be quantified from the available data.

CHAPTER 12: CONCLUSIONS

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12.1 Findings

The changes seen in the types of opioids used, and the increased prevalence of use since the start of the 21st century have been accompanied by an increasing, age-standardised, rate of deaths (Australian Institute of Health and Welfare, 2018d). However, at 4.7 deaths per 100,000 this still remains below the peak in 1999 when the rate was 6.5 deaths per 100,000, at a time when heroin and plant-based opioids where the most frequently implicated opioids (Australian Institute of Health and Welfare, 2018d). Currently, pharmaceutical opioids, both synthetic and plant derived, represent three out of five deaths (Chrzanowska et al., 2019). These changes, together with the interval since the last evaluation by Moore (2007) are important contexts to the production of this report.

In the current study, the tangible cost of extra-opioid use was $5.63 billion with a further $10.13 billion in intangible costs with an overall total of $15.76 billion. The last comprehensive assessment of the social costs of opioids in Australia was conducted for 2004 (Moore, 2007) and included costs from: premature mortality; years lost due to disability; crime; and, road accidents. The total estimated cost was $4.75 billion, which after adjusting for CPI, equates to $6.08 billion in 2015/16 values (Australian Bureau of Statistics, 2016c). Leaving aside the intangible costs, the current estimate of tangible costs was $5.63 billion: 7.4 percent less than the previous estimate. The current estimate included a greater range of cost domains, including those of hospital separations, out-of-hospital care, primary care, medications and the contribution of informal carers. The previous estimate included welfare and labour market costs in the upper estimate: we have included workplace absenteeism; injuries and disruption due to premature mortality; and, work related traffic accidents (although these were included in the general estimate of traffic accident costs). The difference was mainly associated with the cost of crime, which at $1.71 billion in 2004, was nearly double our estimate, with the inclusion of property loss in the Moore estimates accounting for most of the difference.

There were an estimated 2,203 deaths attributable to opioids in the 12-months of 2015/16. While drug toxicity was the leading cause of death, BBV also extracted a considerable toll, representing about 40 percent of deaths. The mean age at death was 43 years for drug-induced deaths such as overdoses. Although this is a higher age than that for people who use methamphetamine (39 years (Whetton et al., 2016)), the number of cases was far greater than the 170 attributed to methamphetamine in 2013/14. There was a correspondingly greater cost of premature death at $12.61 billion compared with $781.8 [45] million for methamphetamine. By comparison the cost of premature mortality (tangible and intangible) from tobacco was $93.88 billion in 2015/16 (Whetton et al., 2019).

The extra-medical use of opioids has effects that are experienced across the health system. We estimated that there were more than 32,000 hospital separations, but the largest costs were for out-of-hospital care. We estimated that the cost of pharmaceuticals for opioid attributable ill-health exceeded $311 million, not including OST, with primary care costing a further $234 million. In estimating the cost of tobacco-related ill-health, the value of informal carers was the greatest single item, accounting for 30 percent of health costs (Whetton et al., 2019). With respect to extra-medical opioids, informal care represented less than 8 percent of other healthcare costs. However, from the data that were available, we were unable to assign costs to some of the major chronic problems arising from opioid use, especially those that can arise through IDU e.g.

[45] CPI adjusted to December 2015 $795.0 million (Reserve Bank of Australia, 2019)

infection with BBV and their sequelae. Conversely, living with a person who is dependent on extra-medical opioids, is likely to have significant impacts on the quality of life of co-residents, which may include addressing acute health needs: in relation to tobacco use no cost was assigned to being a co-resident other than via hospital separations due to second-hand smoking.

The costs associated with extra-medical opioid use in terms of crime and the criminal justice system were substantial at $936.1 million. This cost domain was second only to premature mortality in terms of tangible costs. In comparison, the 2013/14 equivalent cost relating to criminal justice due to methamphetamine was $3.24 billion [46] (Whetton et al., 2016), which was the largest tangible cost. This difference reflects the significantly higher AF for methamphetamine in DUMA data (16.2% of total crime in 2013/14[47] compared with 3.4% for heroin in 2015/16), as well as real terms increases in justice system costs, the exclusion of opioids other than heroin from the DUMA survey, and the greater prevalence of methamphetamine use compared to heroin (Whetton et al., 2016)).

There were also some domains where we estimated the cost but did not include these in the overall total. There was $14.9 billion arising from the pain and suffering for those people who were dependent on extra-medical opioids and $1.4 billion spent on drug purchases. In addition to these 'internalities' for those dependent on opioid drugs, we estimated that their partners and children incurred $11.98 billion in lost quality of life from living with a person dependent on extra-medical opioids. We adopted a conservative approach and excluded this latter estimate from the total cost because it may result in 'double counting' some intangible costs, for example being the victim of a crime.

A recent review from the USA noted that social cost studies often under-estimate the economic costs of opioids by omitting the 'value of a statistical life' from their calculations (Council of Economic Advisers, 2017). After adjusting all costs to 2015 values, the Council of Economic Advisers' total of USD 504.0 billion was more than six times greater than the next highest estimate for the USA (2017). The Council of Economic Advisors noted the importance of including the full cost of fatalities, given that the total of non-fatal costs (e.g. general health care, substance use treatment, criminal justice, reduced workforce productivity) was USD 72.3 billion, which amounted to just 13 percent of the total costs of opioid use in the USA (Council of Economic Advisers, 2017). In the current analysis the tangible and intangible cost of premature mortality was 80.1 percent of the total.

12.2 Limitations

There will always be a margin of error in attributing events to opioid use and assigning costs from administrative data not designed for the task. However, we did identify some major cost areas where we were unable to find or develop a rationale for apportioning costs. For example, we did not allocate any costs attributable to Federal criminal matters, neither did we allocate any portion of the budgets for border protection, drug interdiction or coronial investigations. Similarly, there were a range of other health costs such as dental care and out-of-hospital physiotherapy / rehabilitation services where this also occurred. In Section 11.2 we speculate that some of the cases that undergo child death reviews could be attributed to opioids, but we were unable to definitively identify any cases to add to our estimate derived from the NCIS.

[46] CPI adjusted to December 2015 $3.35 billion (Reserve Bank of Australia, 2019).

[47] The proportion of crime attributed to methamphetamine from the DUMA data has increased still further, reaching 27.0% in 2015/16 and so the disparity in costs would likely be even greater were the methamphetamine estimates updated (AIC DUMA collection 2015/16 [computer file]).

This report drew on methods used in two earlier reports on the social costs of methamphetamine (Whetton et al., 2016) and the social costs of tobacco (Whetton et al., 2019). However, some differences are apparent because of data availability, improved methods, and differences in the types of costs conventionally included. The largest cost areas that were added in the cost of tobacco study were those of the intangible costs of the lost quality of life arising from ill-health, and the contribution of informal carers, neither of which were included in the methamphetamine report. The differences in the methods that were used are summarised in Table 12.1 and show if methods were the same/similar (✓), different (x) or if the domain was not relevant to a specific substance (n/a). Further, there were some unique costs for specific substances: for example, damage from clandestine laboratories (methamphetamine) and fires from discarded cigarettes (tobacco) that are not noted in the table. Finally, it should be noted that the costs for the methamphetamine report were for the financial year 2013/14.

In Chapter 3, we identified 894 deaths relating to BBV and their sequelae. In Chapter 4, more than $44 million was attributed to hospital separations with these conditions and in Chapter 5 a further $311 million was allocated in PBS pharmacotherapies, primarily for HCV. However, in Chapter 11 we note what appears to be a dramatic change in the HCV antibody prevalence following the introduction of universal access to direct acting antiviral therapy (Heard et al., 2018). Similarly, the introduction of pre-exposure prophylaxis (PrEP) is likely to change rates of HIV infection (Grulich et al., 2018) which have remained at or below 2.1 percent since 1995 (Heard et al., 2019; Iversen and Maher, 2015). Therefore, care will be needed if this cost estimation is updated in the future, to re-assess premature deaths, hospital separations and medication costs for these conditions.

In estimating the costs related to methamphetamine, crime and the criminal justice system was the largest single cost domain, representing 65 percent of the total (Whetton et al., 2016). In this instance crime and the criminal justice system accounted for 5.9 percent of the costs. The primary difference in the drivers of cost was the proportion of police detainees attributing their offending to the substance in question (and having used that substance in the last 30 days). In the combined 2015 and 2016 data, 21.8 percent of those in the survey whose most serious offence was a violent crime attributed their offending to methamphetamines (data not in results). In contrast, 2.1 percent attributed their offending to heroin. Similar proportions were reported in 2018 for violent crime, where the attribution for methamphetamine was 21 percent and for heroin, 2 percent (Voce and Sullivan, 2018). Therefore, if we were to update the costs, it is likely that crime would account for an even larger share of the methamphetamine attributable costs.

However, in both analyses, the limitation of using AF derived from DUMA were apparent. Firstly, because these only consider the most serious offence category, and more importantly, the extent to which it is appropriate to generalise from these AF based on those detained by police to different stages of the justice system. In addition, no reliable data were available with which to calculate the relevant AF for juvenile offenders, who account for 13 percent of offenders (Australian Bureau of Statistics, 2017g, Table 18). While the omission of costs for juveniles will underestimate the costs in this domain, the direction of the effect of generalising the AF from police detainees to more distal aspects of the system is unknown.

In the current analysis we improved the method of estimating deaths arising from IDU compared to the analysis used for methamphetamine (Whetton et al., 2016). BBV and their sequelea were eligible for inclusion but could not be identifed in the NCIS data. In the current analysis, we used indirect attribution for specific conditions (HBV and HCV, HIV, liver cirrhosis secondary to HBV and HCV, liver cancer secondary to HBV and HCV) with data from the GBD (2018). As with the methamphetamine report, we were still unable to quantify deaths from infective endocarditis.

Table 12.1 Comparison of methods between recent social cost reports

Domain	Opioids	Tobacco	Methamphetamine	Comments on difference
Tangible costs				
Mortality	✓	x	✓	National Mortality Data (indirect attribution) v National Coronial Information System data (direct attribution)
Mortality (injecting drug use)	✓	n/a	x	Improved method – see Section 12.2 for details.
Avoided health care cost	✓	✓	✓	
Hospital separations	✓	✓	✓	
Primary care	✓	✓	x	Unique methamphetamine data set
ED / Outpatients	✓	✓	x	Unique methamphetamine data set
Ambulance	✓	✓	x	Unique methamphetamine data set
Community mental health	✓	n/a	✓	
Cessation medications	✓	✓	n/a	(None approved for methamphetamine)
PBS medications	✓	✓	x	Method developed post methamphetamine report
Informal carers	✓	✓	x	Method developed post methamphetamine report
Crime	?	n/a	?	Minor differences in offender categories
Workplace absenteeism	✓	✓	✓	Minor differences in reference wage rates
Workplace presenteeism	x	✓	x	Unable to estimate presenteeism for illicit drugs
Workplace injuries	✓	✓	✓	Minor differences in reference wage rates
Road traffic accidents	✓	x	✓	Unable to estimate RTA for tobacco
Child maltreatment	✓	n/a	✓	
Prevention	✓	x	✓	Excluded from tobacco for reasons of convention
Drug purchase	x	✓	x	Illicit drug purchase costs too speculative to include in the totals, however spending was estimated and reported in Chapter 11
Intangible Costs				
Premature mortality	✓	✓	?	Central estimate cost for 1 year (high bound values same methods used)
Ill-health	✓	x	✓	More data available on tobacco ill health
Harms from living with a dependent person	✓	n/a	✓	

Sources: Methamphetamine (Whetton et al., 2016): Tobacco (Whetton et al., 2019).
n/a = not applicable: x = different method: ? = some / minor differences: ✓ comparable methods.

12.3 Future directions

A major difficulty in assessing harms from illicit drug use compared with licit drugs such as tobacco or alcohol, is determining the size of the population at risk. In this case we used the GBD compare tool to identify the population, but this does not differentiate dependence on heroin from dependence on other (pharmaceutical) opioids. From national survey data, the prevalence of heroin *use* is much lower than the *use* of other opioids (see Table 2.1). In contrast, heroin represents 59 percent of the identified treatment episodes for opioids (Australian Institute of Health and Welfare, 2017c) with the implication that for those using opioids there are greater harms or costs and hence demand for treatment arising from the use of heroin. Therefore, an analysis that includes an assumption that all types of extra-medical opioid dependence are equivalent may be inaccurate. Further work is warranted to determine the ratio of heroin to other forms of opioid dependence and their respective levels of harm.

We excluded the costs arising to resident partners and children from living with a person with extra-medical opioid dependence from our main analysis because of their potential overlap with other costs that were included. Nevertheless, the cost estimates in this area, although tentative, may be considerable (see Chapter 11). We were unable to find any research specifically on the intangible harms experienced by partners and children so instead used estimates of improvements when an individual receives treatment for a substance use disorder (Mortimer and Segal, 2006). In addition, some have argued that there is a tendency for couples to have similar drug use patterns either through assortative mating or direct influence (Kendler et al., 2018). This means that some resident children are likely to have both parents affected by substance use disorders, thus potentially increasing the risk and nature of the harms that they experience.

While noting the impact of new medications for BBV, further reductions in the harms and especially overdose deaths from opioid use may follow the rescheduling of naloxone in Australia (Lenton et al., 2016). Given the costs associated with premature mortality, even reversing a single overdose would have substantial cost savings. The release of an intranasal spray, which should be easier to use than injectable formulations (Paola, 2019), may also increase the number of people willing to carry and administer naloxone. It is too early to determine if this will have a noticeable effect of the number of opioid deaths in Australia, but in the USA there were 26,463 overdose reversals performed by laypersons between 1996 and 2014 (Wheeler et al., 2015). Finally, the importance of opioid agonist treatment (e.g. methadone, buprenorphine) in reducing mortality and improving multiple other health and social outcomes must be emphasised, with modelling suggesting that it could reduce deaths over 20 years by between 7.7 percent and 25.9 percent (depending in the relevant prevalence of HIV) (Degenhardt et al., 2019). Therefore, there is significant potential that the number of opioid related deaths and costs can be reduced. Nevertheless, while each of these individual programs provide benefits, a comprehensive 'overdose' prevention strategy is required to coordinate activities to maximise their effectiveness.

12.4 Conclusions

The overall costs for pharmaceutical opioid misuse and illicit opioid use was $15.76 billion: two-thirds of this cost was attributed to intangibles. Premature deaths, health problems and crime were the leading sources of tangible costs We have also commented on domains where there are insufficient data to allow us to include figures in the main estimate and there were some gaps in data suggesting our estimate of costs is conservative. Even so, we have identified significant impacts for consumers, their families, friends and work colleagues and the broader Australian community. While the number of deaths was the main driver of costs, crime, poor health and accidents also have significant imposts across the community.

These differences in costs may indicate different focuses are appropriate for public policy, for example, in the case of opioids, policies that act to reduce the number of deaths such as those from acute toxicity would target the greatest area of cost.

REFERENCES

Abdel-Latif, M.E., Oei, J., Craig, F., Lui, K., 2013. Profile of infants born to drug-using mothers: a state-wide audit. *Journal of Paediatrics and Child Health* 49, E80-86.

Abelson, P., 2008. Establishing a monetary value for lives saved: Issues and controversies, Working Papers in Cost-Benefit Analysis. WP 2008-02, Office of Best Practice Regulation, Department of Finance and Deregulation.

Akerlof, G., 1991. Procrastination and obedience. *American Economic Review* 81, 1-19.

Aleksandrov, S., 2004. Dynamics of time intervals evaluation in heroin addicts. *Zhurnal Nevrologii i Psikhiatrii Imeni SS Korsakova* 104, 21-24.

Ananthakrishnan, A., Gogineni, V., Saeian, K., 2006. Epidemiology of primary and secondary liver cancers. *Seminars in Interventional Radiology* 23, 047-063.

Andersen, S.N., Skullerud, K., 1999. Hypoxic/ischaemic brain damage, especially pallidal lesions, in heroin addicts. *Forensic Science International* 102, 51-59.

Angeletos, G.-M., Laibson, D., Repetto, A., Tobacman, J., Weinberg, S., 2001. The hyperbolic consumption model: Calibration, simulation, and empirical evaluation. *Journal of Economic Perspectives* 15, 47-68.

Arria, A.M., Mericle, A.A., Meyers, K., Winters, K.C., 2012. Parental substance use impairment, parenting and substance use disorder risk. *Journal of Substance Abuse Treatment* 43, 114-122.

Ashrafioun, L., Bishop, T.M., Conner, K.R., Pigeon, W.R., 2017. Frequency of prescription opioid misuse and suicidal ideation, planning, and attempts. *Journal of Psychiatric Research* 92, 1-7.

Auditor General Victoria, 2003. Drug Education in Government Schools. Melbourne, Government of Victoria.

Australian Bureau of Statistics, 1997. Unpaid Work and the Australian Economy, 5240. Canberra, ABS.

Australian Bureau of Statistics, 2011. Australian and New Zealand Standard Offence Classification, 1234.0. ABS, Canberra.

Australian Bureau of Statistics, 2014. Criminal Courts 2013-14, Cat. no. 4513.0. Canberra, ABS.

Australian Bureau of Statistics, 2016a. Average Weekly Earnings, Australia, Nov 2015. Cat. no. 6302.0. Canberra, ABS.

Australian Bureau of Statistics, 2016b. Causes of Death, Australia 2015 Cat. no. 3303.0. Canberra, ABS.

Australian Bureau of Statistics, 2016c. Consumer Price Index Inflation Calculator. Canberra, ABS. http://www.abs.gov.au/websitedbs/d3310114.nsf/home/Consumer+Price+Index+Inflation+Calculator

Australian Bureau of Statistics, 2016d. Consumer Price Index, Australia, December 2015, Table 1, Cat. no. 6401.0. Canberra, ABS.

Australian Bureau of Statistics, 2016e. Disability, Ageing and Carers, Australia, Cat. no. 4430.0. Canberra, ABS.

Australian Bureau of Statistics, 2016f. Prisoners in Australia, Cat. no. 4517.0. Canberra, ABS.

Australian Bureau of Statistics, 2017a. 2016 Census of Population and Housing, Tablebuilder Pro database. Canberra, ABS.

Australian Bureau of Statistics, 2017b. Causes of Death, Australia, 2016, cat. no. 3303.0. Canberra, ABS.

Australian Bureau of Statistics, 2017c. Confidentialised Unit Record File, Disability, Ageing and Carers, Australia, 2015, 4430.0.30.002. Canberra, ABS.

Australian Bureau of Statistics, 2017d. Crime Victimisation, Australia 2015-16, Cat. no. 4530.0. Canberra, ABS.

Australian Bureau of Statistics, 2017e. Criminal Courts, Australia, 2015-16, Cat. no. 4513.0. Canberra, ABS.

Australian Bureau of Statistics, 2017f. Prisoners in Australia, Cat. no. 4517.0. Canberra, ABS.

Australian Bureau of Statistics, 2017g. Recorded Crime - Offenders, 2015-16. Canberra, ABS.

Australian Bureau of Statistics, 2017h. Schools, Australia, 4221.0 Canberra, ABS.

Australian Bureau of Statistics, 2018a. Australian Demographic Statistics, 3101.0. Canberra, ABS.

Australian Bureau of Statistics, 2018b. Australian National Accounts: National Income, Expenditure and Product, Dec 2017, Table 34, 5206.0. Canberra, ABS.

Australian Bureau of Statistics, 2018c. Causes of Death, Australia, 2017 Cat. No. 3303.0. Canberra, ABS.

Australian Bureau of Statistics, 2018d. Life Tables, States, Territories and Australia, 2015-2017, 3302.055.001. Canberra, ABS.
Australian Bureau of Statistics, 2019a. Australian National Accounts: National Income, Expenditure and Product. cat no. 5206.0, Canberra, Commonwealth of Australia.
Australian Bureau of Statistics, 2019b. Causes of Death, Australia, 2018, cat. no. 3303.0. Canberra, ABS.
Australian Bureau of Statistics, 2019c. Consumer Price Index Inflation Calculator. Canberra, ABS. http://www.abs.gov.au/websitedbs/d3310114.nsf/home/Consumer+Price+Index+Inflation+Calculator
Australian Bureau of Statistics, 2019d. Labour Force Australia. Cat no. 6202.0, Canberra, ABS.
Australian Bureau of Statistics, 2019e. Recorded Crime and Victims, Cat no 4510.0. Canberra, ABS.
Australian Criminal Intelligence Commission, 2018. National Wastewater Drug Monitoring Program—Report 4. Canberra, ACIC.
Australian Government Department of Health and Ageing, 2002. Return on Investment in Needle and Syringe Programs in Australia. Canberra, Australian Government.
Australian Government Department of Health and Ageing, 2009. Return on Investment 2: Evaluating the Cost-Effectiveness of Needle and Syringe Programs in Australia 2009. Sydney, National Centre in HIV Epidemiology and Clinical Research.
Australian Institute of Criminology, 2019. Drug use monitoring in Australia, data extraction: AIC DUMA collection 2015-16 [computer file], AIC, Canberra.
Australian Institute of Health and Welfare, 2012. Dementia in Australia Cat. no. AGE 70. Canberra, AIHW.
Australian Institute of Health and Welfare, 2016a. Australian Burden of Disease study: Impact and causes of illness and death in Australia 2011, Australian Burden of Disease Study Series no. 3. Canberra, AIHW.
Australian Institute of Health and Welfare, 2016b. Child protection Australia 2014-15, Child Welfare Series no. 63. Canberra, AIHW.
Australian Institute of Health and Welfare, 2016c. Emergency department care 2015–16: Australian hospital statistics, Health Services Series no. 72. Cat. no. HSE 182. Canberra, AIHW.
Australian Institute of Health and Welfare, 2017a. 2016 National drug strategy household survey: Online data tables, AIHW, Canberra.
Australian Institute of Health and Welfare, 2017b. Admitted patient care 2015-16. Australian hospital statistics, Health Services Series Number 75. Canberra, Government of Australia.
Australian Institute of Health and Welfare, 2017c. Alcohol and other drug treatment services in Australia 2015-16, Drug Treatment Series no. 29. Canberra, AIHW.
Australian Institute of Health and Welfare, 2017d. Alcohol and other drug treatment services in Australia 2015–16: Supplementary tables, Drug Treatment Series no. 29. Cat. no. HSE 187, Canberra, AIHW.
Australian Institute of Health and Welfare, 2017e. Emergency department care 2016–17: Australian hospital statistics, Health services series no. 80. Cat. no. HSE 194. Canberra, AIHW.
Australian Institute of Health and Welfare, 2017f. Health expenditure Australia 2015–16, Health and Welfare Expenditure series no. 58. Canberra, AIHW.
Australian Institute of Health and Welfare, 2017g. National drug strategy household survey 2016, Drug Statistics Series. Canberra, Government of Australia.
Australian Institute of Health and Welfare, 2017h. National drug strategy household survey 2016 questionnaire. Canberra, AIHW.
Australian Institute of Health and Welfare, 2017i. National drug strategy household survey 2016: Confidentialised unit record file. Available from the Australian Data Archive, Canberra, AIHW.
Australian Institute of Health and Welfare, 2017j. Non-admitted patient care 2015–16: Australian hospital statistics, Health Services Series Number 76. Canberra, Government of Australia.
Australian Institute of Health and Welfare, 2018a. Admitted patient care 2016–17: Australian hospital statistics, Health services series no. 84. Canberra, Government of Australia.
Australian Institute of Health and Welfare, 2018b. Impact of alcohol and illicit drug use on the burden of disease and injury in Australia: Australian Burden of Disease Study 2011, Australian Burden of Disease Study series no. 17. Cat. no. BOD 19. Canberra, AIHW.

Australian Institute of Health and Welfare, 2018c. National Hospital Morbidity Database 2015/16, AIHW, Canberra.
Australian Institute of Health and Welfare, 2018d. Opioid harm in Australia and comparisons between Australia and Canada Cat. no. HSE 210. Canberra, AIHW.
Australian Institute of Health and Welfare, 2019a. Alcohol, tobacco & other drugs in Australia. AIHW, Canberra. 2 Oct 2019. https://www.aihw.gov.au/reports/alcohol/alcohol-tobacco-other-drugs-australia/contents/priority-populations/people-who-inject-drugs
Australian Institute of Health and Welfare, 2019b. National Hospitals Data Collection. AIHW, Canberra. 5 Nov 2019. https://www.aihw.gov.au/about-our-data/our-data-collections/national-hospitals-data-collection
Australian Institute of Health and Welfare, 2019c. State and territory community mental health care services 2015-16, Mental Health Services in Australia. 16 July 2019, Canberra, AIHW.
Australian National Council on Drugs, 2013. Needle and syringe programs, ANCD Position Paper. Canberra, ANCD.
Australian Safety and Compensation Council, 2007. Work-related alcohol and drug use - A fit for work issue. Canberra, Government of Australia.
Azuine, R.E., Ji, Y., Chang, H.-Y., Kim, Y., Ji, H., DiBari, J., Hong, X., Wang, G., Singh, G.K., Pearson, C., 2019. Prenatal risk factors and perinatal and postnatal outcomes associated with maternal opioid exposure in an urban, low-income, multiethnic US population. *JAMA Network Open* 2, e196405-e196405.
Baker, R., Bateman, I., Donaldson, C., Jones-Lee, M., Lancsar, E., Loomes, G., Mason, H., Odejar, M., Pinto Prades, J.L., Robinson, A., Ryan, M., Shackley, P., Smith, R., Sugden, R., Wildman, J., 2010. Weighting and Valuing Quality-Adjusted Life-Years Using Stated Preference Methods: Preliminary Results from the Social Value of a QALY Project. *Health Technology Assessment* 14, 1-161.
Baselt, R.C., 2008. Disposition of Toxic Drugs and Chemicals in Man, 8th edtion. Biomedical Publications, Foster City CA.
Becker, G.S., Murphy, K.M., 1988. A theory of rational addiction. *Journal of Political Economy* 96, 675-700.
Bennett, T., Holloway, K., Farrington, D., 2008. The statistical association between drug misuse and crime: A meta-analysis. *Aggression and Violent Behavior* 13, 107-118.
Birnbaum, H.G., White, A.G., Schiller, M., Waldman, T., Cleveland, J.M., Roland, C.L., 2011. Societal costs of prescription opioid abuse, dependence, and misuse in the United States. *Pain Medicine* 12, 657-667.
Bosch, F.X., Ribes, J., Díaz, M., Cléries, R., 2004. Primary liver cancer: worldwide incidence and trends. *Gastroenterology* 127, S5-S16.
Britt, H., Miller, G., Henderson, J., Bayram, C., Harrison, C., Valenti, L., Pan, Y., Charles, J., Pollack, A., Wong, C., Gordon, J., 2016. General practice activity in Australia 2015–16, General Practice Series no. 40. Sydney, Sydney University Press.
Bromfield, L., Higgins, D., 2005. National comparison of child protection systems, Child Abuse Prevention Issues. Canberra, Australian Institute of Family Studies.
Bryant, B., Knights, K., 2014. Pharmacology for Health Professionals, 4th Edition. Elsevier.
Bryun, E., Gekht, A., Polunina, A., Davydov, D., Gusev, E., 2001. Neuropsychological deficit in chronic heroin abusers. *Zhurnal Nevrologii i Psikhiatrii Imeni SS Korsakova* 101, 10-19.
Bureau of Infrastructure Transport and Regional Economics, 2009. Road crash costs in Australia 2006, Report 118. Canberra, BITRE.
Bureau of Infrastructure Transport and Regional Economics, 2017. Road Trauma Australia 2016, Statistical Summary. Canberra, BITRE.
Bureau of Infrastructure Transport and Regional Economics, 2019. 2019 Australian Road Deaths Database: Fatalities. Australian Government, Australia. 26 Aug 2019. https://www.bitre.gov.au/statistics/safety/fatal_road_crash_database.aspx
Bush, R., Wooden, M., 1995. Smoking and absence from work: Australian evidence. *Social Science and Medicine* 41, 437-446.

Büttner, A., Mall, G., Penning, R., Weis, S., 2000. The neuropathology of heroin abuse. *Forensic Science International* 113, 435-442.
Callinan, S., Laslett, A.-M., Rekve, D., Room, R., Waleewong, O., Benegal, V., Casswell, S., Florenzano, R., Hanh, H.T.M., Hanh, V.T.M., 2016. Alcohol's harm to others: An international collaborative project. *The International Journal of Alcohol and Drug Research* 5, 25-32.
Canadian Substance Use Costs and Harms Scientific Working Group, 2018. Canadian substance use costs and harms (2007–2014). Ottawa, Ont., Prepared by the Canadian Institute for Substance Use Research and the Canadian Centre on Substance Use and Addiction.
Cawley, J., Ruhm, C.J., 2011. The economics of risky health behaviors. In: Pauly, M.V., McGuire, T.G., Barros, P.P. (Eds.), The Handbook of Health Economics, volume 1. North-Holland, Oxford.
Centrelink, 2015. A Guide to Australian Government Payments, 1 July to 19 September 2015. Canberra, Australian Government Department of Human Services.
Ch'ng, C.W., Fitzgerald, M., Gerostamoulos, J., Cameron, P., Bui, D., Drummer, O.H., Potter, J., Odell, M., 2007. Drug use in motor vehicle drivers presenting to an Australian, adult major trauma centre. *Emergency Medicine Australasia* 19, 359-365.
Chaffin, M., Kelleher, K., Hollenberg, J., 1996. Onset of physical abuse and neglect: Psychiatric, substance abuse, and social risk factors from prospective community data. *Child Abuse and Neglect* 20, 191-203.
Chalmers, J., Lancaster, K., Hughes, C., 2016. The stigmatisation of 'ice' and under-reporting of meth/amphetamine use in general population surveys: A case study from Australia. *International Journal of Drug Policy*, dx.doi.org/doi:10.1016/j.drugpo.2016.1006.1001.
Chihuri, S., Li, G., 2017. Use of prescription opioids and motor vehicle crashes: A meta analysis. *Accident Analysis and Prevention* 109, 123-131.
Chihuri, S., Li, G., 2019. Use of prescription opioids and initiation of fatal 2-vehicle crashes. *JAMA Network Open* 2, e188081-e188081.
Chrzanowska, A., Dobbins, T., Degenhardt, L., Peacock, A., 2019. Trends in drug-induced deaths in Australia, 1997-2017, Drug Trends Bulletin Series. Sydney, National Drug and Alcohol Research Centre, UNSW.
Ciccarone, D., Unick, G.J., Cohen, J.K., Mars, S.G., Rosenblum, D., 2016. Nationwide increase in hospitalizations for heroin-related soft tissue infections: Associations with structural market conditions. *Drug and Alcohol Dependence* 163, 126-133.
Clark, N., Gospodarevskaya, E., Harris, A., Ritter, A., 2003. Estimating the Cost of Heroin Use in Victoria, Report to the Premier's Drug Prevention Council. Melbourne, Department of Human Services.
Cleary, B.J., Donnelly, J.M., Strawbridge, J.D., Gallagher, P.J., Fahey, T., White, M.J., Murphy, D.J., 2011. Methadone and perinatal outcomes: A retrospective cohort study. *American Journal of Obstetrics and Gynecology* 204, 139. e131-139. e139.
Collins, D.J., Lapsley, H.M., 1996. The social costs of drug abuse in Australia in 1988 and 1992, National Drug Strategy Monograph Series No. 30. Canberra, Commonwealth Department of Health & Human Services.
Collins, D.J., Lapsley, H.M., 2002. Counting the cost: Estimates of the social costs of drug abuse in Australia in 1998-9, National Drug Strategy Monograph Series No. 49. Canberra, Commonwealth Deapartment of Health & Ageing.
Collins, D.J., Lapsley, H.M., 2008. The costs of tobacco, alcohol and illicit drug abuse to Australian society in 2004/05, National Drug Strategy Monograph Series No. 64. Canberra, Commonwealth of Australia.
Comer, S.D., Cahill, C.M., 2019. Fentanyl: Receptor pharmacology, abuse potential, and implications for treatment. *Neuroscience and Biobehavioral Reviews*, DOI: 10.1016/j.neubiorev.2018.1012.1005.
Commonwealth Director of Public Prosecutions, 2016. Annual Report, 2015-16. Canberra, CDPP.
Commonwealth of Australia, 2006. National Clinical Guidelines for the management of drug use during pregnancy, birth and the early development years of the newborn. Sydney, Australia,

Community Affairs References Committee, 2015. Availability of new, innovative and specialist cancer drugs in Australia. Canberra, The Senate, Commonwealth of Australia.
Compton, W.M., Jones, C.M., Baldwin, G.T., 2016. Relationship between nonmedical prescription-opioid use and heroin use. *New England Journal of Medicine* 374, 154-163.
Corr, T.E., Hollenbeak, C.S., 2017. The economic burden of neonatal abstinence syndrome in the United States. *Addiction* 112, 1590-1599.
Costa, D.L., Kahn, M.E., 2004. Changes in the Value of Life, 1940–1980. *Journal of Risk and Uncertainty* 29, 159-180.
Council of Economic Advisers, 2017. The Underestimated Cost of the Opioid Crisis. Washington, DC, Executive Office of the President.
Council of Obstetric and Paediatric Mortality and Morbidity, 2017. Annual Report 2015. Hobart, Department of Health and Human Services, Tasmania.
Council of Obstetric and Paediatric Mortality and Morbidity, 2018. Annual Report 2016. Hobart, Department of Health and Human Services, Tasmania.
Darke, S., 2010. The toxicology of homicide offenders and victims: A review. *Drug and Alcohol Review* 29, 202-215.
Darke, S., 2011. The Life of the Heroin User: Typical Beginnings, Trajectories and Outcomes. Cambridge University Press, UK.
Darke, S., 2016. Heroin overdose. *Addiction* 111, 2060-2063.
Darke, S., Farrell, M., 2014. Would legalizing illicit opioids reduce overdose fatalities? Implications from a natural experiment. *Addiction* 109, 1237-1242.
Darke, S., Lappin, J., Farrell, M., 2019. The Clinician's Guide to Illicit Drugs and Health. Silverback, London.
Darke, S., Sims, J., McDonald, S., Wickes, W., 2000. Cognitive impairment among methadone maintenance patients. *Addiction* 95, 687-695.
Degenhardt, L., Charlson, F., Ferrari, A.J., Santomauro, D., Erskine, H., Mantilla-Herrara, A., Whiteford, H.A., Leung, J., Naghavi, M., Griswold, M., 2018. The global burden of disease attributable to alcohol and drug use in 195 countries and territories, 1990–2016: A systematic analysis for the Global Burden of Disease Study 2016. *The Lancet Psychiatry* 5, 987-1012.
Degenhardt, L., Gisev, N., Cama, E., Nielsen, S., Larance, B., Bruno, R., 2016a. The extent and correlates of community-based pharmaceutical opioid utilisation in Australia. *Pharmacoepidemiology and Drug Safety* 25, 521-538.
Degenhardt, L., Gisev, N., Trevena, J., Larney, S., Kimber, J., Burns, L., Shanahan, M., Weatherburn, D., 2013a. Engagement with the criminal justice system among opioid-dependent people: A retrospective cohort study. *Addiction* 108, 2152-2165.
Degenhardt, L., Grebely, J., Stone, J., Hickman, M., Vickerman, P., Marshall, B.D.L., Bruneau, J., Altice, F.L., Henderson, G., Rahimi-Movaghar, A., Larney, S., 2019. Global patterns of opioid use and dependence: harms to populations, interventions, and future action. *The Lancet* 394, 1560-1579.
Degenhardt, L., Larney, S., Chan, G., Dobbins, T., Weler, M., Roxburgh, A., Hall, W.D., McKetin, R., 2016b. Estimating the number of regular and dependent methamphetamine users in Australia, 2002–2014. *Medical Journal of Australia* 204, e1.
Degenhardt, L., Peacock, A., Colledge, S., Leung, J., Grebely, J., Vickerman, P., Stone, J., Cunningham, E.B., Trickey, A., Dumchev, K., 2017. Global prevalence of injecting drug use and sociodemographic characteristics and prevalence of HIV, HBV, and HCV in people who inject drugs: A multistage systematic review. *The Lancet Global Health* 5, e1192-e1207.
Degenhardt, L., Whiteford, H.A., Ferrari, A.J., Baxter, A.J., Charlson, F.J., Hall, W.D., Freedman, G., Burstein, R., Johns, N., Engell, R.E., 2013b. Supplement to: Global burden of disease attributable to illicit drug use and dependence: findings from the Global Burden of Disease Study 2010. *The Lancet* 382.
Degenhardt, L., Whiteford, H.A., Ferrari, A.J., Baxter, A.J., Charlson, F.J., Hall, W.D., Freedman, G., Burstein, R., Johns, N., Engell, R.E., Flaxman, A., Murray, C.J.L., Vos, T., 2013c. Global burden of disease

attributable to illicit drug use and dependence: Findings from the Global Burden of Disease Study 2010. *The Lancet* 382, 1564-1574.

Deloitte Access Economics, 2015. The Economic Value of Informal Care in Australia in 2015. Canberra, Carers Australia.

Department of Finance and Administration, 2006. Handbook of cost–benefit analysis, Financial Management Reference Material No. 6. Canberra, Commonwealth of Australia.

Department of the Prime Minister and Cabinet, 2016. Cost-Benefit Analysis: Guidance Note. Canberra, Office of Best Practice Regulation, Australian Government.

Department of Veterans' Affairs, 2018. Factsheet HSV92 - Repatriation Pharmaceutical Benefits Scheme. DVA Australian Government, Canberra. 3 Sept 2018. https://www.dva.gov.au/factsheet-hsv92-repatriation-pharmaceutical-benefits-scheme

Dinis-Oliveira, R.J., Vieira, D.N., Magalhães, T., 2016. Guidelines for collection of biological samples for clinical and forensic toxicological analysis. *Forensic Sciences Research* 1, 42-51.

Director of Public Prosecutions, 2016. Annual Report, 2015-16. Melbourne, ODPP.

Director of Public Prosecutions Northern Territory, 2016. 26th Annual Report 2015-2016. Darwin, DPP.

Dolan, P., 2010. Thinking about it: Thoughts about health and valuing QALYs. *Health Economics* 20, 1407–1416.

Dolan, P., Loomes, G., Peasgood, T., Tsuchiya, A., 2005. Estimating the intangible victim costs of violent crime. *British Journal of Criminology* 45, 958-976.

Donaldson, C., Baker, R., Mason, H., Jones-Lee, M., Lancsar, E., Wildman, J., Bateman, I., Loomes, G., Robinson, A., Sugden, R., Pinto Prades, J.L., Ryan, M., Shackley, P., Smith, R., 2011. The social value of a QALY: Raising the bar or barring the raise? *BMC Health Services Research* 11.

Draper, B., Withall, A., 2016. Young onset dementia. *Internal Medicine Journal* 46, 779-786.

Drummer, O.H., Gerostamoulos, J., Batziris, H., Chu, M., Caplehorn, J., Robertson, M.D., Swann, P., 2004. The involvement of drugs in drivers of motor vehicles killed in Australian road traffic crashes. *Accident Analysis and Prevention* 36, 239-248.

Drummer, O.H., Gerostamoulos, J., Batziris, H., Chu, M., Caplehorn, J.R., Robertson, M.D., Swann, P., 2003. The incidence of drugs in drivers killed in Australian road traffic crashes. *Forensic Science International* 134, 154-162.

Ekpu, V.U., Brown, A.K., 2015. The economic impact of smoking and of reducing smoking prevalence: Review of evidence. *Tobacco Use Insights* 8, 1-35.

English, D.R., Holman, C.D.J., Milne, E., Winter, M.G., Hulse, G.K., Codde, J.P., Bower, C.I., Corti, B., de Klerk, N., Knuiman, M.W., Kurinczuk, J.J., Lewin, G.F., Ryan, G.A., 1995. The Quantification of Drug Caused Morbidity and Mortality in Australia, 1995 edition. Commonwealth Department of Human Services and Health, Canberra.

Eszenyi, D., 2017. Annual Review 2016/17. Adelaide, Child Death and Serious Injury Review Committee.

Fábio Martins, D.O., Catarina Santos, Mário Barroso and Eugenia Gallardo,, 2019. Opioid Use in Pregnant Women and Neonatal Abstinence Syndrome—A Review of the Literature. *Toxins* 7, 9.

Fernandes, R.M., Cary, M., Duarte, G., Jesus, G., Alarcão, J., Torre, C., Costa, S., Costa, J., Carneiro, A.V., 2017. Effectiveness of needle and syringe Programmes in people who inject drugs–An overview of systematic reviews. *BMC Public Health* 17, 309.

Field, C., 2016. Ombudsman Western Australia Annual Report 2015-16. Perth, Parliamentary Commissioner for Administrative Investigations.

Fischer, B., Rehm, J., 2018. Revisiting the 'paradigm shift'in opioid use: developments and implications 10 years later. *Drug and Alcohol Review* 37, S199-S202.

Florence, C., Luo, F., Xu, L., Zhou, C., 2016. The economic burden of prescription opioid overdose, abuse and dependence in the United States, 2013. *Medical Care* 54, 901.

Gelman, A., Greenland, S., 2019. Are confidence intervals better termed "uncertainty intervals"? *British Medical Journal* 366, l5381.

Ghertner, R., Baldwin, M., Crouse, G., Radel, L., Waters, A., 2018. The relationship between substance use indicators and child welfare caseloads, ASPE Research Brief. US Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation.

Gibson, A., Randall, D., Degenhardt, L., 2011. The increasing mortality burden of liver disease among opioid-dependent people: Cohort study. *Addiction* 106, 2186-2192.

Global Burden of Disease Collaborative Network, 2018. Global Burden of Disease Study 2017 (GBD 2017) Results, Institute for Health Metrics and Evaluation, Seattle. Available from http://ghdx.healthdata.org/gbd-results-tool.

Goldstein, P.J., 1985. The drugs/violence nexus: A tripartite conceptual framework. *Journal of Drug Issues* 15, 493-506.

Grant, J., Odlaug, B., Chamberlain, S., Keuthen, N., Lochner, C., Stein, D., 2012. Skin picking disorder. *American Journal of Psychiatry* 169, 1143-1149.

Grant, R.L., 2014. Converting an odds ratio to a range of plausible relative risks for better communication of research findings. *British Medical Journal* 348, e1-7.

Gregory, P., 2015. Annual Review 2014-15. Canberra, ACT Children & Young People Death Review Committee.

Gruber, J., Köszegi, B., 2001. Is addiction 'rational'? Theory and evidence. *Quarterly Journal of Economics* 116, 1261-1303.

Grulich, A.E., Guy, R., Amin, J., Jin, F., Selvey, C., Holden, J., Schmidt, H.-M.A., Zablotska, I., Price, K., Whittaker, B., 2018. Population-level effectiveness of rapid, targeted, high-coverage roll-out of HIV pre-exposure prophylaxis in men who have sex with men: The EPIC-NSW prospective cohort study. *The Lancet HIV* 5, e629-e637.

Gwynne, C., 2016. Annual Review 2015-16. Darwin, Northern Territory Child Deaths Review and Prevention Committee.

Habib, G., 2006. Management of infective endocarditis. *Heart (British Cardiac Society)* 92, 124-130.

Han, B., Gfroerer, J.C., Colliver, J.D., Penne, M.A., 2009. Substance use disorder among older adults in the United States in 2020. *Addiction* 104, 88-96.

Harris, A.H., Hill, S.R., Chin, G., Li, J.J., Walkom, E., 2008. The role of value for money in public insurance coverage decisions for drugs in Australia: A retrospective analysis 1994-2004. *Medical Decision Making* 28, 713-722.

Heard, S., Iversen, J., Geddes, L., Maher, L., 2018. Australian Needle Syringe Program Survey National Data Report 2013-2017: Prevalence of HIV, HCV and injecting and sexual behaviour among NSP attendees. Sydney, Kirby Institute.

Heard, S., Iversen, J., Geddes, L., Maher, L., 2019. Australian Needle Syringe Program Survey National Data Report 2014-2018: Prevalence of HIV, HCV and injecting and sexual behaviour among NSP attendees. Sydney, Kirby Institute, UNSW.

Hickman, M., Taylor, C., Chatterjee, A., Degenhardt, L., Frischer, M., Hay, G., Tilling, K., Wiessing, L., Griffiths, P., McKetin, R., 2002. Estimating the prevalence of problematic drug use: A review of methods and their application. *Bulletin on Narcotics* 54, 15-32.

Hill, J.L., Zacny, J.P., 2000. Comparing the subjective, psychomotor, and physiological effects of intravenous hydromorphone and morphine in healthy volunteers. *Psychopharmacology* 152, 31-39.

HM Treasury (UK), 2018. The Green Book: Central Government Guidance on Appraisal and Evaluation. London, HM Treasury.

Hulse, G.K., Milne, E., English, D.R., Holman, C.D., 1997. The relationship between maternal use of heroin and methadone and infant birth weight. *Addiction* 92, 1571-1579.

Independent Hospital Pricing Authority, 2015. National Efficient Price Determination 2015-16. Canberra, Commonwealth of Australia.

Independent Hospital Pricing Authority, 2018. National Hospital Cost Data Collection Cost Report: Round 20 Financial Year 2015-16. Canberra, Commonwealth of Australia.

Iversen, J., Linsen, S., Kwon, J., Maher, L., 2017. Needle syringe program national minimum data collection: National data report 2016. Sydney, Australia, Kirby Institute, UNSW.

Iversen, J., Maher, L., 2015. Australian Needle Syringe Program Survey 20 Year National Data Report 1995-2014: Prevalence of HIV, HCV and injecting and sexual behaviour among NSP attendees. Sydney, Kirby Institute, UNSW.

Jauncey, M.E., Nielsen, S., 2017. Community use of naloxone for opioid overdose. *Australian Prescriber* 40, 137.

Jeffreys, H., Hirte, C., Rogers, N., Wilson, R., 2009. Parental Substance Misuse and Children's Entry into Alternative Care in South Australia. Adelaide, Government of South Australia, Department of Families and Communities.

Jiang, R., Lee, I., Lee, T.A., Pickard, A.S., 2017. The societal cost of heroin use disorder in the United States. *PloS One* 12, e0177323.

Johnson, J., 2019. Advancing your practice: Recognising and managing opioid overdose in the community: A key role for pharmacists. *Australian Journal of Pharmacy* 100, 62.

Jones, C.M., Einstein, E.B., Compton, W.M., 2018. Changes in synthetic opioid Involvement in drug overdose deaths in the United States, 2010-2016. *Journal of the American Medical Association* 319, 1819-1821.

Justice and Community Safety Directorate, 2016a. ACT State Budget, 2015-16, Budget Statement. Canberra, ACT Government.

Justice and Community Safety Directorate, 2016b. ACT State Budget, 2016-17, Budget Statement. ACT Government.

Kendler, K.S., Lönn, S.L., Salvatore, J., Sundquist, J., Sundquist, K., 2018. The origin of spousal resemblance for alcohol use disorder. *JAMA Psychiatry* 75, 280-286.

Kenkel, D.S., 1991. Health behavior, health knowledge and schooling. *Journal of Political Economy* 99, 287-305.

Kniesner, T.J., Viscusi, W.K., Ziliak, J.P., 2010. Policy relevant heterogeneity in the value of statistical life: New evidence from panel data quantile regressions. *Journal of Risk and Uncertainty* 40, 15-31.

Krausz, M., Degkwitz, P., Haasen, C., Verthein, U., 1996. Opioid addiction and suicidality. *Crisis* 17, 175-181.

Krebs, E., Urada, D., Evans, E., Huang, D., Hser, Y.I., Nosyk, B., 2017. The costs of crime during and after publicly funded treatment for opioid use disorders: A population-level study for the state of California. *Addiction* 112, 838-851.

Kuramoto, S.J., Chilcoat, H.D., Ko, J., Martins, S.S., 2012. Suicidal ideation and suicide attempt across stages of nonmedical prescription opioid use and presence of prescription opioid disorders among U.S. adults. *Journal of Studies on Alcohol and Drugs* 73, 178-184.

Laibson, D., 2001. A cue-theory of consumption. *Quarterly Journal of Economics* 116, 81-119.

Larance, B., Degenhardt, L., Lintzeris, N., Winstock, A., Mattick, R.P., 2011. Definitions related to the use of pharmaceutical opioids: Extramedical use, diversion, non-adherence and aberrant medication-related behaviours. *Drug and Alcohol Review* 30, 236-245.

Larney, S., Bohnert, A.S., Ganoczy, D., Ilgen, M.A., Hickman, M., Blow, F.C., Degenhardt, L., 2015. Mortality among older adults with opioid use disorders in the Veteran's Health Administration, 2000–2011. *Drug and Alcohol Dependence* 147, 32-37.

Larney, S., Hickman, M., Guy, R., Grebely, J., Dore, G.J., Gray, R.T., Day, C.A., Kimber, J., Degenhardt, L., 2017a. Estimating the number of people who inject drugs in Australia. *BMC Public Health* 17, 757-757.

Larney, S., Peacock, A., Mathers, B.M., Hickman, M., Degenhardt, L., 2017b. A systematic review of injecting-related injury and disease among people who inject drugs. *Drug and Alcohol Dependence* 171, 39-49.

Larney, S., Tran, L.T., Santo Jr, T., Hickman, M., Santomauro, D., Leung, J., Peacock, A., Stockings, E., Degenhardt, L., 2019. All-cause and cause-specific mortality in people using extra-medical opioids: A systematic review and meta-analysis. *JAMA Psychiatry*, doi: 10.1001/jamapsychiatry.2019.4170.

Laslett, A.-M., Dietze, P.M., Room, R.G.W., 2013. Carer drinking and more serious child protection case outcomes. *British Journal of Social Work* 43, 1384-1402.

Laslett, A.-M., Room, R., Ferris, J., Wilkinson, C., Livingston, M., Mugavin, J., 2011. Surveying the range and magnitude of alcohol's harm to others in Australia. *Addiction* 106, 1603-1611.

Legal Aid Commission New South Wales, 2016. Annual Report, 2015-16. Sydney, Legal Aid.

Legal Aid Queensland, 2016. Annual Report, 2015-16. Brisbane,

Legal Services Commission of South Australia, 2016. 38th Annual Report, 2015-16. Adelaide, Legal Services Commission.

Leijdesdorff, S., van Doesum, K., Popma, A., Klaassen, R., van Amelsvoort, T., 2017. Prevalence of psychopathology in children of parents with mental illness and/or addiction: An up to date narrative review. *Current Opinion in Psychiatry* 30, 312-317.

Leikin, J.B., Paloucek, F.P., 2015. Poisoning and Toxicology Handbook 4th Edition. Informa Healthcare, New York, NY.

Lenton, S., Dietze, P., 2017. Take-Home Naloxone in Australia: past, present, future. NDARC 30th Anniversary Symposium, Sydney.

Lenton, S., Dietze, P.M., Jauncey, M., 2016. Perspective: Australia reschedules naloxone for overdose. *Medical Journal of Australia* 4, 146-147.

Li, G., Baker, S.n.P., Zhao, Q., Brady, J.E., Lang, B.H., Rebok, G.W., DiMaggio, C., 2011a. Drug violations and aviation accidents: Findings from the US mandatory drug testing programs. *Addiction* 106, 1287-1292.

Li, X., Hong, Y., Poston, D., 2011b. Preventing HIV in women: A top priority in China's efforts in fighting AIDS. *AIDS Care* 23, 1-4.

Lin, S.-H., Chen, K.C., Lee, S.-Y., Hsiao, C.-Y., Lee, I.H., Yeh, T.L., Chen, P.S., Lu, R.-B., Yang, Y.K., 2013. The economic cost of heroin dependency and quality of life among heroin users in Taiwan. *Psychiatry Research* 209, 512-517.

Liu, N., Li, B., Wilson, F.A., Ma, Y., Hu, X., 2005. Gender effect on the right–left discrimination task in a sample of heroin-dependent patients. *Psychopharmacology* 181, 735-740.

Liu, N., Zhou, D., Li, B., Ma, Y., Hu, X., 2006. Gender related effects of heroin abuse on the simple reaction time task. *Addictive Behaviors* 31, 187-190.

Ludlow, J.P., Evans, S.F., Hulse, G., 2004. Obstetric and perinatal outcomes in pregnancies associated with illicit substance abuse. *Australian and New Zealand Journal of Obstetrics and Gynaecology* 44, 302-306.

Lyvers, M., Yakimoff, M., 2003. Neuropsychological correlates of opioid dependence and withdrawal. *Addictive Behaviors* 28, 605-611.

Maloney, E., Degenhardt, L., Darke, S., Mattick, R.P., Nelson, E., 2007. Suicidal behaviour and associated risk factors among opioid-dependent individuals: a case-control study. *Addiction* 102, 1933-1941.

Manchikanti, L., Abdi, S., Atluri, S., Balog, C.C., Benyamin, R.M., Boswell, M.V., Brown, K.R., Bruel, B.M., Bryce, D.A., Burks, P.A., For Society of Interventional Pain Physicians American Society of Interventional Pain Physicians, 2012. American Society of Interventional Pain Physicians (ASIPP) guidelines for responsible opioid prescribing in chronic non-cancer pain: Part 2--guidance. *Pain Physician* 15.

Marchand, K., Palis, H., Fikowski, J., Harrison, S., Spittal, P., Schechter, M.T., Oviedo-Joekes, E., 2017. The Role of Gender in Suicidal Ideation among Long-term Opioid Users. *Canadian Journal of Psychiatry. Revue Canadienne de Psychiatrie* 62, 465-472.

Mark, T.L., Woody, G.E., Juday, T., Kleber, H.D., 2001. The economic costs of heroin addiction in the United States. *Drug and Alcohol Dependence* 61, 195-206.

Marsden, J., Stillwell, G., Jones, H., Cooper, A., Eastwood, B., Farrell, M., Lowden, T., Maddalena, N., Metcalfe, C., Shaw, J., 2017. Does exposure to opioid substitution treatment in prison reduce the risk of death after release? A national prospective observational study in England. *Addiction* 112, 1408-1418.

Martin, J.-L., Gadegbeku, B., Wu, D., Viallon, V., Laumon, B., 2017. Cannabis, alcohol and fatal road accidents. *PloS One* 12, e0187320.
Mather, T., Department of Information Evidence & Research, 2018. WHO methods and data sources for global burden of disease estimates 2000-2016, Global Health Estimates Technical Paper WHO/HIS/IER/GHE/2018.4, Geneva, WHO.
Mathers, B., Degenhardt, L., Bucello, C., Lemon, J., Hickman, M., Wiessing, L., 2013. Mortality among people who inject drugs: A systematic review and meta-analysis. *Bulletin of the World Health Organization* 91, 102-123.
Maucort-Boulch, D., de Martel, C., Franceschi, S., Plummer, M., 2018. Fraction and incidence of liver cancer attributable to hepatitis B and C viruses worldwide. *International Journal of Cancer* 142, 2471-2477.
Mayhew, P., 2003. Counting the costs of crime in Australia: Technical report, Technical and Background Paper Series no. 4. Canberra, Australian Institute of Criminology.
McKetin, R., McLaren, J., Kelly, E., Hall, W., Hickman, M., 2005. Estimating the number of regular and dependent methamphetamine users in Australia, Technical Report 230. Sydney, National Drug and Alcohol Research Centre, UNSW.
McKetin, R., McLaren, J., Riddell, S., Robins, L., 2006. Methamphetamine use and violent behaviour, Crime and Justice Bulletin No 79. Sydney, Office of Drug and Alcohol Policy.
McLean, S., Patel, R., Bruno, R., 2017. Injection of Pharmaceuticals Designed for Oral Use: Harms Experienced and Effective Harm Reduction Through Filtration. In: Nielsen, S., Bruno, R., Schenk, S. (Eds.), Non-medical and illicit use of psychoactive drugs. Springer International Publishing, Cham. pp. 77-98.
McMillan, J., 2017. Report of Reviewable Deaths in 2014 and 2015 Volume 1: Child Deaths. Sydney, NSW, Ombudsman of New South Wales.
Mental Health Commission, 2015. Drug and Alcohol Office Methamphetamine data extract: 19 10 2015. Perth, Government of Western Australia.
Mental Health Commission, 2016. Annual Report 2015/16. Perth, Government of Western Australia.
Miller, T.R., Hendrie, D., 2011. Economic evaluation of interventions. In: Li, G., Baker, S.P. (Eds.), Injury Research: Theories, Methods, and Approaches. Springer, New York. pp. 641-666.
Moffatt, S., Weatherburn, D., Donnelly, N., 2005. What caused the recent drop in property crime? , Crime and Justice Bulletin. no. 85, Sydney, NSW Bureau of Crime Statistics and Research.
Moore, S.E., Scott, J.G., Ferrari, A.J., Mills, R., Dunne, M.P., Erskine, H.E., Devries, K.M., Degenhardt, L., Vos, T., Whiteford, H.A., McCarthy, M., Norman, R.E., 2015. Burden attributable to child maltreatment in Australia. *Child Abuse and Neglect* 48, 208-220.
Moore, T.J., 2005. What is Australia's "Drug Budget?" The policy mix of illicit drug related government spending in Australia, Drug Policy Modelling Project Monograph Series. No. 1, Melbourne, Turning Point Alcohol and Drug Centre Inc.
Moore, T.J., 2007. Working estimates of the social costs per gram and per user for cannabis, cocaine, opiates and amphetamines, Drug Policy Modelling Project Monograph Series No. 14, Sydney, National Drug and Alcohol Research Centre, UNSW.
Morgan, A., Althorpe, L., 2014. Short-term cost-benefit model for imprisonment and community corrections in Victoria: Female prisoners and offenders, Consultancy report for Corrections Victoria. Canberra, Australian Institute of Criminology.
Morrow, R.L., Bassett, K., Maclure, M., Dormuth, C.R., 2019. Outcomes associated with hospital admissions for accidental opioid overdose in British Columbia: A retrospective cohort study. *BMJ Open* 9, e025567.
Mortimer, D., Segal, L., 2006. Economic evaluation of interventions for problem drinking and alcohol dependence: Do within-family external effects make a difference? *Alcohol and Alcoholism* 41, 92-98.
Movig, K.L., Mathijssen, M., Nagel, P., van Egmond, T., de Gier, J.J., Leufkens, H., Egberts, A.C., 2004. Psychoactive substance use and the risk of motor vehicle accidents. *Accident Analysis and Prevention* 36, 631-636.

Murphy, E.L., DeVita, D., Liu, H., Vittinghoff, E., Leung, P., Ciccarone, D.H., Edlin, B.R., 2001. Risk factors for skin and soft-tissue abscesses among injection drug users: a case-control study. *Clinical Infectious Diseases* 33, 35-40.
Nash, F., 2015. Community Affairs Legislation Committee, 2 June 2015, Official Committe Hansard. Canberra, Commonwealth of Australia.
National Centre for Education and Training on Addiction, 2019. Secondary analysis of Australian Institute of Health and Welfare's 2016 National Drug Strategy Household Survey (unpublished analysis). National Centre for Education and Training on Addiction, Flinders University.
National Coronial Information System, 2018. About the data; System manuals. Canberra, NCIS.
National Coronial Information System, 2019a. About Data, Explanatory Notes. 25 March 2019. https://www.ncis.org.au/about-the-data/explanatory-note
National Coronial Information System, 2019b. About the data, Operational Statistics. 9 Jan 2019. https://www.ncis.org.au/about-the-data/operational-statistics/
National Institute for Clinical Excellence, 2004. Guide to the Methods of Technology Appraisal. NICE, UK. 23 May 2019. https://www.gov.uk/government/publications/green-book-supplementary-guidance-health
National Institute for Health and Clinical Excellence, 2009. Needle and syringe programmes: providing people who inject drugs with injecting equipment, NICE Public Health Guidance 18. London, NICE.
Nayak, M.B., Patterson, D., Wilsnack, S.C., Karriker-Jaffe, K.J., Greenfield, T.K., 2019. Alcohol's secondhand harms in the United States: New data on prevalence and risk factors. *Journal of Studies on Alcohol and Drugs* 80, 273-281.
Ngui, R., Shanahan, M., 2010. Cannabis use disorder treatment and associated heath care costs: NSW 2007, Drug Policy Modelling Program Monograph 20. Sydney, National Drug and Alcohol Research Centre, UNSW.
Nicosia, N., Pacula, R.L., Kilmer, B., Lundberg, R., Chiesa, J., 2009. The economic cost of methamphetamine use in the United States, 2005, Monograph 829. MG-829-MPF/NIDA, Santa Monica, CA, RAND Corporation.
Northern Territory Legal Aid Commission, 2016. Annual Report 2015/2016. Darwin, Legal Aid Commission.
NSW Ministry of Health, 2018. NSW Clinical Guidelines: Treatment of Opioid Dependence – 2018. Sydney, NSW Government.
O'Brien, P., Todd, J., 2009. Hypoxic brain injury following heroin overdose. *Brain Impairment* 10, 169-179.
Office of the Director of Public Prosecutions, 2016. Annual Report, 2015-16. Sydney, ODPP.
Oliva-Moreno, J., Trapero-Bertran, M., Peña-Longobardo, L.M., del Pozo-Rubio, R., 2017. The valuation of informal care in cost-of-illness studies: A systematic review. *Pharmacoeconomics* 35, 331-345.
Olsen, A., McDonald, D., Lenton, S., Dietze, P., 2015. Independent evaluation of the 'Implementing Expanded Naloxone Availability in the ACT (I-ENAACT) Program', 2011-2014: Final Report. Canberra, ACT Health.
Orford, J., 2015. Addiction in the Family: Adult and child family members affected by their relatives' excessive substance use or gambling, Addictions and Lifestyles in Contemporary Europe – Reframing Addictions Policy, Policy Brief No. 6. ALICE RAP project.
Orford, J., Velleman, R., Natera, G., Templeton, L., Copello, A., 2013. Addiction in the family is a major but neglected contributor to the global burden of adult ill-health. *Social Science and Medicine* 78, 70-77.
Organisation for Economic Cooperation and Development, 2016a. OECD Statistical Database, OEDC.Stat.org.
Organisation for Economic Cooperation and Development, 2016b. Purchasing power parities (PPP) (indicator). OECD. 5 June 2018. https://data.oecd.org/conversion/purchasing-power-parities-ppp.htm
Organisation for Economic Cooperation and Development, 2018. OECD Economic Surveys: United States. OECD.
Ornstein, T., Iddon, J., Baldacchino, A., Sahakian, B., London, M., Everitt, B., Robbins, T., 2000. Profiles of cognitive dysfunction in chronic amphetamine and heroin abusers. *Neuropsychopharmacology* 23, 113.

Palamara, P., Broughton, M., Chamber, F., 2014. Illicit drugs and driving: An investigation of fatalities and traffic offences in Western Australia. RR 13-001, Perth, Curtin-Monash Accident Research Centre, Curtin University.

Paola, S., 2019. Intranasal naloxone now available in Australia. APJ.com.au. 14 Oct 2019. https://ajp.com.au/news/intranasal-naloxone-now-available-in-australia/

Patterson, E., Sullivan, T., Ticehurst, A., Bricknell, S., 2018. Drug use monitoring in Australia: 2015 and 2016 report on drug use among police detainees, Statistical Report 04. Canberra, Australian Institute of Criminology.

Pau, C.W., Lee, T.M., Chan, S.-f.F., 2002. The impact of heroin on frontal executive functions. *Archives of Clinical Neuropsychology* 17, 663-670.

Payne, J., Gaffney, A., 2012. How much crime is drug or alcohol related? Self-reported attributions of police detainees, Trends and Issues in Crime and Criminal Justice, No. 439. Canberra, Australian Institute of Criminology.

Peacock, A., Bruno, R., Cama, E., Kihas, I., Larance, B., Lintzeris, N., Hordern, A., White, N., Ali, R., Degenhardt, L., 2015. Jurisdictional differences in opioid use, other licit and illicit drug use, and harms associated with substance use among people who tamper with pharmaceutical opioids. *Drug and Alcohol Review* 34, 611-622.

Peacock, A., Gibbs, D., Karlsson, A., Uporova, J., Sutherland, R., Bruno, R., Dietze, P., Lenton, S., Alati, R., Degenhardt, L., 2018. Australian Drug Trends 2018. Key findings from the National Illicit Drug Reporting System (IDRS) Interviews. Sydney, Australia, National Drug and Alcohol Research Centre, UNSW.

Peacock, A., Uporova, J., Karlsson, A., Gibbs, D., Swanton, R., Kelly, G., Price, O., Bruno, R., Dietze, P., Lenton, S., Salom, C., Degenhardt, L., Farrell, M., 2019. Australian Drug Trends 2019: Key Findings from the National Illicit Drug Reporting System (IDRS) Interviews. Sydney, National Drug and Alcohol Research Centre, UNSW.

Pearce, D., 2000. Valuing Risks to Life and Health, Paper prepared for the European Commission (DGXI) Workshop on Valuing Mortality and Valuing Morbidity. Brussels,

Personal communication TK, 2015, Cost of non-residential treatment. Shanahan, M.

Perz, J.F., Armstrong, G.L., Farrington, L.A., Hutin, Y.J.F., Bell, B.P., 2006. The contributions of hepatitis B virus and hepatitis C virus infections to cirrhosis and primary liver cancer worldwide. *Journal of Hepatology* 45, 529-538.

Pharmaceutical Benefits Scheme, 2015. Hepatitis B: utilisation analysis, Drug utilisation sub-committee (DUSC). 18 July 2019. http://www.pbs.gov.au/info/industry/listing/participants/public-release-docs/hep-b/hepatitis-b-utilisation-analysis

Pharmaceutical Benefits Scheme, 2016a. 2016 PBS co-payment and safety net amounts. Australian Government, Department of Health, Canberra. 17 Aug 2018. http://www.pbs.gov.au/info/news/2016/01/2016-pbs-co-payment-safety-net-amounts

Pharmaceutical Benefits Scheme, 2016b. Australian Statistics in Medicines 2015. Australian Government Deartment of Health, Canberra. 16 Aug 2018. http://www.pbs.gov.au/info/statistics/asm/asm-2015

Pharmaceutical Benefits Scheme, 2016c. Table 11(a): PBS items sorted by highest government cost, 2015-16. Australian Government, Canberra. 1 Oct 2018. http://www.pbs.gov.au/info/statistics/pbs-expenditure-prescriptions-30-june-2016

Pharmaceutical Benefits Scheme, 2018a. Pharmaceutical Benefits Schedule Browse by Body System. Australian Government, Department of Health, Canberra. 15 Nov 2018. http://www.pbs.gov.au/browse/body-system

Pharmaceutical Benefits Scheme, 2018b. Pharmaceutical Benefits Schedule Item Reports. Australian Government, Department of Health, Canberra. 16 Aug 2018. http://medicarestatistics.humanservices.gov.au/statistics/pbs_item.jsp

Pidd, K., Kostadinov, V., Roche, A.M., 2015. Do workplace policies work? An examination of the relationship between AOD policies and workers' substance use. *International Journal of Drug Policy* 28, 48-54.

Pidd, K.J., Berry, J.G., Roche, A.M., Harrison, J.E., 2006. Estimating the cost of alcohol-related absenteeism in the Australian workforce: The importance of consumption patterns. *Medical Journal of Australia* 185, 637.

Pierce, M., Hayhurst, K., Bird, S.M., Hickman, M., Seddon, T., Dunn, G., Millar, T., 2017. Insights into the link between drug use and criminality: Lifetime offending of criminally-active opiate users. *Drug and Alcohol Dependence* 179, 309-316.

Pointer, S., 2018. Trends in hospitalised injury, Australia 1999–00 to 2014–15, Injury Research and Statistics Series No. 110. Cat. no. INJCAT 190, Canberra, AIHW.

Pointer, S., 2019. Hospitalised injury and socioeconomic influence in Australia, 2015–16, Injury Research and Statistics Series no. 125. Cat. no. INJCAT 205, Canberra, AIHW.

Productivity Commission, 1991. Australia's Gambling Industries. Report no. 10 AusInfo, Canberra, Productivity Commission.

Pyne, J.M., French, M.T., McCollister, K.E., Tripathi, S., Rapp, R., Booth, B., 2008. Preference-weighted health-related quality of life measures and substance use disorder severity. *Addiction* 103, 1320-1329.

Radford, L., Corral, S., Bradley, C., Fisher, H., Bassett, C., Howat, N., Collishaw, S., 2011. Child Abuse and Neglect in the UK Today. London, NSPCC.

Ramakrishnan, K., Salinas, R.C., Agudelo Higuita, N.I., 2015. Skin and soft tissue infections. *American Family Physician* 92, 474-483.

Ramirez, M., Bedford, R., Sullivan, R., Anthony, T.R., Kraemer, J., Faine, B., Peek-Asa, C., 2013. Toxicology testing in fatally injured workers: A review of five years of Iowa FACE cases. *International Journal of Environmental Research and Public Health* 10, 6154-6168.

Rasul, R., Ward, M., Clews, S., Falconer, J., Feller, J., Lui, K., Oei, J., 2019. Retrospective study found that outpatient care for infants exposed to drugs during pregnancy was sustainable and safe. *Acta Paediatrica* 108, 654-661.

Rehm, J., Baliunas, D., Borges, G.L., Graham, K., Irving, H., Kehoe, T., Parry, C.D., Patra, J., Popova, S., Poznyak, V., Roerecke, M., Room, R., Samokhvalov, A.V., Taylor, B., 2010. The relation between different dimensions of alcohol consumption and burden of disease: an overview. *Addiction* 105, 817-843.

Reserve Bank of Australia, 2019. Inflation Calculator. Sydney, RBA. https://www.rba.gov.au/calculator/quarterDecimal.html

Riddell, S., Shanahan, M., Degenhardt, L., Roxburgh, A., 2008. Estimating the costs of drug-related hospital separations in Australia. *Australian and New Zealand Journal of Public Health* 32, 156-161.

Riddell, S., Shanahan, M., Roxburgh, A., Degelman, M.L., 2007. The cost of drug-related hospital stays in Australia, 1999–2005, Technical Report Number 258. Sydney, National Drug and Alcohol Research Centre, UNSW.

Ritter, A., Berends, L., Chalmers, J., Hull, P., Lancaster, K., Gomez, M., 2014. New Horizons: The Review of Alcohol and Other Drug Treatment Services in Australia. Sydney, Drug Policy Modelling Program.

Ritter, A., McLeod, R., Shanahan, M., 2013. Government drug policy expenditure in Australia - 2009/10, Drug Policy Modelling Project Monograph Series No. 24. Sydney, National Drug and Alcohol Research Centre, UNSW.

Roche, A.M., Pidd, K., Berry, J.G., Harrison, J.E., 2008. Workers' drinking patterns: The impact on absenteeism in the Australian work-place. *Addiction* 103, 738-748.

Roche, A.M., Pidd, K., Kostadinov, V., 2015. Alcohol- and drug-related absenteeism: A costly problem. *Australian and New Zealand Journal of Public Health*, 10.1111/1753-6405.12414.

Roxburgh, A., Burns, L., 2017. Accidental drug-induced deaths due to opioids in Australia, 2013, National Illicit Drug Indicatiors Project (NIDIP) Bulletins. Sydney, National Drug and Alcohol Research Centre, UNSW.

Roxburgh, A., Dobbins, T., Degenhardt, L., Peacock, A., 2018. Opioid-, amphetamine-, and cocaine-induced deaths in Australia: August 2018, Drug Trends Bulletin. Sydney, National Drug and Alcohol Research Centre, UNSW.

Safe Work Australia, 2014. Australian Workers' Compensation Statistics 2012–13. Canberra, Safe Work Australia.

Safe Work Australia, 2015. The Cost of Work-related Injury and Illness for Australian Employers, Workers and the Community: 2012–13. Canberra, Safe Work Australia.

Saka, Ö., McGuire, A., Wolfe, C., 2009. Cost of stroke in the United Kingdom. *Age and Ageing* 38, 27-32.

Salize, H.J., Jacke, C., Kief, S., Franz, M., Mann, K., 2013. Treating alcoholism reduces financial burden on care-givers and increases quality-adjusted life years. *Addiction* 108, 62-70.

Schatz, E., Nougier, M., 2012. IDPC Briefing Paper-Drug Consumption Rooms: Evidence and Practice. London, International Drug Policy Consortium.

Scholl, L., Seth, P., Kariisa, M., Wilson, N., Baldwin, G., 2019. Drug and opioid-involved overdose deaths—United States, 2013–2017. *Morbidity and Mortality Weekly Report* 67, 1419.

Seth, P., Rudd, R.A., Noonan, R.K., Haegerich, T.M., 2018. Quantifying the epidemic of prescription opioid overdose deaths. *American Journal of Public Health* 108, 500-502.

Shanahan, M., Havard, A., Teesson, M., Mills, K.L., Williamson, A., Ross, J., 2006. Patterns and costs of treatment for heroin dependence over 12 months: Fndings from the Australian Treatment Outcome Study. *Australian and New Zealand Journal of Public Health* 30, 305-311.

Slipczuk, L., Codolosa, J.N., Davila, C.D., Romero-Corral, A., Yun, J., Pressman, G.S., Figueredo, V.M., 2013. Infective endocarditis epidemiology over five decades: A systematic review. *PloS One* 8, e82665.

Smith, H., 2009. Opioid metabolism. *Mayo Clinic Proceedings* 84, 613-624.

Smith, R.G., Jorma, P., Sweeney, J., Fuller, G., 2014. Counting the costs of crime in Australia: A 2011 estimate, Research and Public Policy Series 129. Canberra, Australian Institute of Criminology

Sordo, L., Barrio, G., Bravo, M.J., Indave, B.I., Degenhardt, L., Wiessing, L., Ferri, M., Pastor-Barriuso, R., 2017. Mortality risk during and after opioid substitution treatment: Systematic review and meta-analysis of cohort studies. *British Medical Journal* 357, j1550.

Stafford, J., Breen, C., 2016. Australian Drug Trends 2016. Findings from the Illicit Drug Reporting System (IDRS), Australian Drug Trends Series No. 163. Sydney, National Drug and Alcohol Research Centre, UNSW.

Steering Committee for the Review of Government Service Provision, 2017a. Volume C: Justice, Report on Government Services 2017. Canberra, Productivity Commission.

Steering Committee for the Review of Government Service Provision, 2017b. Volume F: Community Services, Report on Government Services 2017. Canberra, Productivity Commission.

Steering Committee for the Review of Government Service Provision, 2018a. Volume B: Child Care, Education and Training, Report on Government Services. Canberra, Productivity Commission.

Steering Committee for the Review of Government Service Provision, 2018b. Volume E: Health. Canberra, Productivity Commission.

Steering Committee for the Review of Government Service Provision, 2018c. Volume F: Community Services, Report on Government Services 2018. Canberra, Productivity Commission.

Stretesky, P.B., 2009. National case-control study of homicide offending and methamphetamine use. *Journal of Interpersonal Violence* 24, 911-924.

Suranovic, S.M., Goldfarb, R.S., Leonar, T.C., 1999. An economic theory of cigarette addiction. *Journal of Health Economics* 18, 1-29.

Taylor, N., Bareja, M., 2005. 2002 National police custody survey, Technical and Background Paper Series No. 13. Canberra, Australian Institute of Criminology.

Taylor, P., Moore, P., Pezzullo, L., 2008. The Cost of Child Abuse in Australia. Melbourne, Australian Childhood Foundation and Child Abuse Prevention Research Australia.

Teesson., M., Ross., J., Darke., S., Lynskey., M., Ali., R., Ritter., A., Cooke., R., 2006. One year outcomes for heroin dependence: Findings from the Australian Treatment Outcome Study (ATOS). *Drug and Alcohol Dependence* 83, 174-180.

The Treasurer, 2015. WA State Budget, 2015-16, Budget Statements, Volume 2, Budget Paper No. 2. Perth, Government of Western Australia.

The Treasurer, 2016. Tasmania State Budget, 2015-16, Government Services, Volume 2, Budget Paper No. 2. Hobart, Tasmanian Government.

The Treasurer, 2017. SA State Budget, 2017-18, Volume 1, Budget Paper No. 4., Agency Statements. Adelade, Government of South Australia.

Tilling, C., Kro, M., Tsuchiya, A., Brazier, J., van Exel, J., Brouwer, W., 2012. Does the EQ-5D reflect lost earnings? *Pharmacoeconomics* 30, 47-61.

Topp, L., Darke, S., Bruno, B., Fry, C., Hargreaves, K., Humeniuk, R., McAllister, R., O'Reilly, B., Williams, P., 2001. Australian Drug Trends 2000, Findings of the Illicit Drug Reporting System (IDRS), Monograph Number 47. Sydney, National Drug and Alcohol Research Centre, UNSW.

Tornos, P., Iung, B., Permanyer-Miralda, G., Baron, G., Delahaye, F., Gohlke-Barwolf, C., Butchart, E.G., Ravaud, P., Vahanian, A., 2005. Infective endocarditis in Europe: lessons from the Euro heart survey. *Heart* 91, 571-575.

Torok, M., Darke, S., Kaye, S., 2008. Comparative rates of violent crime amongst methamphetamine and opioid users: Victimisation and offending, NDLERF Monograph Series No. 32. Canberra, National Drug Law Enforcement Research Fund.

Transport Accident Commission, 2016. Annual Report 2015/16. Melbourne, TAC.

Turnbull, M., Keenan, M., Nash, F., 2015. A new action plan to tackle ice Prime Minister's Office. Canberra, Commonwealth of Australia.

United Nations Office of Drugs and Crime, 2018a. Analysis of drug markets, World Drug Report 2018. Vienna, United Nations.

United Nations Office of Drugs and Crime, 2018b. Executive summary, conclusions and policy implications, World Drug Report 2018. Vienna, United Nations.

United Nations Office of Drugs and Crime, 2019a. World Drug Report 2019: Booklet 2 Global Overview of drug demand and supply. E.19.XI.8, Vienna, UNODC.

United Nations Office of Drugs and Crime, 2019b. World Drug Report 2019: Depressants. E.19.XI.9, Vienna, United Nations.

US Department of Health and Human Services, 2006. The Health Consequences of Involuntary Exposure to Tobacco Smoke. Atlanta, GA, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

US Department of Transportation, 2015. Revised departmental guidance 2014: Treatment of the value of preventing fatalities and injuries in preparing economic analyses Guidance on Treatment of the Economic Value of a Statistical Life (VSL). Washington, DC, Office of the Secretary of Transportation.

US National Cancer Institute and World Health Organization, 2016. The economics of tobacco and tobacco control, National Cancer Institute Tobacco Control Monograph 21. NIH Publication No. 16-CA-8029A, Bethesda, MD and Geneva, CH, U.S. Department of Health and Human Services, National Institutes of Health, National Cancer Institute; and World Health Organization.

Vardon, C., 2016. Annual Report: Deaths of children and young people, Queensland, 2015 - 16. Brisbane, Queensland Family and Child Commission.

Verdejo, A., Orozco-Gimenez, C., Meersmans, M.S.-J., de Arcos Aguilar, F., Pérez-García, M., 2004. The impact exerted by the severity of recreational drug abuse on the different components of the executive function. *Revista de Neurología* 38, 1109-1116.

Verstraete, A.G., Legrand, S.-A., 2014. Drug use, Impaired Driving and Traffic Accidents. Luxembourg: Publications Office of the European Union, European Monitoring Centre for Drugs and Drug Addiction.

Victoria Legal Aid, 2016. Annual Report 2015-16. Melbourne, Victoria.

Victoria Police, 2014. Crime Statistics 2013/2014. Melbourne, Victoria Police.

Victorian Government, 2016. Child protection additional service delivery data 2015-16. Melbourne, Department of Health and Human Services

Viscusi, W.K., Aldy, J.E., 2003. The value of a statistical life: A critical review of market estimates throughout the World. *Journal of Risk and Uncertainty* 27, 5-76.
Voce, A., Sullivan, T., 2018. Drug use monitoring in Australia: Drug use among police detainees, 2018, Statistical Report 18. Canberra, Australian Institute of Criminology.
Vos, T., Abajobir, A.A., Abate, K.H., Abbafati, C., Abbas, K.M., Abd-Allah, F., Abdulkader, R.S., Abdulle, A.M., Abebo, T.A., Abera, S.F., GBD 2016 Disease and Injury Incidence and Prevalence Collaborators, 2017. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet* 390, 1211-1259.
Wall, R., Rehm, J., Fischer, B., Gliksman, L., Stewart, J., Medved, W., Blake, J., 2000. Social costs of untreated opioid dependence. *Journal of Urban Health* 77, 688-722.
Western Australian Police, 2014. Questions on Notice No A7, Standing Committee Estimates and Financial Operations Committee. Perth, WA, Parliament.wa.gov.au.
Wheeler, E., Jones, T.S., Gilbert, M.K., Davidson, P.J., 2015. Opioid overdose prevention programs providing naloxone to laypersons—United States, 2014. *MMWR. Morbidity and Mortality Weekly Report* 64, 631.
Whetton, S., O'Neil, M., Halim, S.A., Li, S.Q., Skov, S., 2013. Harms from and Costs of Tobacco Consumption in the Northern Territory. Adelaide, SA, Menzies School of Health Research.
Whetton, S., Shanahan, M., Allsop, S., Burns, L., Chikritzhs, T., Degenhardt, D., Farrell, M., Ferrante, A., Gray, D., Kaye, S., Liang, W., Lenton, S., McKetin, R., Ritter, A., Tait, R.J., Wilkes, T., 2015. Identifying the Social Costs of Methamphetamine: Establishing a Methodology to Identify the Social Costs of Drugs and Alcohol: Methodological Report. Perth, WA, National Drug Research Institute, Curtin University.
Whetton, S., Shanahan, M., Cartwright, K., Duraisingam, V., Ferrante, A., Gray, D., Kaye, S., Kostadinov, V., McKetin, R., Pidd, K., Roche, A., Tait, R.J., Allsop, S., 2016. The Social Costs of Methamphetamine in Australia 2013/14, Tait, R.J., Allsop, S. (Eds.). Perth, WA, National Drug Research Institute, Curtin University.
Whetton, S., Tait, R.J., Scollo, M., Banks, E., Chapman, J., Dey, T., Halim, S.A., Makate, M., McEntee, A., Muhktar, A., Norman, R., Pidd, K., Roche, A., Allsop, S., 2019. Identifying the Social Costs of Tobacco Use to Australia in 2015/16, Tait, R.J., Allsop, S. (Eds.). Perth, Australia, National Drug Research Institute, Curtin University.
White, J.M., Irvine, R.J., 1999. Mechanisms of fatal opioid overdose. *Addiction* 92, 961-972.
World Health Organization, 1993. The ICD-10 Classification of Mental and Behavioural Disorders: Diagnostic Criteria for Research. WHO, Geneva.
World Health Organization, 2000. International Guide for Monitoring Alcohol Consumption and Related Harm. MSD/MSB/00.4, Geneva, WHO, Department of Mental Health and Substance Dependence.
World Health Organization, 2009. Lexicon of alcohol and drug terms published by the World Health Organization. WHO. 16 July 2019. https://www.who.int/substance_abuse/terminology/who_lexicon/en/
World Health Organization, 2016. Global Health Estimates 2016: DALYs by age, sex and cause. 11 June 2019. https://www.who.int/healthinfo/global_burden_disease/estimates/en/index1.html
World Health Organization, 2019. Children: reducing mortality. WHO. 19 Sept 2019. https://www.who.int/news-room/fact-sheets/detail/children-reducing-mortality

APPENDICES

Appendix 2.1: Detailed method - Basis for inclusion of social costs

It is generally accepted that social cost/cost of illness studies of substance use should exclude any net private costs borne by the user themselves. This is because the standard assumption underpinning much economic analysis is that consumption decisions are made through a rational assessment of their benefits and costs, and any private costs incurred would be expected to have an equal or greater private benefit offsetting them. For example, it is reasonable to assume that when deciding to buy tickets to a sports game or concert that a consumer has not only considered the purchase price but has also factored in their expectation of the time and cost of travelling to and from the venue, any expected annoyance from queuing or congestion etc. (Cost benefit studies will include all of the purely private costs, but they will also attempt to quantify the increase in utility arising from the use of the substance).

Whilst there is a consensus around this approach for "normal" goods and services, there is considerable debate on how such studies should treat those costs incurred by users with a drug dependence. This situation does not necessary meet the criteria of a rational, fully informed, consumer which is the basis for excluding these costs from a social cost study; and therefore such costs cannot necessarily be considered as a purely private cost (or at least cannot be considered as a cost that can be assumed to have an at least equal benefit offsetting it). The text by Cawley and Ruhm (Cawley and Ruhm, 2011) informed this section.

Some economists maintain that, even for those drugs that have the potential to cause dependence, harms borne by the substance user themselves should be excluded in assessing public policy approaches to the substance in question. The rationale for this approach is the view that these costs would have been fully internalised by the users in their consumption decisions. This contention rests on two key assumptions:

1) That users would have anticipated the possibility of a dependence developing and have internalised any potential costs associated with the potential for developing a drug dependence when they were making their initial consumption decisions, and that for those individuals the expected benefits of the consumptions must have outweighed the expected value of the potential costs, including any potential costs associated with dependence, e.g. they will have fully internalised the costs; and,
2) That dependent users are best characterised as normal consumers who, as a result of the dependence derive much higher utility from their use of the substance. This is because they gain utility not just from their current consumption of the substance on which they are dependent, but also from the "stock" of previous consumption. In effect, dependence is treated as a hysteretic process where each unit of consumption increases the value of future consumption.

This approach to considering costs to users of drugs of dependence is what is known as the rational addiction hypothesis, which was first set out in Becker and Murphy (1988), and is supported by a considerable body of empirical work (c.f. (Becker et al., 2008; Chaloupka, 1991)).

Some conclusions from the 'rational addiction' hypothesis are broadly accepted, for example the conclusion that a dependent user will still respond to price signals, both in the present but also anticipated future price changes. However, there are two key implications of the hypothesis which have attracted considerable criticism, namely the contentions that:

- dependent users' current consumption is optimal for them given current and anticipated future costs; and,

- that dependent consumers will be *more* responsive to permanent increases in price than non-dependent users (due to the importance of past "stocks" of consumption on current utility).

More formally the hypothesis postulates that the consumer maximises lifetime utility (U) at time t=0 subject to an expected budget constraint in a way that can be characterised by the following utility function:

$$U(0) = \int_0^T e^{-\sigma t} U[Y(t), C(t), S(t)]dt$$

Where:
σ = a constant rate of time preference;
t = the period of time, from t=0 (the present) to t=T (expected years of life remaining);
C(t) = the consumption of the addictive good at time t;
Y(t) = the consumption of all other goods at time t; and,
S(t) = the current "stock" of past consumption of the addictive good at time t.

The stock of past consumption evolves over time according to:

$$\dot{S}(t) = C(t) - \delta S(t) - h[D(t)]$$

Where:
C(t) = the consumption of the addictive good at time t;
δ = the depreciation rate in the addictive stock; and,
D(t) = expenditure on the endogenous depreciation (appreciation) of the stock of the addictive good (Becker and Murphy, 1988).

The key implication of the hypothesis for cost of illness studies is that **even if users can become dependent on the substance in question, any costs borne by the user should still be excluded from the social cost calculation as they would have been offset by private benefits**.

The 'rational addiction' model has been very influential in economic analysis of addiction since it was first proposed, and historically social cost studies of drugs of dependence have excluded most or all of the costs borne by the addict themselves (Makate et al., 2019).

However, the core assumptions that underpin the 'rational addiction' models treatment of drugs of dependence – that drug users have perfect foresight in making a fully rational and informed decision to commence and continue drug use – have been increasingly called into question based on the findings of empirical work with drug users (U.S. National Cancer Institute and World Health Organization, 2016).

There is an increasing body of research that contends that the weight of the evidence from behavioural studies does not support critical underpinning assumptions of the 'rational addiction' hypothesis. This has led researchers to argue that current consumption levels for the drug of dependence are not necessarily optimal. The evidence presented to refute the assumption that current consumption is a rational optimisation of the costs and benefits of the study are data suggesting that consumers generally:

- Underestimate the probability that their individual consumption patterns will lead to dependence (Gruber and Köszegi, 2001; Kenkel, 1991);
- Hold incomplete information on the potential health impacts of consuming the drug in question, and in particular underestimate the potential impacts on themselves (Gruber and Köszegi, 2001; Kenkel, 1991; Khwaja et al., 2007; Smith et al., 2008; US Department of Health and Human Services, 1994);

- Have different preferences for their preferred drug over their lifetime, such as holding positive views about drug use when young but later wishing that they had not started (this is more formally known as time inconsistent preferences (Angeletos et al., 2001; Gruber and Köszegi, 2001; Laibson, 2001)); and,
- Engage in optimisation behaviours that can be characterised by 'bounded rationality', that is using 'rules of thumb' to make decisions or optimising using an incomplete information sets (Akerlof, 1991; Suranovic et al., 1999).

If any of the four departures from rational, fully informed consumers listed above do hold with respect to a potentially addictive (and potentially harmful) substance, then it can no longer be asserted that current consumption levels of the addictive good will maximise the lifetime utility of use to the dependent user.[48] Thus, at least some of the costs arising from dependence can justify public policy responses to reduce consumption to its optimal level for the user once all costs are fully taken into account (U.S. National Cancer Institute and World Health Organization, 2016). This could involve, but is not limited to, decreasing availability, increasing price, or providing information to users and potential users.

Following this rationale, whilst costs to a dependent user are not strictly social costs, in that they are borne by the users themselves, but have not been included (or have only been partially included) in consumption decisions, and therefore cannot necessarily be assumed to have delivered an equal or greater benefit to the consumer to offset their costs. Such costs are often referred to as 'internalities'; costs to the user that were not factored into their consumption decision. Internality theory postulates that government policies should include both internal and external costs, such that changes in taxation levels can be justified even when there are no external costs as such interventions ensure that consumers are taking these costs into account in their decision making (U.S. National Cancer Institute and World Health Organization, 2016). The question then arises as to how, if at all, these costs should be included in a social cost study.

There is no consensus in the literature on how internalities should be incorporated into economic analyses such as social cost studies.

Many social cost studies continue to exclude costs borne by the substance user themselves either because the authors consider the 'rational addiction' hypothesis to still be a useful heuristic for considering individual behaviours, or due to the difficulty in identifying what net costs borne by the user should be included given that even for drugs of dependence consumers are likely to derive *some* utility from their consumption.

Another approach that is often taken is to include those cost borne by the consumers themselves that are most closely related to dependent use (potentially including their expenditure induced by dependence) but to disregard costs incurred by non-dependent users as the four departures from a rational utility maximising consumer are greatest in the presence of drug dependence. In some cases an attempt is made to identify the level of consumption (and therefore harm) that these consumers would face if they were not dependent (see, for example, the Productivity Commission's inquiry into the social costs of gambling in Australia (Productivity Commission, 1991)). In other cases, a subset of all costs borne by dependent users are treated as internalities. For example Collins and Lapsley (2008) included the intangible costs of premature mortality of all substance users, and the expenditure by dependent users on the drug of dependence.

[48] The rational addiction hypothesis still has considerable 'positive' value (that is in predicting behavioural responses to policy changes), for example it correctly predicts that increasing prices such as by restricting supply, will be effective at reducing drug consumption despite the dependence forming nature of the drug.

The final approach that can be taken is to treat ***all*** costs borne by dependent consumers as social costs, on the basis that empirical research with people who use drugs suggests that the assumptions underpinning rational utility maximisation are met amongst dependent consumers (see above), and as the evidence suggests that continued use those who are dependent is driven by the dependence rather than by utility maximisation amongst consumers (US Department of Health and Human Services, 2010, p.9). If consumers are not aware of these costs, or have not consistently taken them into account in their consumption decisions, then there is no reason to assume that the harms associated with drug consumption will have been offset by a utility gain to drug consumers. Costs borne by non-dependent persons as a result of their own substance use is still treated as a private cost and excluded from the analysis.

This latter approach has been adopted in the current study, and all costs borne by those with drug dependence will be included in the social cost calculation.

Appendix 4.1: Relationship between conditions and ICD codes

Table A4.1 Relationship between conditions and ICD-10-AM codes

Condition	ICD-10-AM Diagnosis/external causes	Source
Directly opioid-related		
Mental and behavioural disorders due to use of opioids	F11*	(Australian Institute of Health and Welfare, 2018)
Poisoning by opium	T40.0	
Poisoning by heroin	T40.1	
Poisoning by other opioids (incl. Codeine, Morphine)	T40.2	
Poisoning by methadone	T40.3	
Poisoning by other synthetic narcotics (incl. Pethidine)	T40.4	
Poisoning by other and unspecified narcotics	T40.6	
Related conditions		
Injecting-related skin and vascular infections		(Janjua et al., 2018)
Skin and soft tissue infections including vascular infections		
Cutaneous abscess, furuncle and carbuncle	L02*	
Cellulitis	L03*	
Phlebitis or thrombophlebitis	I80*	
Ulcer of lower limb, not elsewhere classified	L97*	
Other specified disorders of skin and subcutaneous tissue	L98.8	
Panniculitis, unspecified	M79.3	
Gas gangrene	A48.0	
Intracranial and intraspinal abscess and granuloma	G06*	
Sequelae of inflammatory diseases of central nervous system	G09	
Abscess of intestine	K63.0	
Acute peritonitis	K65.0	
Abscess of liver	K75.0	
Panniculitis affecting regions of neck and back, cervical region	M54.02	
Necrotising fasciitis	M72.6*	
Acute tubulo-interstitial nephritis	N10	
Gangrene, not elsewhere classified	R02	
Bacteremia or Sepsis	A40*, A41*, I26.9, I40.0, R57.2, R65.1, R65.9	
Osteomyelitis	M86*, M89.9	
Brain injury		
Episodic and paroxysmal disorders	G40-G47	
Toxic encephalopathy	G92	
Anoxic brain damage, not elsewhere classified	G93.1	
Cerebral Oedema	G93.6	
Disorder of brain, unspecified	G93.9	
Hydrocephalus in other diseases classified elsewhere	G94.2	
Somnolence, stupor, coma	R40	
Asphyxia	R09.0	
Respiratory arrest	R09.2	
HIV		(World Health Organization, 2014)
Human immunodeficiency virus disease resulting in infectious and parasitic diseases	B20*	
Human immunodeficiency virus disease resulting in malignant neoplasms	B21*	

Condition	ICD-10-AM Diagnosis/external causes	Source
Human immunodeficiency virus disease resulting in other specified diseases	B22*	
Human immunodeficiency virus disease resulting in other conditions	B23*	
Unspecified human immunodeficiency virus [HIV] disease	B24*	
HBV		(Australian Consortium for Classification Development, 2014)
Acute hepatitis B	B16*	
Acute delta-(super)infection of hepatitis B carrier	B17.0	
Chronic viral hepatitis B with delta-agent	B18.0	
Chronic viral hepatitis B without delta-agent	B18.1	
HCV		(Australian Consortium for Classification Development, 2014)
Acute hepatitis C	B17.1	
Chronic viral hepatitis C	B18.2	
Liver cancer (Malignant neoplasm of liver and intrahepatic bile ducts)	C22*	(Australian Consortium for Classification Development, 2014)
Cirrhosis		(Australian Consortium for Classification Development, 2014)
Alcoholic fibrosis and sclerosis of liver	K70.2	(Powell et al., 2019)
Alcoholic cirrhosis of liver	K70.3	
Alcoholic hepatic failure	K70.4	(Powell et al., 2019)
Chronic hepatic failure	K72.1	(Powell et al., 2019)
Fibrosis and cirrhosis of liver	K74.0	(Powell et al., 2019)
Primary biliary cirrhosis	K74.3	
Secondary biliary cirrhosis	K74.4	
Biliary cirrhosis, unspecified	K74.5	
Other and unspecified cirrhosis of liver	K74.6	
Oesophageal varices	I85.0 & .9	(Powell et al., 2019)
Gastric varices	I86.4	(Powell et al., 2019)
Oesophageal varices without bleeding in diseases classified elsewhere	I98.2	(Powell et al., 2019)
Oesophageal varices with bleeding in diseases classified elsewhere	I98.3	(Powell et al., 2019)
Maternal exposure - Low birthweight	P07.0, P07.1	(Australian Consortium for Classification Development, 2014)
Infective Endocarditis (Acute and subacute infective endocarditis)	I33.0	(Australian Consortium for Classification Development, 2014)
Neonatal withdrawal symptoms from maternal use of drugs of addiction (NAS)	P96.1	(Australian Consortium for Classification Development, 2014)
Accidental injuries		(Australian Consortium for Classification Development, 2014)
Road crash injuries	V12-V14 (.3 -.9), V19.4-V19.6, V19.9, V20-V28 (.3 -.9), V29-V79 (.4 -.9), V80.3-V80.5, V81.1, V82.1, V82.9, V83-V86 (.0 -.3), V87.0-V87.9, V89.2, V89.3, V89.9 V02-V04 (.1, .9), V06.1, V09.2, V09.3	(Chihuri and Li, 2019)
Other transport accidents	V01–V99 (excl. road crash injuries)	
Falls	W00–W19	

Condition	ICD-10-AM Diagnosis/external causes	Source
Exposure to mechanical forces	W20–W64	
Accidental drowning and submersion	W65–W74	
Other accidental threats to breathing	W75–W84	
Exposure to electricity, radiation, extreme temperature/pressure	W85–W99	
Exposure to smoke, fire, flames, hot substances	X00–X19	
Accidental exposure to other and unspecified factors	X58–X59	
Sequelae of other accidents	Y85*, Y86	
Intentional self-harm	X60-84	(Australian Consortium for Classification Development, 2014)
Sequelae of intentional self-harm	Y87.0	
Interpersonal violence injury (Assault)	X85–Y09	(Australian Institute of Health and Welfare, 2012)
Sequelae of assault	Y87.1	

*All ICD-10-AM codes that start with this letter-digit combination.

Appendix 4.2: Alternative estimate for infective endocarditis

As noted in section 4.4.2, the cost for infective endocarditis could alternatively be estimated using the population attributable fraction (PAF = 0.14) developed by English et al. (1995) for injecting drug use, multiplied by the proportion of people who inject opioids. It is unclear whether this approach would under or over-estimate the cost given the passage of time since the original estimate and scale-up of interventions (e.g., needle-syringe programs) to reduce injecting risk behaviour.

Table A4.2: Alternative estimate for infective endocarditis (IE)

				Number of separations		Attributable separations					
	AF of IE due to injecting drugs	proportion of PWI opioids	AF of IE due to injecting opioids	IE principle diagnosis	IE additional diagnosis	IE principle diagnosis	IE additional diagnosis	total	Average costweight	average cost	Total cost
Male	0.14	59.60%	0.08344	1378	2235	114	186	300	5.104208	$5,194	$7,953,377.27
Female	0.14	61.30%	0.08582	609	1018	52	87	139	5.333526	$5,194	$3,850,624.10
Persons								439			$11,804,001.37

Appendix 5.1: PBS item codes

Table A5.1: PBS Items used for calculating pharmaceutical costs

Condition	PBS item codes
HIV / AIDS	10272P, 10284G, 10285H, 10297Y, 10305J, 10307L, 10314W, 10327M, 10345L, 10347N, 10357D, 10903W, 11099E, 11104K, 11113X, 11114Y, 11146P, 11149T, 11246X, 11276L, 11296M, 11306C, 10266H, 10273Q, 10275T, 10276W, 10286J, 10298B, 10299C, 10300D, 10303G, 10304H, 10307L, 10319D, 10321F, 10326L, 10335Y, 10336B, 10337C, 10349Q, 10360G, 10361H, 10366N, 11103J, 11107N, 11114Y, 11248B,
Hepatitis C	10623D, 10624E, 10625F, 10628J, 10629K, 10630L, 10631M, 10635R, 10637W, 10638X, 10641C, 10642D, 10643E, 10644F, 10645G, 10646H, 10647J, 10648K, 10651N, 10653Q, 10654R, 10657X, 10659B, 10660C, 10661D, 10663F, 10665H, 10666J, 10667K, 10668L, 10669M, 10670N, 10671P, 10672Q, 10673R, 10675W, 10676X, 10678B, 10679C, 10747P, 10749R, 10750T, 10751W, 10752X, 10753Y, 10754B, 10761J, 10765N, 10766P, 10768R, 10769T, 10771X, 10772Y, 10773B, 10914K, 10923X, 10928E, 10929F, 10937P, 10938Q, 10978T, 10979W, 10986F, 10991L, 11011M, 11021C, 11144M, 11145N, 11147Q, 11332K, 11333L, 11337Q, 11344C, 11345D, 11346E, 11353M, 11354N, 11355P
Hepatitis B	10279B, 10290N, 10310P, 10311Q, 10315X, 10317B, 10320E, 10348P, 10353X, 10369R, 11155D, 5759D, 5762G, 5945X, 5946Y, 5949D, 5998Q, 6210W, 6213B, 8180M, 8181N, 8184R, 8553E, 6439X, 6449K, 9515T, 9516W
Skin and Soft Tissue Infections	10605E, 10609J, 10784N, 10788T, 1525G, 1526H, 1527J, 1884E, 1886G, 1887H, 1888J, 1889K, 1891M, 1892N, 2269K, 2270L, 2824P, 2951H, 3103H, 3113W, 3114X, 3130R, 3131T, 3138E, 3300Q, 3301R, 3302T, 3310F, 3323X, 3390K, 3391L, 3393N, 5006L, 5008N, 5009P, 5011R, 5057E, 5083M, 5090X, 5091Y, 5095E, 5225B, 5257Q, 5258R, 8254K, 8319W, 8581P, 8705E, 9149M, 9150N, 9714G
Neonatal Abstinence Syndrome	1850J, 2122Q, 2123R, 2124T, 2138M, 5237P, 5238Q, 5239R
Opioid Agonist Therapy	10746N, 10755C, 10756D, 10770W, 10948F, 10949G, 10953L, 10957Q, 10959T, 10964C, 10970J, 1606M, 1609Q, 5399E, 5400F, 6171T, 6172W, 6307Y, 6308B, 6309C, 8865N, 8866P, 8867Q, 9749D, 9750E

Appendix 6.1: Safe Work Australia's incident approach methodology

Safe Work Australia's incidence approach assessed the number of people entering the compensation system during 2012/13 as a result of a work-related incident and the costs (both current and expected future costs) associated with those cases. In order to estimate total costs, the expected future lifetime cost of each new cases was used to represent the cost of cases in the reference year that were already in the compensation system (Safe Work Australia, 2015).

Appendix 6.2: Safe Work Australia's cost estimation methodology

The cost estimation methodology utilised by Safe Work Australia (2015) was based on the concept of the 'human cost' of occupational injury with only costs associated with actual injuries including:

- Production costs - costs incurred in the short term until production is returned to pre-incident levels;
- Human capital costs - long run costs, such as loss of potential output, occurring after a restoration of pre-incident production levels;
- Medical costs - costs incurred by workers and the community though medical treatment of workers injured in work-related incidents;
- Administrative costs - costs incurred in administering compensation schemes, investigating incidents and legal costs;
- Transfer costs - deadweight losses associated with the administration of taxation and welfare payments; and;
- Other costs - costs not classified in other areas, such as the cost of carers and aids and modifications (Safe Work Australia, 2015).

Appendix 6.3: Recalculated workplace absenteeism costs with different daily wage estimate

The Social Costs of Methamphetamine in Australia (Whetton et al., 2016) used a similar methodology to that reported here (see Section 6.2.2). The main difference between the two costing projects was the year and type of daily wage value used from the ABS average weekly earnings report. The ABS provides average weekly earnings that are seasonally adjusted and trend estimates (see explanatory notes in https://www.abs.gov.au/ausstats/abs@.nsf/mf/6302.0 for more information). The methamphetamine costing project used November 2013 weekly wage trend data for person's total earnings (Australian Bureau of Statistics, 2014). The daily wage calculated was $267.70 (including 20% employer on-costs). Workplace absenteeism costs attributed to the use of extra-medical opioids were determined using seasonally adjusted full-time adult total weekly earnings for November 2015 (Australian Bureau of Statistics, 2016). The daily wage calculated was $373.66 (including 20% employer on-costs). The following three tables recalculate the cost of extra-medical use of opioids using the daily wage of $274.94. This daily wage was calculated from person's total weekly earnings for November 2015 (trend data) with 20% employer on-costs added (Australian Bureau of Statistics, 2016).

It is also important to note that the NDSHS collection years were different compared with the present report which used 2016 data whilst the methamphetamine report used 2013 data.

Table A6.3.1: Recalculation of **Table 6.5**. Adjusted excess workplace absenteeism due to illness/injury among opioid users and other drug users compared to non-drug users (2016 NDSHS data [a]) and associated costs (2015 ABS data [b]) [c]

		Annual Illness or Injury Absence			
Drug use status	**Estimated Population**	**Mean Days Absent (95% CI)**	**Difference [d] (95% CI)**	**Excess Days Absent (95% CI) [e]**	**Cost $ (95% CI) [f]**
No drug use	8,536,278	7.556 (6.909 – 8.203)			
Extra-medical opioid use at least weekly	80,106	19.692 (12.619 – 26.765)	12.136 (5.710 – 18.562)	972,150 (457,378 – 1,486,921)	267,282,875 (125,751,602 – 408,814,162)
Extra-medical opioid use less often than weekly	302,521	4.247 (0.909 – 7.584)	-3.309 (-6.000 – -0.619)	0 (0 – 0) [g]	0 (0 – 0) [g]
Other drug use	1,449,475	11.074 (9.547 – 12.600)	3.518 (2.638 – 4.397)	5,098,715 (3,824,159 – 6,373,271)	1,401,840,783 (1,051,414,389 – 1,752,267,083)

[a] Australian Institute of Health and Welfare, 2017. National Drug Strategy Household Survey (NDSHS) 2016, Drug Statistics Series. Canberra, Government of Australia.
[b] Australian Bureau of Statistics (ABS), 2016. Average Weekly Earnings, Australia, Nov 2015. Cat. no. 6302.0. Canberra, ABS.
[c] Calculations based on estimated absenteeism means adjusted for age, gender, marital status, socio-economic status, and occupation.
[d] Mean days absent due to a) illness/injury for extra-medical use of opioids at least weekly, b) extra-medical use of opioids less often than weekly, c) other drug use, minus mean days absent for no drug use.
[e] Difference in mean absence multiplied by estimated population.
[e] Excess absence multiplied by $274.94 (2015 average daily wage for person total earnings (trend data) plus 20% employer on-costs).
[g] To simplify interpretation of results, negative difference values (including 95% confidence intervals) were rounded to 0.

Table A 6.3.2: Recalculation of **Table 6.6**. Adjusted excess workplace absenteeism due to illicit drug use by drug use type (2016 NDSHS data [a]) and associated costs (2015 ABS data [b]) [c]

Drug use status	Estimated Population	Annual Absence Due to Drug Use		
		Mean Days Absent (95% CI)	**Excess Days Absent (95% CI)** [d]	**Cost $ (95% CI)** [e]
Extra-medical opioid use at least weekly	80,106	0.402 (-0.640 – 1.445)	32,240 (0 – 115,786) [f]	8,864,116 (0 – 31,834,259) [f]
Extra-medical opioid use less often than weekly	302,521	0.262 (-0.248 – 0.772)	88,902 (0 – 233,452) [f]	24,442,840 (0 – 64,185,188) [f]
Other drug use	1,449,475	0.208 (-0.015 – 0.430)	301,024 (0 – 623,604) [f]	82,763,558 (0 – 171,453,592) [f]

[a] Australian Institute of Health and Welfare, 2017. National Drug Strategy Household Survey (NDSHS) 2016, Drug Statistics Series. Canberra, Government of Australia.
[b] Australian Bureau of Statistics (ABS), 2016. Average Weekly Earnings, Australia, Nov 2015. Cat. no. 6302.0. Canberra, ABS.
[c] Calculations based on estimated absenteeism means adjusted for age, gender, marital status, socio-economic status, and occupation.
[d] Days in excess of non-drug users. Mean days absent multiplied by estimated population.
[e] Excess absence multiplied by $274.94 (2015 average daily wage for person total earnings (trend data) plus 20% employer on-costs).
[f] To simplify interpretation of results, negative difference values (including 95% confidence intervals) were rounded to 0.

Table A6.3.3: Recalculation of **Table 6.8**. Summary: Workplace costs due to extra-medical opioid use

Cost area	Central estimate $	Low bound $	High bound $
Occupational injury [a]	319,145,000 [a]	142,770,000 [b]	495,520,000 [c]
Absenteeism	102,660,461 [c]	22,750,653	182,570,270
Total	**421,805,461**	**165,520,653**	**678,090,270**

[a] Cost to employer ($61,765,000) plus cost to community ($257,380,000). Employee costs are an internal cost and thus not included in the total cost estimate for occupational injury (see Table 6.3).
[b] Cost to employer ($27,630,000) plus cost to community ($115,140,000). Employee costs are an internal cost and thus not included in the total cost estimate for occupational injury (see Table 6.3).
[c] The mid point of the low and high bound estimates.

Note: the figures in Recalculated Table 6.8 account for poly-drug use. That is, illness/injury-related absenteeism (Recalculated Table 6.5) and drug-related absenteeism (Recalculated Table 6.6) costs attributed to extra-medical opioid use were divided by 1.464 (see main report Section 6.3.2 and Table 6.7 for more information about this procedure).

References (appendices)

Akerlof, G., 1991. Procrastination and obedience. *American Economic Review* 81, 1-19.

Angeletos, G.-M., Laibson, D., Repetto, A., Tobacman, J., Weinberg, S., 2001. The hyperbolic consumption model: Calibration, simulation, and empirical evaluation. *Journal of Economic Perspectives* 15, 47-68.

Australian Bureau of Statistics, 2014. Average Weekly Earnings, Australia, Nov 2013, Cat. no. 6302.0. Canberra, ABS.

Australian Bureau of Statistics, 2016. Average Weekly Earnings, Australia, Nov 2015. Cat. no. 6302.0. Canberra, ABS.

Australian Consortium for Classification Development, 2014. The International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM), Ninth (Ed.). Darlinghurst, NSW, Independent Hospital Pricing Authority.

Australian Institute of Health and Welfare, 2012. Hospitalised interpersonal violence and perpetrator coding, Australia, 2002–05, Injury Research and Statistics Series Number 77. Canberra, AIHW.

Australian Institute of Health and Welfare, 2018. Opioid harm in Australia and comparisons between Australia and Canada Cat. no. HSE 210. Canberra, AIHW.

Becker, G.S., Grossman, M., Murphy, K.M., 2008. An empirical analysis of cigarette addiction. *American Economic Review* 84, 396-418.

Becker, G.S., Murphy, K.M., 1988. A theory of rational addiction. *Journal of Political Economy* 96, 675-700.

Cawley, J., Ruhm, C.J., 2011. The economics of risky health behaviors. In: Pauly, M.V., McGuire, T.G., Barros, P.P. (Eds.), The Handbook of Health Economics, volume 1. North-Holland, Oxford.

Chaloupka, F., 1991. Rational addictive behavior and cigarette smoking. *Journal of Political Economy* 99, 722-742.

Chihuri, S., Li, G., 2019. Use of prescription opioids and initiation of fatal 2-vehicle crashes. *JAMA Network Open* 2, e188081-e188081.

Collins, D.J., Lapsley, H.M., 2008. The costs of tobacco, alcohol and illicit drug abuse to Australian society in 2004/05, National Drug Strategy Monograph Series No. 64. Canberra, Commonwealth of Australia.

English, D.R., Holman, C.D.J., Milne, E., Winter, M.G., Hulse, G.K., Codde, J.P., Bower, C.I., Corti, B., de Klerk, N., Knuiman, M.W., Kurinczuk, J.J., Lewin, G.F., Ryan, G.A., 1995. The Quantification of Drug Caused Morbidity and Mortality in Australia, 1995 edition. Commonwealth Department of Human Services and Health, Canberra.

Gruber, J., Köszegi, B., 2001. Is addiction 'rational'? Theory and evidence. *Quarterly Journal of Economics* 116, 1261-1303.

Janjua, N.Z., Islam, N., Kuo, M., Yu, A., Wong, S., Butt, Z.A., Gilbert, M., Buxton, J., Chapinal, N., Samji, H., Chong, M., Alvarez, M., Wong, J., Tyndall, M.W., Krajden, M., 2018. Identifying injection drug use and estimating population size of people who inject drugs using healthcare administrative datasets. *International Journal of Drug Policy* 55, 31-39.

Kenkel, D.S., 1991. Health behavior, health knowledge and schooling. *Journal of Political Economy* 99, 287-305.

Khwaja, A., Sloan, F., Chung, S., 2007. The relationship between individual expectations and behaviors: Mortality expectations and smoking decisions. *Journal of Risk and Uncertainty* 35, 179-201.

Laibson, D., 2001. A cue-theory of consumption. *Quarterly Journal of Economics* 116, 81-119.

Makate, M., Whetton, S., R.J., T., Dey, T., Scollo, M., Banks, E., Norman, R., Pidd, K., Roche, A., Allsop, S., 2019. Tobacco cost of illness studies: A systematic review *Nicotine and Tobacco Research*, DOI.org/10.1093/ntr/ntz1038.

Powell, E.E., Skoien, R., Rahman, T., Clark, P.J., O'Beirne, J., Hartel, G., Stuart, K.A., McPhail, S.M., Gupta, R., Boyd, P., Valery, P.C., 2019. Increasing hospitalization hates for cirrhosis: Overrepresentation of disadvantaged Australians. *EClinicalMedicine* 11, 44-53.

Productivity Commission, 1991. Australia's Gambling Industries. Report no. 10 AusInfo, Canberra, Productivity Commission.

Safe Work Australia, 2015. The Cost of Work-related Injury and Illness for Australian Employers, Workers and the Community: 2012–13. Canberra, Safe Work Australia.

Smith, V., Taylor, D., Sloan, F., Johnson, F., Desvousges, W., 2008. Do smokers respond to health shocks? *Review of Economics and Statistics* 83, 675-687.

Suranovic, S.M., Goldfarb, R.S., Leonar, T.C., 1999. An economic theory of cigarette addiction. *Journal of Health Economics* 18, 1-29.

U.S. National Cancer Institute and World Health Organization, 2016. The Economics of Tobacco and Tobacco Control, National Cancer Institute Tobacco Control Monograph Series 21. Bethesda, MD & geneva, CH, Department of Health & Human Services, National Institutes of Health, National Cancer Institute: World Health Organization.

US Department of Health and Human Services, 1994. Preventing Tobacco Use Among Young People: A Report of the Surgeon General. Atlanta, GA, US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

US Department of Health and Human Services, 2010. How Tobacco Smoke Causes Disease: The Biology and Behavioral Basis for Smoking-Attributable Disease: A Report of the Surgeon General. Atlanta, GA, U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

Whetton, S., Shanahan, M., Cartwright, K., Duraisingam, V., Ferrante, A., Gray, D., Kaye, S., Kostadinov, V., McKetin, R., Pidd, K., Roche, A., Tait, R.J., Allsop, S., 2016. The Social Costs of Methamphetamine in Australia 2013/14, Tait, R.J., Allsop, S. (Eds.). Perth, WA, National Drug Research Institute, Curtin University.

World Health Organization, 2014. Guidelines for HIV Mortality Measurement. WHO, Geneva. 18 Sept 2019. https://www.ncbi.nlm.nih.gov/books/NBK236995/

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