The diversion and supply of pharmaceutical drugs for non-medical use

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BCCJ (Hons Class 1)

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Thesis / dissertation sheet

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Abstract 350 words maximum: (PLEASE TYPE)

Consistent with international trends, in 2016 Australia experienced its highest number of drug-related deaths in 20 years, with most attributed to pharmaceutical opioids and benzodiazepines. A large international evidence-base exists on mechanisms, drivers and profitability of illicit drug supply, yet equivalent research examining pharmaceutical drugs is scarce. This thesis aimed to fill this gap by examining, through four empirical studies, the diversion and supply of pharmaceutical drugs for non-medical use.

First, a systematic review and meta-analysis pooled results from 34 international studies to estimate the prevalence of medical and non-medical/intermediary sourcing and diversion. Most pharmaceuticals for non-medical use were sourced via friends/family (57%, 95% CI 53%-62%) and few studies examined supply beyond end-user perspectives. Addressing this gap, the role of health practitioners and suppliers in Australia was explored next. Diversion from the medical system was examined through 117 cases of health practitioner misconduct using AustLII records. Persistent over-prescribing by a small number of practitioners due to inadequate skills to manage complex patient groups was identified. The final two empirical chapters analysed data from semi-structured interviews with 51 people involved in supplying pharmaceutical drugs. Negative binomial regressions and thematic analysis explored drug sourcing and motivations. Suppliers used medical (47% legitimate, 7% illegitimate prescriptions) and intermediary sources (e.g. 18% friends/family) and were financially (65%) and/or altruistically (61%) motivated. Those using illegitimate medical sources distributed larger quantities, while altruistically motivated suppliers distributed smaller quantities (e.g. leftover supplies) to people with perceived therapeutic need. Mark-up calculations showed that for every dollar-invested, suppliers earned $3.19 (median) or $19.90 (mean). Mixed-effects regressions found mark-up was predicted by source, such that mark-up was higher for medically sourced drugs, compared with those sourced via intermediaries (median $13.49 cf. $1.23).

This research holds implications for research, policy and practice. The supply chain for pharmaceutical diversion is shorter than for illicit drugs and supply mechanisms and motives are diverse, warranting multifaceted responses. For example: 1) prescription monitoring for the small number of high-volume suppliers, 2) broader education for social supply, 3) consideration of supplier motive at sentencing, 4) support for health practitioners, and 5) addressing demand factors in marginalised populations.

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Suzanne Nielsen 15 August 2019

Caitlin Hughes 15 August 2019

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Details of publication #1:
Full title: The source and diversion of pharmaceutical drugs for non-medical use: A systematic review and meta-analysis
Authors: Hulme S, Bright D, Nielsen S.
Journal or book name: Drug and Alcohol Dependence
Volume/page numbers: 186, pp.242-256
Date accepted/ published: 27 March 2018

Status	*Published*	***X***	*Accepted and In press*		*In progress (submitted)*	

The Candidate's Contribution to the Work
Shann Hulme designed the study, managed the systematic searches, summarised and coded the literature, conducted the meta-analyses and wrote the first and subsequent versions of the manuscript, including responding to all reviewer feedback and preparing for publication.

Location of the work in the thesis and/or how the work is incorporated in the thesis:
This publication forms **Chapter Two** of the thesis and provides a comprehensive review of the global evidence-base in relation to the source and diversion of pharmaceutical drugs that are used non-medically. By using meta-analytic techniques, this paper produces original estimates of the prevalence of drug sourcing and diversion among different population groups. This review identifies gaps in the evidence base and provides the basis for the following empirical components of this thesis.

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Details of publication #2:
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The Candidate's Contribution to the Work
Shann Hulme designed the study and the research protocol, coordinated ethics clearance, conducted the search for relevant cases, reviewed and coded the tribunal decisions, conducted the quantitative analyses and wrote the first and subsequent versions of the manuscript, including incorporating supervisor feedback and responding to reviewer comments.

Location of the work in the thesis and/or how the work is incorporated in the thesis:
This publication forms **Chapter Three** of the thesis and builds upon the findings of the review (**Chapter Two**) that identified the medical system to be a key source of drugs that are used non-medically. The focus is on unpacking the role of health practitioners in diversion and factors contributing to their misconduct.

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A/Prof Suzanne Nielsen		*15/06/19*
A/Prof Caitlin Hughes		*15/06/19*

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The Candidate's Contribution to the Work
Shann Hulme designed the study and developed the research plan and interview protocol, coordinated ethics clearance, conducted the interviews with suppliers, transcribed and coded the data, conducted the quantitative and qualitative analyses, and the wrote the first and subsequent versions of the manuscript including incorporating supervisor feedback and responding to reviewer comments.

Location of the work in the thesis and/or how the work is incorporated in the thesis:
This publication forms **Chapter Four** of the thesis and emerges from the key finding from the review (**Chapter Two**) that majority of research to date has been conducted with end-users and thus little is known about supply from the perspective of suppliers themselves. This chapter presents analysis of interviews conducted with a sample of people involved in pharmaceutical diversion and supply in Australia and focuses on sourcing routes and motivations for supply. Importantly, this study examines the quantity and frequency of supply by each source and motivating factor, as well as other correlates such as supplier demographics.

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A/Prof Caitlin Hughes		*15/06/19*

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The Candidate's Contribution to the Work
Shann Hulme designed the study and developed the research and analysis plan, coordinated ethics clearance, conducted the interviews with suppliers, transcribed and coded the data, conducted the econometric analyses, and the wrote the first and subsequent versions of the manuscript, including the incorporation of supervisor feedback.

Location of the work in the thesis and/or how the work is incorporated in the thesis:
This publication forms **Chapter Five** of the thesis and utilises the same methodology for data collected as described in **Chapter Four,** however a separate dataset was created at the cycle rather than participant-level. The purpose of this chapter is to better understand factors influencing the price of drugs diverted and supplied on the Australian black market and quantify the financial return from supply. This work stems from the assumption that the diversion and supply of pharmaceutical drugs is a financially lucrative venture and is the first internationally to examine the economics of black-market pharmaceutical supply.

Primary Supervisor's Declaration
I declare that:
- the information above is accurate
- this has been discussed with the PGC and it is agreed that this publication can be included in this thesis in lieu of a Chapter
- All of the co-authors of the publication have reviewed the above information and have agreed to its veracity by signing a 'Co-Author Authorisation' form.

Supervisor's name	*Supervisor's signature*	*Date (dd/mm/yy)*
A/Prof Suzanne Nielsen		*02/07/19*
A/Prof Caitlin Hughes		*02/07/19*

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My work has undoubtedly benefitted from the brutal and constructive feedback of the anonymous reviewers of my papers – I will always be grateful for the wisdom you provided. Much of this thesis is based upon the lives of 51 people who were brave enough to open up to me. Thank you so much for the incredible insights you provided. I hope that in some small way my work might contribute to overcoming some of the challenges that you face.

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I have been blessed growing up with two incredible older sisters, Shey and Bree. The two rocks in my life who showed me from a young age what it was to be powerful, accomplished women. Thank you for being my true inspirations.

Last but not least, to my parents. Thank you for the unconditional love and support you never fail to provide. For submitting this PhD for me as I sit in my office on the other side of the world! Mum and Dad, I love you so much and to you both, I dedicate this thesis.

Abstract

Consistent with international trends, in 2016 Australia experienced its highest number of drug-related deaths in 20 years, with most attributed to pharmaceutical opioids and benzodiazepines. A large international evidence-base exists on mechanisms, drivers and profitability of illicit drug supply, yet equivalent research examining pharmaceutical drugs is scarce. This thesis aimed to fill this gap by examining, through four empirical studies, the diversion and supply of pharmaceutical drugs for non-medical use.

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List of publications included in this thesis

1. **Hulme, S**., Bright, D. & Nielsen, S. 2018. The source and diversion of pharmaceutical drugs for non-medical use: a systematic review and meta-analysis. *Drug & Alcohol Dependence*, 186**,** 242-256.
2. **Hulme, S**., Hughes, C.E. & Nielsen, S. 2019. What factors contributed to the misconduct of health practitioners? An analysis of Australian cases involving the diversion and supply of pharmaceutical drugs for non-medical use between 2010 and 2016. *Drug & Alcohol Review*, 38**,** 366-376.
3. **Hulme, S.**, Hughes, C. E. & Nielsen, S. 2019. Drug sourcing and motivations among a sample of people involved in the supply of pharmaceutical drugs in Australia. *International Journal of Drug Policy*, 66**,** 38-47.
4. **Hulme, S.**, Hughes, C.E. & Nielsen, S. The price and mark-up of pharmaceutical drugs supplied on the black market. *International Journal of Drug Policy* (under review).

Other publications during candidature

1. **Hulme S**, Morgan A & Bryant W 2017. Multi-site evaluation of CCTV projects: A feasibility study. Report to the Community Crime Prevention Unit, Victorian Department of Justice. Australian Institute of Criminology, Canberra.
2. Dowling C, Morgan A, **Hulme S**, Manning M & Wong G 2018. Protection orders for domestic violence: A systematic review. *Trends & Issues in Crime and Criminal Justice*, 551. Australian Institute of Criminology, Canberra.
3. Australian Institute of Health and Welfare 2018. Alcohol, tobacco and other drugs in Australia. Web report. Available at: https://www.aihw.gov.au/reports/alcohol/alcohol-tobacco-other-drugs-australia/contents/introduction [last accessed October 2018].
4. Hughes C.E., Stevens A, **Hulme S** & Cassidy R 2018. *Review of approaches taken in Ireland and in other jurisdictions to simple possession drug offences*. A report for the Irish Department of Justice and Equality and the Department of Health. UNSW Australia and University of Kent.
5. Stevens A, Hughes C.E., **Hulme S** & Cassidy R. Depenalisation, diversion and decriminalisation: A realist review and programme theory of alternatives to criminalisation for simple drug possession. *European Journal of Criminology* (under review).
6. Hughes C.E., **Hulme S** & Ritter A. The relationship between drug price, purity and population-level harms. *Trends & Issues in Crime and Criminal Justice* (under review).

Presentations arising from this thesis

1. **Hulme S**, Vali N & Abid M 2019. 'On the couch session': Q&A on understanding and addressing the diversion and supply of steroids and other pharmaceutical drugs. IPED Practitioner Workshop, Birmingahm, UK, 4 July.
2. **Hulme S,** Hughes C.E. & Nielsen S 2019. The price and mark-up of pharmaceutical drugs supplied on the black market: An Australian case study. Oral presentation at the 13th Annual ISSDP Conference, Paris, France, 22 May.
3. **Hulme S**, Hughes C.E. & Nielsen S 2018. Drug sourcing and motivations among a sample of people involved in the supply of pharmaceutical drugs for non-medical use in Australia. Poster presentation at the NDARC Symposium, 8 October. *Winner of Outstanding Research Poster, People's Choice Award.*
4. **Hulme S**, Hughes C.E. & Nielsen S 2018. The source and diversion of pharmaceutical drugs for non-medical use. Oral presentation at the NDARC lunchtime seminar series, 30 August.
5. **Hulme S**, Hughes C.E. & Nielsen S 2018. What sources are used by pharmaceutical drug dealers to obtain their drug supplies? An Australian study. Oral presentation at the 12th Annual ISSDP Conference, Vancouver, Canada, 18 May. *Awarded Doctoral Scholarship for the Best Submitted Abstract and formal mention at the conference for presenting one of top ten Early Career Researcher presentations.*
6. **Hulme S**, Djordjevic D, Hughes C.E. & Nielsen S 2017. The role of health practitioners in the diversion of pharmaceutical drugs for non-medical use in Australia. Poster presentation at the Illicit Networks Workshop, Flinders University, Adelaide, 11-12 December. *Winner of Outstanding Research Poster Award.*
7. **Hulme S**, Djordjevic D, Hughes C.E. & Nielsen S 2017. The role of health practitioners in the diversion of pharmaceutical drugs for non-medical use in Australia. Oral presentation at the Australasian Professional Society on Alcohol & other Drugs (APSAD) conference, Melbourne, 15 November.
8. **Hulme S**, Bright D & Nielsen S 2017. The supply chain of pharmaceutical drugs for non-medical use. Poster presentation at the Australasian Professional Society on Alcohol & other Drugs (APSAD), Melbourne, 13-15 November.

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Abbreviations

ABS	Australian Bureau of Statistics
ACIC	Australian Criminal Intelligence Commission
ACT	Australian Capital Territory
ADHD	Attention-deficit hyperactivity disorder
AHPRA	Australian Health Practitioner Regulation Authority
AIC	Akaike Information Criterion
AIHW	Australian Institute of Health and Welfare
AOR	Adjusted odds ratio
ATS	Amphetamine-type stimulants
BIC	Bayesian information criterion
BOCSAR	Bureau of Crime Statistics and Research
CI	Confidence interval
DDD	Defined daily dose
EDRS	Ecstasy and related Drugs Reporting System
EMCDDA	European Monitoring Centre for Drugs and Addiction
HIV	Human immunodeficiency virus
IDRS	Illicit Drugs Reporting System
IRR	Incidence rate ratio
MDMA	methylenedioxymethamphetamine
NSP	Needle and syringe program
NDARC	National Drug and Alcohol Research Centre
NDSHS	National Drug Strategy Household Survey (Australia)
NMU	Non-medical use
NPS	National Prescribing Service
NSDUH	National Survey on Drug Use and Health (United States)

NSW	New South Wales
NT	Northern Territory
ODE	Oral diazepam equivalent
OME	Oral morphine equivalent
OR	Odds ratio
OST	Opioid substitution therapy
OTC	Over-the-counter
PBS	Pharmaceutical Benefits Scheme
PDMP	Prescription drug monitoring program
PIED	Performance and image enhancing drug
PRISMA	Preferred reporting items for systematic reviews and meta-analyses
PWUD	People who use drugs
RACGP	Royal Australian College of General Practitioners
RUM	Return Unwanted Medicines
QLD	Queensland
SA	South Australia
TAS	Tasmania
TGA	Therapeutic Goods Administration
UK	United Kingdom
UN	United Nations
UNODC	United Nations Office on Drugs and Crime
US	United States
WA	Western Australia
WHO	World Health Organisation

1 Chapter One: Introduction

International drug policy has traditionally focused on illicit drugs like cannabis, cocaine, heroin and meth/amphetamine. However, grey and black markets for pharmaceutical drugs are on the rise in many countries around the world, including Australia, posing new challenges for policy makers (Babor et al., 2018, United Nations Office on Drugs and Crime [UNODC], 2018). Pharmaceutical drugs are responsible for significant improvements in patient outcomes and quality of life. Nevertheless, the use of drugs like pharmaceutical opioids, benzodiazepines and stimulants may result in harms such as substance use disorders and overdose. The risk of harm is exacerbated when pharmaceutical drugs are not used as intended, including when they are diverted from the medical system, used in excessive quantities or frequencies, or when used in combination with other substances (Daniulaityte et al., 2014).

Harms related to pharmaceutical drugs are an increasing global concern (UNODC, 2018). North America is amid an opioid 'epidemic', which began with dramatic increases in opioid prescribing throughout the 1980s and 1990s (Belzak and Halverson, 2018, Ciccarone, 2019, Fischer et al., 2018). Increased utilisation of pharmaceutical opioids have been met with adverse health consequences, whereby in 2017 the United States (US) saw 17,029 deaths attributed to commonly prescribed opioids, particularly hydrocodone, oxycodone and methadone – a fivefold increase since 1999 (Centers for Disease Control and Prevention, 2019, Scholl et al., 2019). The magnitude of harms due to pharmaceutical drugs in other parts of the world remain below that of North America, nevertheless there are international concerns. In Australia, for example, there were 1,808 drug-related deaths in 2016 and most involved pharmaceutical opioids and benzodiazepines (Australian Bureau of Statistics [ABS], 2017). In England and Wales, 3,756 drug-related deaths were recorded in 2017 – the highest number in over a decade and of which, 27% involved commonly prescribed opioids (Office for National Statistics, 2018). Scotland now has the highest rate of drug-related deaths in the EU, and like Australia, pharmaceutical opioids and benzodiazepines were present in the majority of deaths. Particular concerns have been

raised in Scotland due to the presence of 'street benzodiazepines' in 57% of deaths – which includes those that were deemed to have come from illicit sources (National Records on Scotland, 2019). The concomitant use of pharmaceutical opioids and benzodiazepines has been attributed to a considerable proportion of overdose deaths across the globe (European Monitoring Centre for Drugs and Drug Addiction [EMCDDA], 2015, UNODC, 2017a).

Non-medical use (NMU) of pharmaceuticals is relatively common. The 2017 National Survey on Drug Use and Health (NSDUH) in the US found that approximately 6.6% or 18.1 million people aged 12 and over had misused[1] a prescription opioid, sedative, tranquiliser or stimulant in the prior 12 months. Of these, 4.2% or 11.4 million people had misused a prescription opioid and while this represents a slight decrease from 12.7 million users in 2015, pharmaceutical opioids remained the second most commonly used illicit drug, after cannabis (McCance-Katz, 2017). This is comparable to the prevalence of NMU within the European Union where in 2014, 5.0%, 5.8% and 2.8% of the general population aged between 12 and 49 reported NMU of pharmaceutical opioids, sedatives and stimulants, respectively (Novak et al., 2016). Meanwhile, Africa faces increasing problems related to the trafficking and NMU of tramadol, a prescription opioid used for the treatment of moderate pain, particularly among vulnerable populations (UNODC, 2018, UNODC, 2019b).

The NMU of pharmaceutical drugs often involves diversion from the medical system. This may include diversion for personal use or supply through practices such as theft, doctor or pharmacy shopping, illegal sale, sharing or trading among family and friends, overprescribing by health practitioners and online or dark net sales (Inciardi et al., 2007a). According to the 2019 World Drug Report, 71 countries reported cases of pharmaceutical opioid diversion from licit sources between 1998 and 2017 (UNODC, 2019b). Most research focused on this issue has examined the risk factors, motivations and harms from pharmaceutical NMU and as has been acknowledged elsewhere (Babor et al., 2018, Inciardi et al., 2009b, Roxburgh, 2018), very little is known about the extent and nature of pharmaceutical diversion and supply. While there are

[1] Use in any way not directed by a doctor, including use without a prescription of one's own; use in greater amounts, more often; or for longer than told to take.

additional policy and clinical practice levers available for controlling the supply of legal substances like pharmaceutical drugs when compared with those for illicit substances, there are also added challenges in striking a balance between legitimate therapeutic access and minimising harms from diversion and supply for NMU (Babor et al., 2018, UNODC, 2019a). Research examining both the demand and supply of pharmaceutical drugs for NMU is needed.

This thesis is focused on understanding pharmaceutical diversion and supply for NMU in Australia, one country where harms related to pharmaceutical drugs have reached unprecedented levels. This introductory chapter will first, provide background and context for the rest of this thesis in terms of the terminology used, pharmaceutical drugs and their regulation in Australia, and trends and harms in relation to pharmaceutical NMU. Second, a review of the extant knowledge on the nature of pharmaceutical NMU and the supply of illicit drugs will be presented. Third, the policy and legislative framework for addressing pharmaceutical diversion and supply for NMU in Australia will be summarised, followed by a brief discussion of international approaches. This chapter concludes with an overview of the empirical chapters of this thesis.

1.1 Thesis terminology

The terminology used throughout this thesis is listed alphabetically and defined in Table 1.1.

Table 1.1. Thesis terminology

Term	Definition
Black market	Unlawful exchanges of legal or controlled commodities (Grzybowski, 2004).
Diversion	The unlawful channelling of pharmaceuticals from the medical system for NMU (Inciardi et al., 2007a).
End-user	The final consumer of the drug.
Grey market	Sometimes referred to as a parallel market, includes goods supplied outside of their authorised channels of trade.
Hypnotic-sedatives (referred to as 'sedatives')	A group of drugs that cause calming and sedative effects due to their depressive activity on the central nervous system. Benzodiazepines comprise the largest group of drugs in this class and examples include diazepam, alprazolam and temazepam. Barbituarates and z-drugs (non-benzodiazepine drugs) are also classified as hypnotic-sedatives (Nielsen and Gisev, 2017).
Illicit drugs	Substances that have been prohibited under UN Conventions and in most member states, including Australia. Prohibited drugs in Australia

Term	Definition
	are classified under Schedule 9 or 10 such as cocaine, heroin and meth/amphetamine (Therapeutic Goods Administration [TGA], 2018d).
Medical source	The legal marketplace for pharmaceutical drugs (Babor et al., 2018) – acquired using a legitimately obtained and authorised prescription or illegitimately obtained via doctor shopping, pharmacy shopping or prescription forgery.
Non-medical source (also referred to as 'intermediary')	Illegal sources for pharmaceutical drugs – acquired without a legitimately obtained or authorised prescription through intermediaries such as friends or family, illicit dealers and online.
Non-medical use (NMU)	The consumption of a pharmaceutical drug for non-therapeutic purposes or other than directed by a registered healthcare professional (Barrett et al., 2008, Larance et al., 2011b).
Pharmaceutical opioids (referred to as 'opioids')	A class of legally manufactured medicines that bind to the opioid receptors and are used therapeutically to treat pain and opioid dependence. Examples include oxycodone, buprenorphine and codeine (Nielsen and Gisev, 2017).
Over-the-counter (OTC)	Pharmacist-only or pharmacy-only medication available without a prescription written by a health practitioner. In Australia, OTC drugs are classified as Schedule 2 and 3 (TGA, 2018d).
Performance and image enhancing drugs (PIEDs)	Substances that are generally used to enhance muscle growth ('anabolic' effects) or to reduce body fat ('catabolic effects') (Larance et al., 2005).
Pharmaceutical	Any prescribed or OTC medicine that was manufactured with the intention of it being used therapeutically (World Health Organisation [WHO], 2019).
Prescription drug/medicine	Pharmaceutical drugs that require a prescription from a registered health practitioner in order for them to be legitimately obtained. In Australia, prescription drugs are classified as Schedule 4 or Schedule 8. This excludes OTC (Schedule 2 and 3) drugs (TGA, 2018d).
Pharmaceutical stimulants (referred to as 'stimulants')	A group of drugs that produce stimulatory effects by increasing nerve transmission in the brain and body. Included in this group are drugs commonly used for therapeutic purposes to treat attention deficit-hyperactivity disorder (e.g. methylphenidate, dexamphetamine) and for use as appetite suppressants in weight loss (e.g. phentermine) (Nielsen and Gisev, 2017).
Supply	The distribution of illicit or pharmaceutical drugs from one person to another, through gifting, selling or trading and irrespective of whether money was exchanged.
Supply chain or distribution system	The system and processes that facilitate the movement of drugs, as well as the interrelationships among producers, distributors, retailers and end-users (May and Hough, 2004, Ritter et al., 2012).

1.2 Pharmaceutical drug classes

Pharmaceutical drugs include any prescribed or OTC medicine that was manufactured with the intention of it being used therapeutically (WHO, 2019). The pharmaceutical drugs covered in this thesis include those susceptible to NMU, namely pharmaceutical opioids, sedatives,

stimulants and others including antipsychotics, antidepressants and PIEDs. The definitions and broad indications for therapeutic use for each of these drug classes are provided in Table 1.2.

Table 1.2. Therapeutic indications of drug classes susceptible to non-medical use

Drug class	Example drug types	Examples of common indications for use
Pharmaceutical opioids	Buprenorphine, codeine, fentanyl, hydrocodone, methadone, morphine, oxycodone, pethidine, tapentadol, tramadol	Analgesia and pain relief, treatment of opioid dependence
Hypnotic-sedatives	*Barbiturates:* Phenorbarbital	Older class of sedatives used for treatment of insomnia and epilepsy
	Benzodiazepines: Alprazolam, clonazepam, diazepam, flunitrazepam, lorazepam, midazolam, oxazepam, temazepam	Treatment of anxiety and insomnia
	Benzodiazepine-like drugs (Z-drugs): Zopiclone, zolpidem	Newer class of sedatives, mainly used for treatment of insomnia
Pharmaceutical stimulants	Dexamphetamine, methylphenidate, phentermine	Treatment of attention deficit-hyperactivity disorder (ADHD) and for use as appetite suppressants in weight loss
PIEDs	Anabolic androgenic steroids, growth hormones, peptides	Treatment of hypogonadism, cachexia, anaemia, for muscle wasting and in testosterone replacement therapy
Antidepressants and antipsychotics	*Selective serotonin reuptake inhibitors (SSRIs) antidepressants:* Fluoxetine, sertraline, escitalopram *Antipsychotics:* Quetiapine	Treatment of depressive disorders, obsessive compulsive disorder, anxiety disorders and schizophrenia

Source: Information adapted from Nielsen and Gisev (2017).

1.3 Drug scheduling in Australia

In Australia, the Therapeutic Goods Administration (TGA) is the authority that regulates pharmaceutical drugs. The Scheduling Policy Framework classifies each drug according to the "risk of harm and level of access control required to protect consumers" (TGA, 2018a) and the Schedules are published in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) (the Poisons Standard). The Poisons Standard is implemented under state and territory legislation for regulatory purposes (such as the *Poisons and Therapeutic Goods Act 1966* and the *Poisons and Therapeutic Goods Regulation 2008* in NSW), so there are minor

jurisdictional differences. Table 1.3 provides a summary of the drug schedules and regulatory requirements relevant to the pharmaceutical drugs within the scope of this thesis.

Table 1.3. Australian scheduling framework for pharmaceutical drugs

Schedule	Description	Regulation	Example drug types
Schedule 2	Pharmacy medicine Substances and preparations for therapeutic use, which are substantially safe in use but where advice or counselling is available.	Location and storage varies between jurisdictions.	Paracetamol [a]
Schedule 3	Pharmacist-only medicine Considered substantially safe with pharmacist intervention to ensure the quality use of the medicine. Has a well-defined risk profile and is not expected to produce dependence.	Medicines must be kept genuinely out of public access (e.g. behind the counter).	*Opioid antagonist:* Naloxone *Stimulants:* Pseudoephedrine
Schedule 4	Prescription-only medication Substances that require professional monitoring or management by a medical practitioner.	Available by prescription from an authorised prescriber. May only be dispensed with a valid prescription that adheres to the regulatory requirements (e.g. clearly specifies date, patient name and address). Must be kept in the dispensary or other area to which customers do not have access.	*Opioids:* Codeine (when compounded with another active ingredient), tramadol *Sedatives:* Diazepam, clonazepam, diazepam, lorazepam, midazolam, oxazepam, temazepam *Other:* Quetiapine, fluoxetine, sertraline, escitalopram
Schedule 8	Controlled drug or drugs of dependence Substances that have been recognised to cause dependence or have a high propensity for NMU.	Prescribing and supply generally requires a special authority. These drugs must be kept separate from other goods in a safe or equivalent secure locked facility meeting certain specified requirements that vary by jurisdiction, including being fixed to the building. The safe must be securely locked when not in immediate use.	*Opioids:* Buprenorphine, codeine (as a single ingredient), fentanyl, methadone, morphine, oxycodone, pethidine *Sedatives:* Alprazolam, flunitrazepam *Stimulants:* Dexamphetamine, methylphendiate

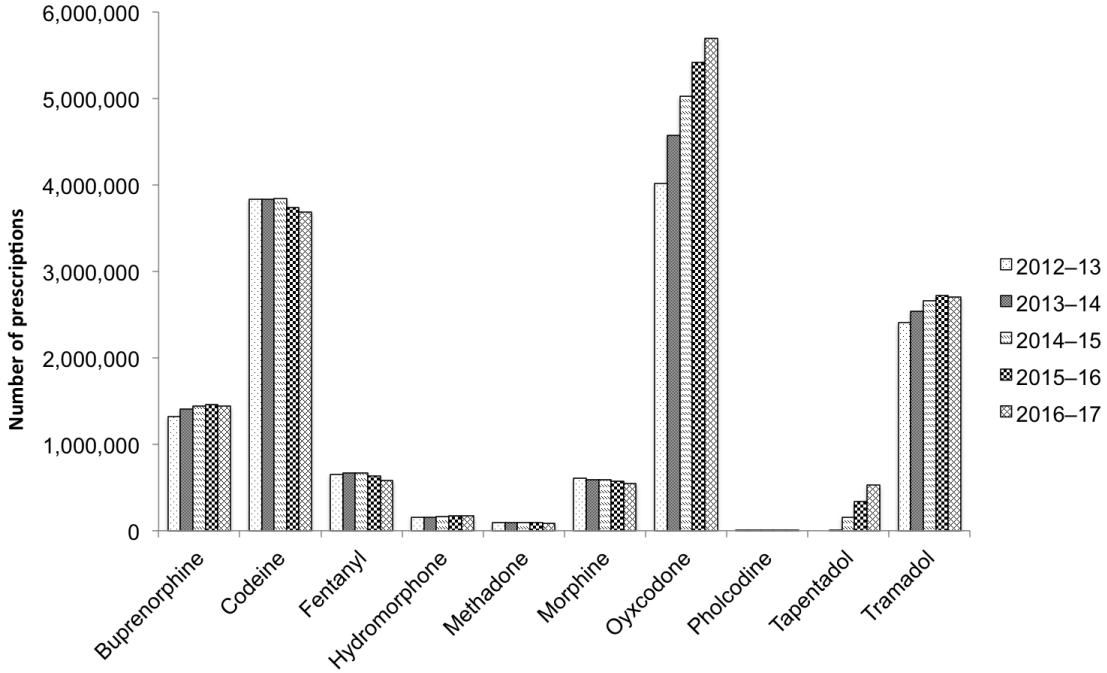
Source: NSW Health (2015), TGA (2019)

Notes: [a)] When combined with ibuprofen in preparations for oral use when labelled with a recommended daily dose of 1200mg or less of ibuprofen in divided doses in a primary pack containing no more than 12 dosage units per pack or in tablets or capsules each containing 500 mg or less of paracetamol as the only therapeutically active constituent.

1.4 Prescribing trends in Australia

Understanding prescribing trends is important for understanding the supply chain and research has shown that increased medical utilisation is a strong predictor of NMU and related harms (Dasgupta et al., 2006, Fischer et al., 2013, Fischer et al., 2012, Wisniewski et al., 2008). Since the 1990s, there have been a four-fold increase in opioid prescribing in Australia (Karanges et al., 2016). This has been primarily attributed to the shift toward the use of high-potency opioids in primary care and for the treatment of chronic non-cancer pain (Campbell et al., 2018, Karanges et al., 2016, Nielsen and Dietze, 2019). As shown in Figure 1.1, between 2012-13 and 2016-17, the most frequently dispensed opioid in Australia was oxycodone (a Schedule 8 drug) followed by codeine[2] (a Schedule 4 drug as of 2018) (Australian Institute of Health and Welfare [AIHW], 2018).

Figure 1.1. Number of opioid prescriptions dispensed in Australia, 2012–13 to 2016–17

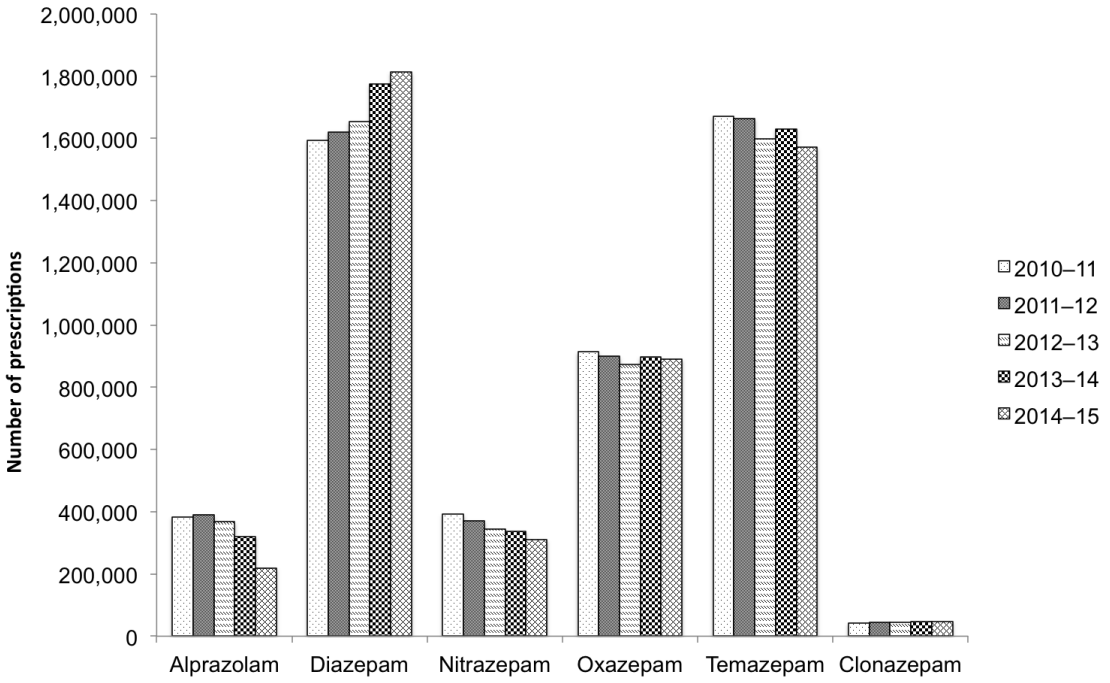


Source: Pharmaceutical Benefits Scheme (PBS) data published in in AIHW (2018).
Notes: Codeine includes codeine/paracetamol and codeine/aspirin. Oxycodone includes oxycodone/naloxone. Data not captured include OTC opioids, private prescription opioids, opioids from doctor bags, opioids provided during a hospital admission in public hospitals and on discharge to patients in NSW and the ACT. AIHW's PBS data do not include under co-payment prescriptions, Repatriation Schedule of PBS data and medicines supplied under the Aboriginal Health Services program.

[2] When compounded with another active ingredient.

There has been no overall increase observed in the rate of benzodiazepine prescribing over the past two decades, however, 20 years of data up until 2011 showed there has been a shift toward the use of alprazolam – a high-potency sedative – and concomitant reductions in the use of oxazepam and flunitrazepam – lower-potency sedatives (Islam et al., 2014a). As shown in Figure 1.2, subsequent to this, alprazolam prescribing declined following its up-scheduling from a Schedule 4 to a Schedule 8 drug in February 2014 (NSW Health, 2018). Over the five-year period since 2010-11 the most frequently dispensed benzodiazepine in Australia is diazepam, followed by temazepam (AIHW, 2018).

Figure 1.2. Number of benzodiazepine prescriptions dispensed in Australia, 2010–11 to 2014-15



Source: PBS published in AIHW (2018).
Notes: AIHW's PBS data do not include under co-payment prescriptions, RPBS data and medicines supplied under the Aboriginal Health Services (AHS) program.

1.5 Pharmaceutical non-medical use and related harms

1.5.1 Defining non-medical use

There are various terms used to refer to the problematic use of pharmaceutical drugs, including ‘misuse’, ‘extra-medical use’, ‘aberrant use’ and ‘non-medical use’ (Casati et al., 2012, Larance et al., 2011b). This thesis adopts the term non-medical use (hereafter, ‘NMU’) to capture the use

of pharmaceutical drugs for non-therapeutic purposes or other than directed by a registered health practitioner (Barrett et al., 2008, Larance et al., 2011b). NMU includes the use of a drug that has been legitimately obtained from the medical system, but is used for reasons other than intended such as for recreational and experimental purposes, to minimise the negative effects of other drugs, to substitute for or in combination with other drugs, and for performance and image enhancement, as well as the non-prescribed use of pharmaceutical drugs for therapeutic purposes such as for the self-treatment of pain and drug dependence (Larance et al., 2011b, Lipari et al., 2017).

1.5.2 Prevalence of pharmaceutical non-medical use in Australia

The prevalence of pharmaceutical NMU is difficult to estimate due to variations in the way in which it is measured. However, recent data suggest that consistent with international trends the NMU of pharmaceuticals is relatively common in Australia. According to the 2016 National Drug Strategy Household Survey (NDSHS), 4.8% of the general population aged 14 and over reported the misuse[3] of a pharmaceutical drug in the prior 12 months, the second most commonly used illicit drug after cannabis at 10.4% (AIHW, 2017a).

Sentinel surveys have shown that pharmaceutical NMU is common among people who regularly use and inject illicit drugs. As shown in Figures 1.3 and 1.4, the prevalence of non-prescribed[4] pharmaceutical use among people who regularly use and inject drugs and were interviewed as part of the National Drug and Alcohol Research Centre's (NDARC) Illicit Drug Reporting System (IDRS) (targeted at people who regularly inject drugs) and Ecstasy and related Drugs Reporting System (EDRS) (targeted at people who regularly use psycho-stimulants), is well above that reported by the general population. Among IDRS participants, non-prescribed benzodiazepine and morphine use were the most commonly reported at 30% and 22%, respectively in 2018. Trends have been generally stable overtime, however there were

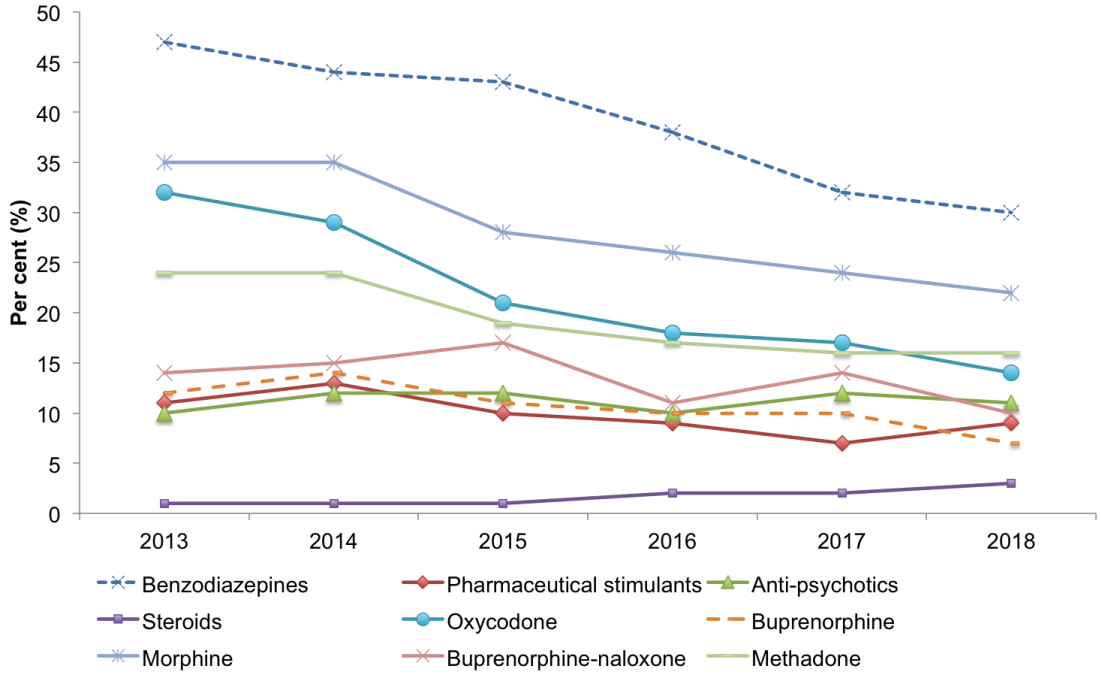
[3] Misuse was defined as use for non-medical purposes or in doses or frequencies other than those prescribed (AIHW, 2017a).

[4] Use of pharmaceuticals obtained in someone else's name. This does not include people who misuse drugs that were prescribed to them (Peacock et al., 2018a).

reductions in the non-prescribed use of oxycodone around 2014 when an abuse-deterrent (or tamper resistant) formulation was introduced onto the market (Larance et al., 2018). EDRS participants were most likely to report non-prescribed use of pharmaceutical stimulants (34%) and benzodiazepines (41%) in 2018 – the latter of which has been rising steadily since 2015 (Peacock et al., 2018a).

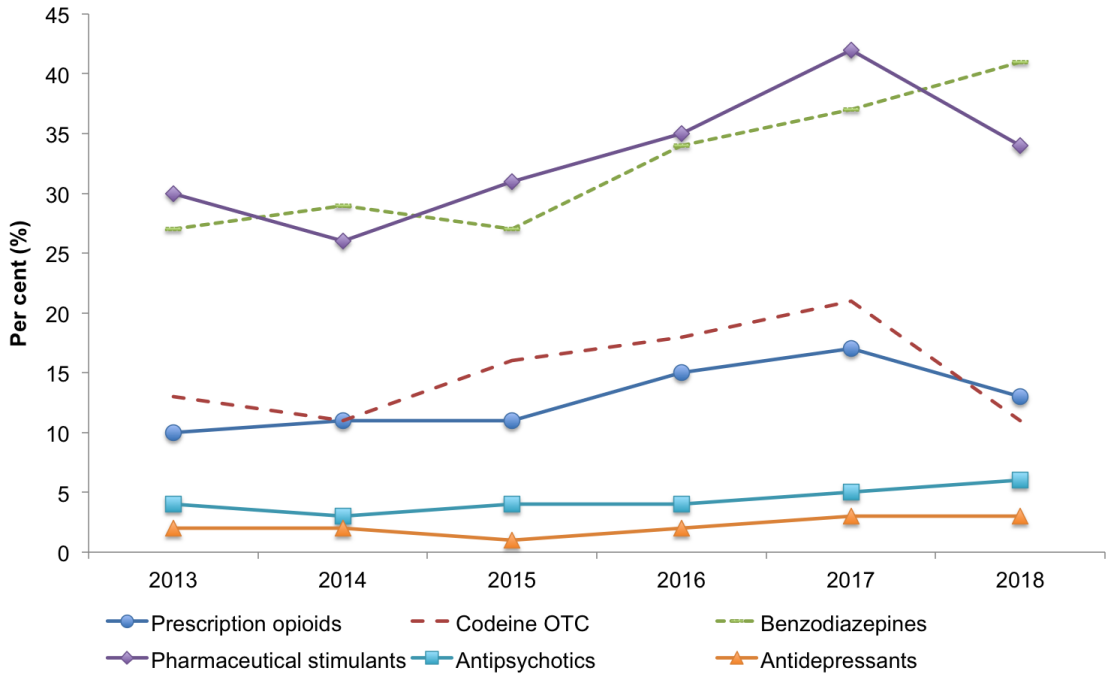
Pharmaceutical NMU is also common among people who have been detected for criminal activity. Specifically, in 2016 the Australian Institute of Criminology's Drug Use Monitoring in Australia program found that of 389 police detainees surveyed about their drug use, 40% reported pharmaceutical NMU in the prior 12 months (Patterson et al., 2018).

Figure 1.3. Past six-month non-prescribed use of pharmaceutical drugs by IDRS participants, 2013 - 2018



Source: Peacock et al. (2018b)
Notes: The IDRS samples people who regularly inject drugs across Australia.

Figure 1.4. Past six-month non-prescribed use of pharmaceutical drugs by EDRS participants, 2013 - 2018



Source: Peacock et al. (2018a)
Notes: The EDRS samples people who regularly use psycho-stimulants across Australia.

1.5.3 Harms related to non-medical use

As shown in Table 1.4, there are a number of drug-specific harms associated with NMU. Poly drug use – the use of pharmaceuticals in combination or with other substances – can magnify these problems and result in an increased risk of serious adverse consequences such as mortality (ABS, 2017). Further, the injection of pharmaceuticals increases the risk of contracting blood borne viruses, and may cause vein damage and scarring, deep vein thrombosis and clots (Australian Drug Foundation, 2016, Drugs and Crime Prevention Committee, 2007, Fry et al., 2007).

Table 1.4. Common harms attributed to pharmaceutical non-medical use by drug class

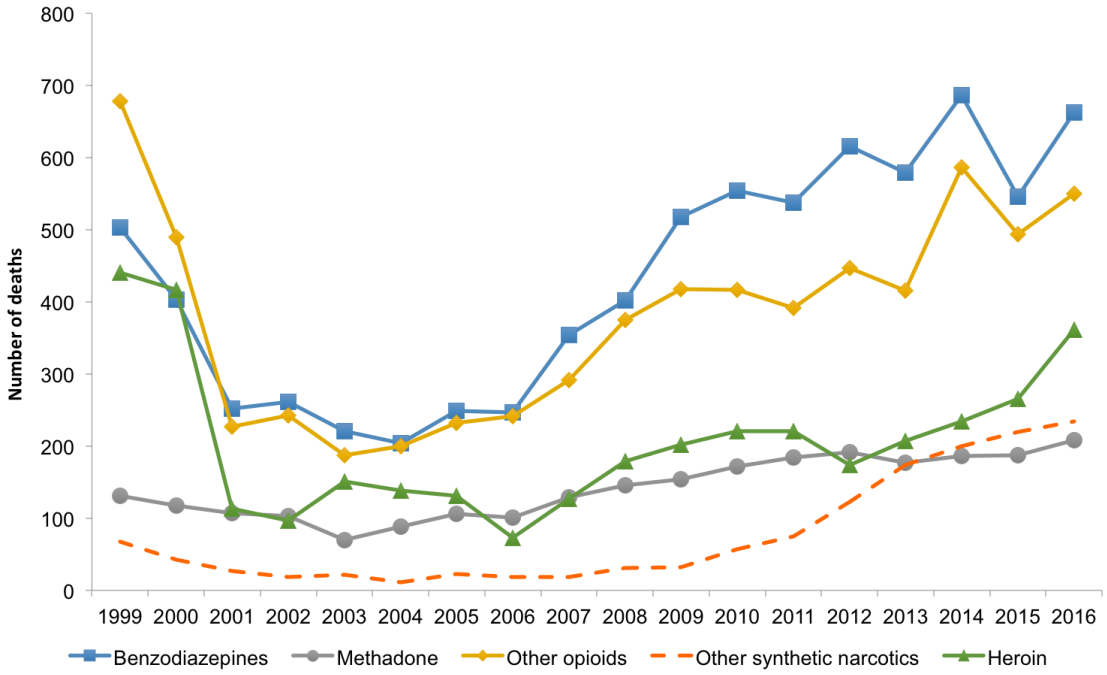
Drug class	Harms related to non-medical use
Opioids	• Sedation and acute intoxication • Tolerance and withdrawal with symptoms that include anxiety, craving, restlessness, lacrimation (teary), yawning, sweating, runny nose • Fatal and non-fatal overdose • Opioid use disorder
Sedatives	• Sedation contributing to memory and concentration problems • Amnesia • Aggression, also known as the 'Rambo' effect • Tolerance, dependence and withdrawal symptoms that include headache, depression, loss of balance, nausea, extreme anxiety, panic attacks and insomnia, as well as increased risk of seizure, tachycardia and hypertension • Mental health problems including impaired social functioning and lifetime psychiatric diagnoses • Overdose, commonly as a result of poly drug use • Dementia
Stimulants	• Acute cardiac events (e.g. arrhythmias) • Myocardial infarcation • Stroke • Chronic changes to cardiovascular functioning • Dependence
PIEDs	• Cardiovascular toxicity, especially atherosclerotic effects and cardiomyopathy • Psychiatric effects including mood syndromes, and progression to other forms of substance abuse
Antidepressants and antipsychotics	• Seizures, confusion, and psychotic-like symptoms • Sedation, combined drug toxicity with poly-pharmacy

Source: Information adapted from Drugs and Crime Prevention Committee (2007), Evans and Sullivan (2014), Fry et al. (2007), Kanayama et al. (2008), Kaye and Darke (2012), Kaye et al. (2014), Nielsen and Gisev (2017) and van de Ven et al. (2018).

Consistent with international trends (UNODC, 2018), there are increasing harms due to pharmaceutical drugs in Australia. In 2016, there were 1,808 drug-induced deaths in Australia – the highest recorded number in almost twenty years (Figure 1.5). Of these, 992 (55%) involved commonly prescribed opioids, an increase from 440 (40%) in 2007. Moreover, 663 (37%) involved benzodiazepines, an increase from 354 (32%) in 2007 (ABS, 2017). Unlike 1999 when the average decedent was a younger person in their early 30s using heroin, in 2016 the average decedent was a middle-aged person using combinations of prescription drugs (ABS, 2017, Pennington Institute, 2018). The presence of multiple drugs is common in drug-induced deaths (ABS, 2017, Roxburgh et al., 2015, Roxburgh et al., 2017). In 2016, multiple drugs were detected in over half (59%) of accidental drug-induced deaths in Australia and in over 96% of

deaths where benzodiazepines were detected, they were in combination with other substances including alcohol (ABS, 2017, Pennington Institute, 2018).

Figure 1.5. Drug-induced deaths in Australia, 1999-2016



Source: ABS (2017) in AIHW (2017b)
Notes: 'Other opioids' includes oxycodone, codeine, morphine; 'Other synthetic opioids' includes fentanyl, tramadol, pethidine

1.6 Pharmaceutical diversion and supply

1.6.1 Defining diversion and supply

Diversion is defined as the channelling of pharmaceutical drugs from the legal supply chain to people for NMU (Inciardi et al., 2007b). This includes practices such as inappropriate or oversupply by health practitioners, theft of medical supplies, supply and sharing amongst family and friends and illegal sale by dealers. It may also involve diversion from shipments at the wholesale level or at the import/export level when crossing borders (UNODC, 2019b). Diversion may be undertaken for personal use or supply. Supply involves the distribution of pharmaceutical drugs from one person to another following their diversion, through gifting, selling or trading and thus, may or may not involve monetary exchanges.

1.6.2 Understanding the nature and extent of diversion and supply

While there are difficulties in estimating the prevalence of NMU, understanding the nature and extent of diversion and supply is even more challenging and limited research has attempted to do so. Given that diversion may occur through a number of mechanisms such as informal trading within social networks, doctor shopping and online sales, no data source adequately captures the totality of the problem and the relative importance of each diversion mechanism is not known (Babor et al., 2018). Thus, it becomes necessary to estimate the nature and extent of diversion using a range of different methods and proxy indicators, each of which carry their own limitations and caveats.

One official data source that provides an indication of scale is criminal offence data. In Australia, most criminal offence data is collected at the state and territory level. Table 1.5 presents five years of data obtained from the NSW Bureau of Crime Statistics and Research (BOCSAR) on the number of finalised charges in NSW for three offences – prescription forgery, obtaining a prescription under false representation and unlawful possession of a prescription. NSW has the largest population of all Australian states and territories. As shown, the overall the number of offences between 2014 and 2018 were relatively low, with on average less than 32 finalised charges per year in each category. Over this five-year period there were fluctuations in the total number of charges across the three offence types.

Table 1.5. Number of finalised charges for selected sections of the NSW *Drug Misuse and Trafficking Act 1985*

	Forge or alter script which includes prohibited drug (s15)	**Utter script which includes a prohibited drug (s15)**	**Obtain script by false representation (s16a(i))**	**Induce pharmacist to dispense false script (s16a(ii))**	**Possess forged prescription (s16(b))**	**Possess script unlawfully obtained (s16(b))**	**Total**
2014	29	41	9	5	41	4	129
2015	33	14	8	1	14	3	73
2016	53	21	15	14	23	15	141
2017	27	22	5	1	11	7	73
2018	17	22	19	16	17	0	91
Total	**159**	**120**	**56**	**37**	**106**	**29**	**507**

Source: Data provided to author by NSW BOCSAR (2019).

Table 1.6 presents data on the number of finalised charges for dealing and trafficking offences in NSW by drug type. One shortcoming of these data is that pharmaceutical drugs are not explicitly distinguished from illicit drugs. Nonetheless, the observation can be made that the dealing and trafficking in 'other drugs' (which includes pharmaceutical drugs) is lower than for illicit drugs like amphetamines, cannabis and cocaine. This may indicate that the diversion and supply of pharmaceutical drugs is less enforced in NSW than trafficking in illegal drugs. Importantly however, in common with all recorded offence data these data are likely to underestimate the scale as they only include detected and finalised charges and as such, may be more reflective of policing practices than actual misconduct (McDonald, 2013).

Table 1.6. Number of finalised charges for dealing and trafficking offences in NSW by drug type

Dealing, trafficking in	2017/18	2018/19
Cocaine	775	798
Narcotics [a]	222	661
Cannabis	830	1056
Amphetamine [b]	1920	1733
Ecstasy	801	550
Other drugs [c]	363	463

Source: NSW BOCSAR (2019)

Notes: Dealing, trafficking includes the supply or purchase of an illicit drug or controlled substances (where the amount involved is deemed to be of a quantity for commercial purposes).

[a] Narcotics include any depressant drug derived from opium or compounds similar to opium including heroin, morphine and methadone.

[b] Amphetamines include ice, base and speed.

[c] 'Other drugs' include any other drug not otherwise listed in the table, including pharmaceutical drugs like benzodiazepines.

Seizure data reported by the Australian Criminal Intelligence Commission (ACIC) provides an indicator of the scale of diversion via cross-border importations, which may include diversion from the licit supply chain, as well as illicit online purchases. According to the most recent Illicit Drug Data Report, the total number of detections of illegally imported pharmaceutical opioids and benzodiazepines at the Australian border increased over the last decade (ACIC, 2018a), which was largely consistent with international trends (UNODC, 2019b). Specifically, in Australia in 2007/08 there were less than 500 detections and in 2017/18 there were over 2,500 (ACIC, 2018a). As with the criminal offence data, these data are a reflection of enforcement activity and thus, likely underestimate the true extent of such supply methods.

Finally pharmaceutical claims data has been used to estimate the scale of NMU and diversion through doctor shopping (Blanch et al., 2017). Doctor shopping is the unlawful practice of visiting multiple practitioners and pharmacies to obtain the same drug in greater quantities and is an established indicator of NMU (Larance et al., 2011b). Blanch et al. (2017) found that 3% of people in their sample of adults reinitiating or initiating strong opioid treatment between 2010 and 2012 accessed four or more prescribers, three or more dispensing pharmacies and 20 or more dispensings. However as Blanch et al. (2017) acknowledged, there were challenges in defining doctor shopping and distinguishing legitimate from problematic use. As such, these data may also capture high-need groups including those with a history of cancer treatment.

1.7 Extant knowledge on the demand, risk factors and harms related to pharmaceutical non-medical use

Prior international research examining pharmaceutical NMU has overwhelmingly focused on the epidemiology and motivations for use, as well as patterns of use and related-harms. Large-scale general population surveys have been used to identify the demographic, social and economic factors associated with engagement in NMU. For instance, Australian research using the NDSHS found that people in remote and disadvantaged socioeconomic areas, people who are unemployed or unable to participate in the workforce, Aboriginal and Torres Strait Islander people, people who inject drugs and people in contact with the criminal justice system were more likely to engage in NMU (AIHW, 2017b). This is largely consistent with what has been found internationally, such as in the US where analyses of the NSDUH data showed that at-risk groups include the elderly, females, people who report poor or fair health and people who drink alcohol daily (Simoni-Wastila and Strickler, 2004). Moreover, a systematic review conducted by Casati et al. (2012) in the European context over the period 2001 to 2011 found that the NMU of pharmaceutical opioids is primarily by people suffering from chronic pain, women, the elderly and people with substance use disorders, while sedatives like benzodiazepines and Z-drugs are used non-medically by people with alcohol use disorders and the elderly.

Further research has explored in-depth NMU by at-risk population groups or has focused on specific drug classes. One such focus has been on the NMU of opioid substitution therapy (OST) medications such as methadone and buprenorphine. Motivations for the NMU of OST drugs include mitigating the effects of withdrawal and in substitute for illicit opioids like heroin (Johnson and Richert, 2015a, Johnson and Richert, 2015b, Johnson and Richert, 2015c, Larance et al., 2011a, Larance et al., 2011c, Nielsen et al., 2008, Winstock and Lea, 2010, Winstock et al., 2009a, Winstock et al., 2008, Winstock et al., 2009b). Nielsen et al. (2008) found that comorbidities such as chronic pain and psychiatric problems were common among people in treatment who used pharmaceuticals non-medically in Australia. Also in Australia, Winstock et al. (2009a) found that some people involved in diverting supervised doses of buprenorphine did so to stockpile for later or give to another person. Larance et al. (2011a) compared the diversion and injection of OST medications and found that buprenorphine was more often injected than buprenorphine-naloxone, however both of these drugs were diverted more often than methadone, which is consistent with Swedish research by Johnson and Richert (2015a).

A rapidly growing area of research, particularly in North America, is that examining the NMU of pharmaceutical stimulants. This research has shown that drugs such as methylphenidate (e.g. Ritalin) and dexamphetamine are used to improve performance (particularly academically), as well as for their recreational and euphoric effects (Wilens et al., 2008) and this is particularly common among younger populations and students (Cassidy et al., 2015a, Cassidy et al., 2015b, Crime and Misconduct Commission, 2002, DeSantis et al., 2009, DeSantis et al., 2010, DeSantis et al., 2008, McCabe et al., 2006b, Novak et al., 2007, Rabiner et al., 2009, Wilens et al., 2008, Wilens et al., 2006). Recent Australian research, however, found that prescription stimulant NMU may be less common among Australian university populations, as rates of stimulant prescribing are lower than in the US university populations (Lucke et al., 2018). Other research found that stimulant NMU extends beyond student and young populations to other groups such as people who use and inject drugs (Kaye et al., 2014).

The NMU of PIEDs, particularly anabolic androgenic steroids, has received increasing attention within the media and academia. While traditional conceptions of PIEDs have tended to focus on use by elite athletes for performance maximisation, current evidence suggests that there is significant heterogeneity in this population (Kanayama et al., 2008, Pope et al., 2014, Zahnow et al., 2018). For instance, Australian research by van de Ven et al. (2018) identified that people who injected PIEDs and recently used psychoactive substances, primarily heroin and meth/amphetamine, were younger, less educated and more likely to have experienced injection-related problems than those who had not also used psychoactive substances. While PIEDs are often injected and as such carry risks associated with the transmission of blood-borne viruses such as human immunodeficiency virus (HIV) and hepatitis C (McVeigh and Begley, 2016), recent research using data from the Global Drug Survey identified a subgroup of users who only consume steroids orally and thus, may be 'hidden' from the primary service provider for PIED users – needle and syringe programs (NSPs) (van de Ven et al., 2019).

While there is a large body of work that has examined the demand, risk factors and harms related to pharmaceutical NMU, there has been a much lesser focus on understanding diversion and supply – the focus of this thesis.

1.8 Extant knowledge on the mechanisms, methods, price, profit and drivers of illicit drug supply

While research examining the diversion and supply of pharmaceutical drugs is in its relative infancy, there is a large international evidence base that has examined the supply of illicit drugs like cannabis, cocaine, heroin and meth/amphetamine (see for example Babor et al. (2018), Bouchard (2007), Caulkins and Reuter (1998), MacCoun and Reuter (2001), Reuter and Kleiman (1986)). As demonstrated below, this research has unpacked nuances in the illicit drug trade in terms of the supply chain, distribution methods, drivers, profitability and harms. It has also challenged assumptions and offered new insights that have been important for informing appropriate policy responses and targeting of resources.

1.8.1 Mechanisms and methods of supply

The supply chain is defined as the processes that facilitate movement of drugs, as well the interrelationships among producers, distributors, retailers and end-users (Ritter et al., 2012). Generally, the supply chain for illicit drugs is long – involving many players at various levels, which is at least partially reflective of the inefficiencies of trafficking in illegal goods and the costs of avoiding detection (Babor et al., 2018, Caulkins et al., 2016, Caulkins et al., 2009, Desroches, 2007, Giommoni et al., 2017, Hughes et al., 2016a, McFadden et al., 2014, Reuter, 2014, Ritter et al., 2012, Tzvetkova et al., 2016). There is no consensus on the best framework for classifying dealers according to their market level, which reflects the real-life complexities of the drug trade (McFadden et al., 2014, Tzvetkova et al., 2016). In the UK, the Matrix Knowledge Group (2007) conducted interviews with high-level cocaine and heroin traffickers and defined a four-tier classification system that comprised international, national, local and retail-level dealers. Though each level may involve one or more players and the complexity of the supply chain tends to increase when drugs cross national borders (McFadden et al., 2014).

Research has shown that drug supply chains vary by drug type. For instance, cannabis is cultivated widely across the globe, whereby a total of 159 countries reported cannabis plant cultivation over the period 2010 to 2017 (UNODC, 2019b). In contrast, the production of other plant-based drugs like heroin and cocaine, are concentrated within a small number of source countries. Specifically, 96% of the global opium production in 2018 occurred in Afghanistan, Myanmar and Mexico, and Afghanistan alone accounted for 82% of the total, whilst cocaine production mainly occurred in South America, specifically Columbia, Bolivia and Peru (UNODC, 2019b). The clandestine laboratories required for the production of amphetamine-type stimulants (ATS) including MDMA and meth/amphetamine are less geographically concentrated, however according to the 2019 World Drug Report, meth/amphetamine production – which now dominates the international ATS market – is centred within North America and East and South East Asia (UNODC, 2019b). There are further variations in supply routes within regions. For instance, Columbian-sourced heroin supplies the Eastern-side of the

US, while Mexican 'black tar' heroin supplies the Western-side (Ciccarone, 2019). Moreover, the Northeast and Midwest of the US are the main regions that have detected fentanyl-adulterated heroin, and fentanyl is illicitly manufactured and imported from China (Ciccarone, 2019).

The supply chain and distribution methods used are also influenced by geography, the capacity of different regions to produce illicit drugs, in addition to other demand-side factors. For instance, island regions like the UK and Australia, have more emphasis upon importing drugs by sea or air (Hughes et al, 2016a). For instance, the Australian Department of Home Affairs reported that in 2016/17, 57.7% of ATS (by weight) was imported by sea cargo, while 35.8% of heroin and 45.7% of cocaine were imported by air cargo. It was estimated by Hughes et al. (2016a) that approximately 35% of commercial importation seizures at the Australian border may be connected to poly-drug trafficking. Poly-trafficking mainly occurs via sea cargo, often aided by corrupt officials who exploit customs officers and/or waterfront workers (Hughes et al., 2016a).

Drug trafficking organisations and criminal groups have traditionally been depicted as highly organised and hierarchical structures led by high-level key players or 'king pins', however this has been challenged by academic literature (May and Hough, 2004, McFadden et al., 2014). It has been shown that in fact, such organisations tend to operate in loose networks that are flexible and decentralised, which decreases their susceptibility to supply shocks such as law enforcement intervention (Bouchard, 2007, Bright et al., 2012, Morselli and Petit, 2007). Research has also shown that traffickers are highly adaptable to supply changes and to regulatory and law enforcement interventions (O'Reilly, 2018). In Australia, for example, the supply chain for methamphetamine traditionally involved the retail-level diversion of precursor drugs like pseudoephedrine by 'pseudo runners' for use in the domestic production by cooks in small, clandestine laboratories (Ferris et al., 2016). However, following the introduction of *Project STOP* in 2008 – an electronic monitoring system designed to reduce precursor diversion from pharmacies – research has shown that there has been a reduction in domestic

manufacturing and a concomitant increase in the importation of methamphetamine from Asia and China (Mazerolle et al., 2016, Roche, 2017). Furthermore, methamphetamine is often imported alongside other illicit drugs (MDMA and cocaine) and often other illicit commodities (Hughes et al, 2016a). This work has been important for understanding the unintended impacts from law enforcement and supply control measures.

Drug markets have also evolved with the advancement of technology (Barratt et al., 2013, May and Hough, 2004). At the retail-level, there are now far more sources available for accessing illicit drugs including surface websites, the dark net and telephone and encrypted communications. Research by Kruithof et al. (2016) identified that illegal drug transactions on crypto markets doubled between 2013 and 2016 and there is evidence that buyers may source stock online for offline distribution. However, despite its growth, this remains a niche market compared to the traditional offline market.

Research has shown that different mechanisms and methods of supply carry variable risks and harms. For instance, research by Hughes et al. (2016b) showed that when compared with mono-trafficking, the poly-trafficking of multiple drugs was associated with larger quantities of drugs seized (7 times greater weight), larger network size (1.8 times more persons of interest) and more involvement in other types of serious crime (43 times more additional cases). Other research by Hughes et al. (2019b) compared profiles of high-level drug traffickers in Australia over an eight year period and showed that concurrent trade in firearms was much more common for traffickers who traded in meth/amphetamine and who were affiliated with outlaw motorcycle gangs (OMCGs).

1.8.2 Price, profitability and drivers of illicit drug supply

Bouchard (2007) defines a ‘market’ as “the network in which a set of buyers and sellers interact to exchange goods and services for money”. Like any market, the laws of demand and supply are central to their operation. As explained by Moore et al. (2005):

> *"For the demand curve, this means that when the price rises, the amount consumers wish to buy and use declines (and vice versa; assuming that nothing about the users change). On the other hand, the amount suppliers are willing to produce and sell will increase when the price rises (and vice versa; assuming nothing about the suppliers or the conditions they face changes) (p.2)."*

One of the unique aspects of illicit drugs markets is that the quality of drugs is not controlled and thus, purity varies widely. Caulkins and Reuter (1998) explained that illicit drugs are 'experience goods' because their quality is not known until after the drug is purchased, if at all. Purity adjustments may be made by manufacturers and suppliers, such as through the addition of adulterants or diluents, as a means by which to manipulate the purity-adjusted price. This is a strategy often employed by traffickers in response to supply changes and because the nominal price of drugs is rarely negotiated at the point of sale as prolonged transactions may increase the likelihood of detection (Moore et al., 2005). Research has shown that there is price elasticity of demand (Gallett, 2014), whereby changes in purity-adjusted price influence consumption and in turn, drug-related health and social harms (Hughes et al., 2019a). For instance, in the US Caulkins (2001) found that changes in purity-adjusted prices for cocaine and heroin explained at least 95% of the variation in emergency department mentions for these drug types.

A large body of research has examined the profitability of the drug trade. The UNODC (2011) estimated that illegal drugs account for between 17% and 25% of global crime proceeds, while the European Monitoring Centre for Drugs and Addiction (EMCDDA, 2016) estimated that the retail market for illicit drugs was estimated to have been worth at least 24 billion euros in 2013. Research has shown that there are considerable mark-ups at each distribution level from manufactures/producers to wholesalers/importers and to retail-level/street dealers (Caulkins et al., 2016, Caulkins et al., 2009, Caulkins et al., 1999, Gong et al., 2012, Matrix Knowledge Group, 2007, McFadden et al., 2014, Pardal et al., 2014, Tzvetkova et al., 2016). Revenues from the illicit drug trade, particularly at the highest levels of distribution, can be enormous (Babor et al., 2018, EMCDDA, 2016, Matrix Knowledge Group, 2007). For instance, Caulkins et al.

(2009) calculated that among a sample of incarcerated drug traffickers in the UK, domestic brokers – who sell the entire quantity of drugs acquired in one lot – realised revenues of at least £30,000 and up to £125,000 per transaction. Money laundering was identified by Europol (2017) as a priority crime threat due to its central role in facilitating the drug trade (and other forms of organised crime) by passing illicit profits into the legitimate economy for use such as through cash smuggling and false invoicing.

There is, however, wide variability in the size of organisations involved in drug trafficking and thus the profits resultant from the trade are similarly diverse. It has been shown that retail-level dealers often retain little of their earnings (Harlow, 2000) and the money they do make is often channelled back into the drug trade to fund personal use. Non-financial motives such as the amassment of social capital, the desire for a shared social or cultural experience, to support one's own substance use and simply for 'the thrill of it' are also commonly citied reasons for the involvement in drug supply (Pardal et al., 2014, Tzvetkova et al., 2016). This has led to the emergence of the concepts of 'social supply' (Coomber and Turnbull, 2007) and more recently, 'minimally commercial supply' (Coomber and Moyle, 2014) to capture exchanges that occur between family and friends for little or no monetary reward.

Clearly, the illicit drug trade is diverse in terms of its distribution methods, drivers and consequences. The resilience and adaptability of drug trafficking organisations further challenges law enforcement efforts and supply control, accentuating the need to thoroughly unpack supply mechanisms so as to avoid causing unintended effects such as displacement to other, potentially more harmful, supply routes. This thesis addresses an important gap in knowledge given the growth in grey and black markets for pharmaceutical drugs and the limited research that has been conducted to understand diversion and supply.

1.9 Policy and legislative framework

International drug control is based on three widely adopted United Nations (UN) conventions: the *Single Convention on Narcotic Drugs, 1961*, the *Convention on Psychotropic Substances, 1971* and the *Conventions against the Illicit Traffic in Narcotic Drugs and Psychotropic*

Substances, 1988. The overall stated aim of these conventions is "to ensure the availability of narcotic drugs and psychotropic substances for medical and scientific purposes, and to prevent their diversion into illicit channels" (UNODC, 2019a). Two pillars – demand reduction and supply reduction, underpin the conventions.

In Australia, the overarching drug strategy is the *National Drug Strategy 2017 – 2026* ('the Strategy'), which has at its core the principle of harm minimisation, which acknowledges that drug and alcohol use is an inevitable part of society, associated with a range of harms and a range of approaches can be used to respond to these harms (Department of Health, 2017b). In line with the international conventions this includes demand and supply reduction, in addition to harm reduction. The Strategy states that harm reduction is aimed at "reducing the adverse health, social and economic consequences of the use of drugs, for the user, their families and the wider community" (Department of Health, 2017b). The Australian emphasis upon harm reduction is similar to countries such as the Netherlands and Portugal, but differs to other parts of the world such as the US and UK, where harm reduction has not been explicitly adopted federally[5] (Ritter et al., 2017). Nonetheless, estimates by Ritter et al. (2013) showed that despite this harm minimisation approach, funding for strategies to address drug-related problems in Australia are disproportionately targeted towards supply reduction. In 2009/10, 64.1% of government expenditure in Australia was allocated to law enforcement and supply control, with the remaining allocated to treatment (22.5%), prevention (9.7%), harm reduction (2.2%) and other (1.4%) (Ritter et al., 2013). These estimates are now dated and exclude expenditures on the regulation or control of legal substances like pharmaceuticals, but nevertheless highlight that similar with the international approach (Ritter et al., 2017, Room and Reuter, 2012), supply and demand reduction continue to dominate national policies.

The strategies targeted at reducing non-medical pharmaceutical use, diversion and supply in Australia are summarised in Table 1.7 below, some of which are aimed at reducing drug-related

[5] There are elements of harm reduction in the US and United Kingdom (UK) contexts such as naloxone distribution and needle and syringe programs (NSPs) – however, these have been implemented locally, rather than being an explicit focus of federal drug policy.

harms more broadly, rather than being specific to pharmaceutical drugs. This is followed by a brief summary of the international policy and regulatory approaches.

Table 1.7. Responses aimed at reducing non-medical pharmaceutical use, diversion and supply in Australia

Domain	Strategy	Description
Prevention	Prescription guidelines	There are a number of resources for health practitioners that guide effective and safe prescribing and supply practices, and to prevent inappropriate use and diversion. For example: The Royal Australian College of General Practitioners (RACGP) produced a comprehensive guide for prescribing drugs of dependence in general practice (The RACGP, 2015).
	Public education and awareness campaigns	The National Prescribing Service (NPS), established in 1998 and now known as NPS Medicinewise, provides information to "enable people to make and act on the best decisions about medicines, medical tests, health technologies and other options for better heath and economic outcomes" (NPS Medicinewise, 2019). This includes resources for health practitioners and consumers. ScriptWise is a non-profit organisation specifically aimed at reducing mortality associated with the NMU of pharmaceutical drugs through awareness raising, community engagement and advocacy. Specific activities include the provision of information on the risks associated with commonly misused drugs and treatment options, engaging with consumers and supporting policy change (ScriptWise, 2019).
	Drug disposal schemes	In Australia, the Return Unwanted Medicines (RUM) project provides disposal bins at all PBS approved community pharmacies, to encourage people to safely dispose of their leftover medications (Return Unwanted Medicines, 2019).
Treatment	Pharmacology treatment / OST	The provision of alternative, prescribed medications such as methadone and buprenorphine to people with drug dependence.
	Non-pharmacology treatment	The provisions of treatment that does not involve the prescription of

Domain	Strategy	Description
		medications such as through cognitive behavioural therapy, residential rehabilitation, counselling, telephone and online interventions, outreach and general health services (Ritter et al., 2014).
Law enforcement	Criminal law	The criminal law is the formal mechanism by which pharmaceutical diversion and supply is regulated post-retail – that is, after the health practitioner has issued a prescription and the pharmacist has filled it (Babor et al., 2009). The *Criminal Code Act 1995* is the federal legislation in Australia that provides offences for the trafficking of commercial quantities of controlled drugs (Section 302.2(1)) and carries a maximum penalty of lifetime imprisonment. Each jurisdiction also has its own set of laws, which may differ slightly. In NSW for example, under Section 25 of the *Drug Misuse and Trafficking Act 1985* it is a criminal offence subject to up to ten years imprisonment to supply a prohibited drug, which includes pharmaceutical drugs without a valid prescription and without an authority to do so. There are also offences prohibiting the forgery of prescriptions (Section 15), obtaining prescription drugs by false representation and unlawful possession (Section 16), obtaining prohibited drugs (including pharmaceutical drugs) from medical practitioners, nurse practitioners or midwife practitioners (Section 18).
	Civil and administrative law	The Australian Health Practitioner Regulation Agency (AHPRA),

Domain	Strategy	Description
		governed by the *Health Practitioner Regulation National Law 2010*, supports 15 National Boards[6] that are responsible for regulating health practitioners to ensure the protection of the public. This includes managing concerns raised about health practitioners for a range of behaviours including diversion and problematic supply of pharmaceutical drugs. AHPRA investigates and refers complaints for disciplinary action, which may involve conditions being imposed on the practitioners registration or suspension or cancellation (AHPRA, 2015).
Supply control	Abuse-deterrent formulations (also referred to as tamper-resistant formulations)	Pharmaceutical companies have developed formulations of medications that are less prone to NMU and diversion. For example, an abuse-deterrent formulation of OxyContin® tablets was introduced onto the Australian market in April 2014 to minimise the risk of injection practices (Degenhardt et al., 2015).
	Drug scheduling	The Poisons Standard prohibits the sale, prescribing and possession of Schedule 3, Schedule 4/4D and Schedule 8 pharmaceutical drugs under certain circumstances, such as without a valid authority or prescription (TGA, 2019). The Scheduling Framework restricts the availability and access of pharmaceutical drugs according to their level of risk. The TGA may also reschedule substances if it is deemed that their accessibility is contributing to harm. For example, in February 2014 alprazolam was up-scheduled from a Schedule 4 (prescription-only medicine) to a Schedule 8 (drug of dependence)

[6] The 15 National Boards are: Aboriginal and Torres Strait Islander Health Practice Board of Australia, Chinese Medicine Board of Australia, Chiropractic Board of Australia, Dental Board of Australia, Medical Board of Australia, Medical Radiation Practice Board of Australia, Nursing and Midwifery Board of Australia, Occupational Therapy Board of Australia, Optometry Board of Australia, Osteopathy Board of Australia, Paramedicine Board of Australia, Pharmacy Board of Australia, Physiotherapy Board of Australia, Podiatry Board of Australia, Psychology Board of Australia.

Domain	Strategy	Description
		(NSW Health, 2018). In May 2010 codeine products were up-scheduled from Schedule 2 (pharmacy medicine) to a Schedule 3 (pharmacist-only/OTC medicine) (Cairns et al., 2016) and then again in February 2017 to a Schedule 4 (prescription-only) drug (TGA, 2018b).
	State-based permit systems	Each state and territory has its own requirements for obtaining an authority to prescribed Schedule 8 medicines as a health practitioner. This includes special permits for prescribing to people with a drug dependency and for periods of longer than eight weeks (Hua et al., 2015).
	Prescription drug monitoring programs (PDMPs)	PDMPs are electronic databases that provide health practitioners with a means by which to track prescriptions (Islam and McRae, 2014). In Australia, Victoria, the ACT and Tasmania currently operate comprehensive PDMPs, though specific characteristics differ jurisdictionally (Nielsen and Dietze, 2019).

Notes: Some of the strategies listed in this table may fall under multiple domains. For example, PDMPs may also be considered a prevention strategy.

Like Australia, other parts of the world including North America and Europe have introduced myriad policies to address the NMU, diversion and supply of pharmaceutical drugs. PDMPs are one of the primary policy levers by which pharmaceutical diversion and supply has been addressed in North America. This has been a priority in the US where there was evidence of 'pill mills' involving the systematic and deliberate overprescribing by health practitioners in pain clinics (Inciardi et al., 2006, Rigg et al., 2010). There were 11 states with operational PDMPs in 1999 and this had grown to 47 states by 2014 (Pardo, 2016). By 2017 all 50 states and the District of Columbia had implemented some form of PDMP (Fink et al., 2018). In Canada, PDMPs have now been implemented in seven of ten provinces (Donroe et al., 2018). PDMPs do not currently operate in the UK. There has, however, been a focus on educating prescribers and providing resources to help with the identification and prevention of pharmaceutical NMU and other drug-related harms. For example, Public Health England (2019) recently released guidelines for practitioners in relation to the *Misuse of illicit drugs and medicines* – though there is no evidence as to whether such resources are useful in preventing or reducing pharmaceutical NMU and diversion.

While there are considerable variations in the regulatory and scheduling frameworks for pharmaceutical drugs in different countries, there has been a common focus on restricting the supply of drugs that are deemed to be at risk of NMU and diversion. For instance, in 2014 the US placed restrictions on the availability of hydrocodone combination products by rescheduling these substances from Schedule III (less controlled) to Schedule II (more controlled) (Seago et al., 2016). In 2010 the US, similar to Australia, introduced a tamper-resistant formulation of oxycodone to reduce harms from injection practices (Alpert et al., 2018). Problems related to the NMU of pregabalin and gabapentin, particularly in Europe and the UK, have also prompted scheduling changes (UNODC, 2019b). For instance, in April 2019 in the UK, pregabalin and gabapentin were reclassified as Class C drugs under the *Misuse of Drugs Act 1971* and rescheduled to a Schedule 3 drug under the *Misuse of Drugs Regulation 2001* (NHS England, 2019). This increased requirements for practitioners to carefully evaluate patients for a history

of substance use disorder before prescribing and removed the ability of practitioners to issue repeat prescriptions.

The scheduling changes in the US have been met with mixed effectiveness and in some cases, unintended harms (Powell, 2019). The US situation has recently been described as a "crisis of unintended consequences" (Powell, 2019) that has led to an even more detrimental crisis involving the introduction of synthetic opioids, namely fentanyl, into the heroin supply. In 2017, synthetic opioids were involved in 28,466 deaths in the US (Scholl et al., 2019). Ciccarone (2019) explained that this new crisis is intertwined with the NMU and diversion of pharmaceutical drugs, whereby "demand for opioid pills partially drove demand for heroin while demand for heroin unsuspectingly feeds demand for synthetics-as-substitutes".

1.10 Thesis overview

As has been demonstrated in this introductory chapter, Australia – along with many high-income countries – is currently experiencing unprecedented harms from pharmaceutical drugs. While there has been increasing focus in Australia and internationally to address rising concerns related to pharmaceuticals, international research examining diversion and supply is lacking. The large international evidence base on illicit drug markets has highlighted the importance of unpacking the supply chain and identifying nuances in supply in terms of modus operandi, motives and harms. This is imperative for avoiding unintended effects such as displacement to other, potentially more harmful, supply routes. This seems particularly important for pharmaceutical diversion and supply given that some international policy changes have already been met with unintended effects.

The core aim of this thesis is to fill the gap in knowledge and provide a greater understanding of the diversion and supply of pharmaceutical drugs for NMU. Specifically, this thesis will focus on unpacking the illegal supply chain from the medical system to end users, including the mechanisms, methods, motivations, price and mark-ups associated with pharmaceutical diversion and supply. The remainder of this thesis is presented as a series of four empirical chapters – of which, three have been published in academic journals and one is currently under

peer-review. The sixth and final chapter summarises the key findings of each of these studies and discusses implications for policy and future research. The detailed structure is outlined below.

Chapter Two: International systematic review and meta-analysis on drug sourcing and diversion

The purpose of **Chapter Two** was to consolidate what is known about the source and diversion of pharmaceutical drugs in countries with reported NMU, namely Australia, North America and Europe. The review was international in scope to reflect the global nature of pharmaceutical diversion and supply for NMU. This study aimed to illuminate how supply of pharmaceuticals varies between different pharmaceutical types and populations. The specific aims of this chapter were to:

1. Estimate the prevalence of medical and non-medical (intermediary) sourcing of pharmaceutical drugs for NMU.
2. Estimate the prevalence of pharmaceutical diversion via gifting, selling and trading among different populations.
3. Identify gaps in existing international and Australian knowledge to inform future research directions.

Chapter Three: Diversion from the medical system and the role of health practitioners

Building upon the findings from **Chapter Two**, **Chapter Three** sought to better understand the circumstances surrounding diversion directly from the medical system, in particular the role of health practitioners in problematic prescribing and diversion. Through an analysis of a sample of the most serious and detected incidents of health practitioner misconduct between 2010 and 2016, this study identified the individual characteristics of health practitioners involved in diversion and problematic supply (i.e. gender, age, practitioner type), the methods and mechanisms of diversion (i.e. drug type, scale, theft, overprescribing etc.) and the factors

contributing to the misconduct (i.e. individual and system-level factors). The specific aims of this chapter were to:

1. Identify in what ways are Australian health practitioners are involved in the diversion and supply of pharmaceutical drugs for NMU.
2. Identify the individual and system-level factors contributing to their involvement.

Chapter Four: Drug sources and motivations for pharmaceutical diversion and supply

Chapter Four sought to better understand the source and motivations of people involved in pharmaceutical diversion and supply and in doing so, extend previous research that has primarily focused on capturing end-user perspectives (**Chapter Two**). Through interviews with 51 people involved in the gifting, selling or trading of pharmaceutical drugs in Australia, this study identified patterns of supply by specifying drug sourcing and motivations and their relationship to supplier demographics, frequency and quantity of supply. The specific aims of this chapter were to:

1. Identify the sources used by pharmaceutical dealers in Australia to obtain their drug supplies.
2. Identify factors motivating diversion and supply.
3. Examine correlates of drug sourcing and motivations in terms of demographics, quantity and frequency of supply.

Chapter Five: Price and mark-up of pharmaceutical drugs supplied on the black market

Research with end-users has identified that pharmaceutical drugs may be sold on the black market for prices that far exceed their costs when obtained medically, which has led to the assumption that the practice may be financially lucrative. However, a lack of supply-side research has meant that there have been no attempts to reliably estimate the revenue, profit and mark-up of pharmaceutical drugs supplied on the black market. Using the drug transaction cycle as the unit of analysis, **Chapter Five** aimed to:

1. Provide an overview of the pharmaceutical black market in terms of price, revenue and mark-up.
2. Examine supply-side factors influencing price and mark-up of pharmaceutical drugs supplied on the black market.
3. Explore the practice of gifting and quantify the non-realised revenue from gifts.

Chapter Six: Discussion

This final chapter summarises the key findings from the four sub-studies of this thesis, outlines the contributions made to the literature and discusses the implications for policy and practice. The strengths and limitations of the thesis are discussed and recommendations for future research are detailed.

2 Chapter Two: International systematic review and meta-analysis on drug sourcing and diversion

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2.1 Copyright statement

I certify that this publication was a direct result of my research towards this PhD, and that reproduction in this thesis does not breach copyright regulations.

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Shann Hulme 15 August 2019

2.2 Abstract

Background: The non-medical use (NMU) of pharmaceutical drugs is an increasing public health concern. This systematic review consolidates current knowledge about how pharmaceutical drugs are obtained for NMU and the processes and people involved in diversion.

Methods: Peer-reviewed and grey literature databases were searched for empirical studies published between 1996 and 2017 that examined the source or diversion of pharmaceutical opioids, sedatives or stimulants for NMU in countries with reported misuse problems. Pooled prevalence meta-analyses using random effects models were used to estimate the prevalence of medical and non-medical sourcing reported by end-users, and gifting, selling and trading by various populations.

Results: This review synthesises the findings of 54 cross-sectional studies via meta-analyses, with a remaining 95 studies examined through narrative review. Pharmaceutical drugs are primarily sourced for NMU from friends and family (57%, 95% CI 53% – 62%, I^2 = 98.5, n = 30) and despite perceptions of healthcare professionals to the contrary, illegitimate practices such as doctor shopping are uncommon (7%, 95% CI 6% – 10%, I^2 = 97.4, n = 29). Those at risk of diversion include patients displaying aberrant medication behaviours, people with substance use issues and students in fraternity/sorority environments. Sourcing via dealers is also common (32%, 95% CI 23% – 41%, I^2 = 99.8, n = 25) and particularly so among people who use illicit drugs (47%, 95% CI 35% – 60%, I^2 = 99.1, n = 15). There is little to no organised criminal involvement in the pharmaceutical black market.

Conclusion: Pharmaceutical drugs for NMU are primarily sourced by end-users through social networks. Future research should examine how dealers source pharmaceutical drugs.

Key words: Pharmaceutical diversion, pharmaceutical drug misuse, non-medical use, prescription sharing, pharmaceutical black market

2.3 Introduction

Pharmaceutical NMU involves the consumption of a prescription or over-the-counter (OTC) drug for non-therapeutic purposes or other than directed by a health practitioner (Barrett et al., 2008, Larance et al., 2011b, Nielsen et al., 2008, Sembower et al., 2013). The prevalence of pharmaceutical NMU now rivals the use of illicit drugs in many developed countries around the world. For instance, general population surveys conducted in the US, Canada and Australia have found that the NMU of pharmaceutical opioids is second only to the illicit use of cannabis (AIHW, 2017a, Center for Behavioral Health Statistics and Quality, 2015, Health Canada, 2012, Office of National Drug Control Policy [ONDCP], 2011).

The health, social and economic costs of the NMU of pharmaceutical drugs are well documented. The health risks range from fatal and non-fatal overdose to intoxication and dependence (Kaye and Darke, 2012, Olfson et al., 2015, Saha et al., 2016). In addition, poly drug use – the NMU of pharmaceutical drugs in combination with alcohol or other drugs – can magnify these problems and result in an increased risk of serious adverse consequences such as death (McCabe et al., 2006a, UNODC, 2017b). Recent data indicates that pharmaceutical opioid-related deaths are increasing in Australia (ABS, 2017), Canada (Canadian Institute of Health Information, 2017), the US (UNODC, 2017b) and the UK (Office for National Statistics, 2017). In the US, the NMU of pharmaceutical opioids has been estimated to cost over $70 billion annually (Florence et al., 2016). The harms related to the NMU of sedative and stimulant drugs are also well documented and include dependence, hospitalisation and death (ABS, 2017, AIHW, 2017a, National Institute on Drug Abuse, 2017, Sussman et al., 2006).

Pharmaceutical drugs for NMU may be sourced directly from medical sources via a prescription or OTC from a pharmacy, or from non-medical sources such as friends, relatives, a dealer or online (Substance Abuse and Mental Health Services Administration, 2017). The process of accessing pharmaceutical drugs for NMU involves diversion, whereby pharmaceuticals are channelled from legal sources to the illicit marketplace for NMU (Inciardi et al., 2007b). There is a large evidence base concerning the diversion of pharmaceutical drugs. Diversion is believed

to occur through a number of mechanisms such as doctor or pharmacy shopping, prescription forgery or alteration, illegal sale, theft, online sales, sharing among family and friends, and over-prescribing by health practitioners (Ford and Lacerenza, 2011, Fountain et al., 1997, Inciardi and Cicero, 2009, Inciardi et al., 2009b, Inciardi et al., 2007b, Parran Jr and Grey, 2000, Rodwell et al., 2010). In light of the prominence of pharmaceutical NMU and the associated costs, it is timely to consolidate what is known about sourcing and diversion. An understanding of the source and access points of pharmaceutical drugs that are used non-medically, as well as the processes and people involved in diversion is critical for informing the development of effective prevention, treatment and law enforcement interventions to address it (Ritter, 2005).

To date, reviews of this topic have tended to focus on canvassing issues related to the demand for pharmaceutical drugs without examining source and diversion (Lofwall and Walsh, 2014, Mounteney et al., 2015) or focused on one particular drug class (Kaye and Darke, 2012, Manchikanti et al., 2010) or diversion mechanism (Nielsen and Barratt, 2009). Further, most of the reviews have focused on the problem as it occurs only in the US (Fischer et al., 2010, Inciardi and Cicero, 2009, Inciardi et al., 2009b), despite increasing concerns elsewhere. In order to carve a path for future research and policy efforts, this review seeks to consolidate what is known about the source and diversion of pharmaceutical drugs for NMU in Australia, Canada, Europe and the US.

2.4 Method

This review was undertaken using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (PRISMA Statement, 2015).

2.4.1 Search strategy

With the assistance of a librarian trained in systematic review methodologies, searches were conducted in seven peer-reviewed and grey literature databases: MEDLINE, EMBASE, PsycINFO, CINCH, Criminal Justice Abstracts, Drug database: DRUG and the US National Criminal Justice Reference Service. The detailed search strategy used for each of these

databases is provided in Appendix 2A. Three groups of search terms were developed and Boolean operators were used to separate each term (OR) and each group (AND):

1. Pharmaceuticals, medication, prescri* (-ption, -bed), prescription drug, therapeutic drug, non-prescription drugs, over-the-counter, opioid, analgesic, stimulant, benzodiazepine, barbiturate, sedative, tranquiliser/zer; (AND)
2. Supply chain, supply, supplier, diversion, drug diversion, sourcing routes, source, drug market, drug trade, drug trafficking, dark web, dark net, Internet, doctor shopping, pharmacy shopping, drug dealing, on-selling, over-prescribing, theft, fraud; (AND)
3. Non-medical use, misuse, illicit use, recreational use, abuse, poly drug use.

For MEDLINE, EMBASE, PsycINFO and Drug database: DRUG, the search terms were mapped to the associated subject headings, in addition to keyword searches for specific phrases. For CINCH, Criminal Justice Abstracts and the NCJRS, keyword searches only were used.

Additionally, a number of selected websites were searched for relevant grey literature. International websites included: UNODC, the Center for Disease Control and the World Health Organisation (WHO). Australian websites included: Australian Policy Online, Australian Institute of Criminology, NSW Bureau of Crime Statistics and Research (BOCSAR), Australian Institute of Health and Welfare (AIHW), Australian Criminal Intelligence Commission (ACIC) and the National Drug and Alcohol Research Centre (NDARC).

Reference lists in retrieved articles were also scanned to identify any relevant studies not captured. Citations were managed using the bibliographic software EndNote with duplicates removed manually.

2.4.2 Study selection

Inclusion and exclusion criteria were developed, with a focus on including empirical studies that contained content relating to the source or diversion of pharmaceutical drugs that are most often subject to NMU, namely pharmaceutical opioids (full agonists like oxycodone and partial

agonists like buprenorphine), sedatives (barbiturates, benzodiazepines and benzodiazepine-like drugs or 'z-drugs') and stimulants.

The searches were limited to 'humans' and the English language, and published between 1996 and 2017 (22 years). The lower cut-off was chosen because it aligns with the increased prescribing and NMU of pharmaceutical opioids in the US (King et al., 2014), and to focus on results in the past two decades so that findings are most relevant to current policy and practice. For comparability, studies from Australia, Canada, Europe and the US were included in the review. Although challenges relating to the NMU of pharmaceuticals in developing countries are equally important, the supply issues experienced are different and warrant separate analysis that is outside the scope of this review.

Literature was also excluded if it focused on the supply of illicit drugs (e.g. marijuana, cocaine, heroin) with no mention of pharmaceuticals; or focused only on the trends or prevalence of NMU, in the absence of any focus on source or diversion. Reviews, editorials, commentaries, letters or notes, opinion pieces and media articles were also excluded.

2.4.3 Data extraction and quality assessment

A standardised coding form was developed to ensure that consistent information was extracted from each study, including: author, year, country of origin, methodology, study design, sample size, target population, prescription drug class and key findings relating to the source and diversion of pharmaceutical drugs.

A modified version of the Checklist for the Evaluation of Research Articles (Parts V and VI) developed by DuRant (1994) was used to assess the quality of the cross-sectional studies included in the meta-analyses (also used by Pont et al. (2009)). A score of one was given for 'YES' responses and zero for 'NO', thus a higher score indicates better methodological quality. Studies with a high score were strong in their sample description, including detailed inclusion criteria and demographic characteristics of the sample and had sample sizes of greater than 100. Stronger studies also employed validity or reliability testing of the survey instruments and

achieved a response rate of greater than 80%, indicating lower risk of bias. The statistical procedures employed in the higher quality studies were clearly described and involved multivariate analyses. The modified appraisal tool and detailed scoring for each study is provided in Appendix 2B and 2C.

2.4.4 Data synthesis

To synthesise the findings of the cross-sectional studies that examined the source of pharmaceutical drugs for NMU, several meta-analyses were performed using a random-effects model using the MetaXL add-in for Microsoft Excel (Barendregt, 2016). A pooled prevalence figure was calculated with 95% confidence intervals (CIs) for each source. Similarly, the cross-sectional studies that examined the prevalence of diversion by gifting, selling and trading among different populations groups were synthesised via random-effects meta-analyses in MetaXL. A random-effects model was used to account for heterogeneity (Schroll et al., 2011). Pooled prevalence meta-analysis is a useful tool for synthesising information from similar studies and it is often used in epidemiology to estimate the prevalence of disease. It has been used in this review to highlight patterns in pharmaceutical sourcing and diversion for NMU as reported in cross-sectional surveys. As the surveys allowed respondents to select multiple sources (e.g. friends, online) and diversion mechanisms (e.g. gift, sell), several meta-analyses were required to determine the prevalence of each. Potential causes of heterogeneity were explored by carrying out sensitivity testing and subgroup analyses, where possible.

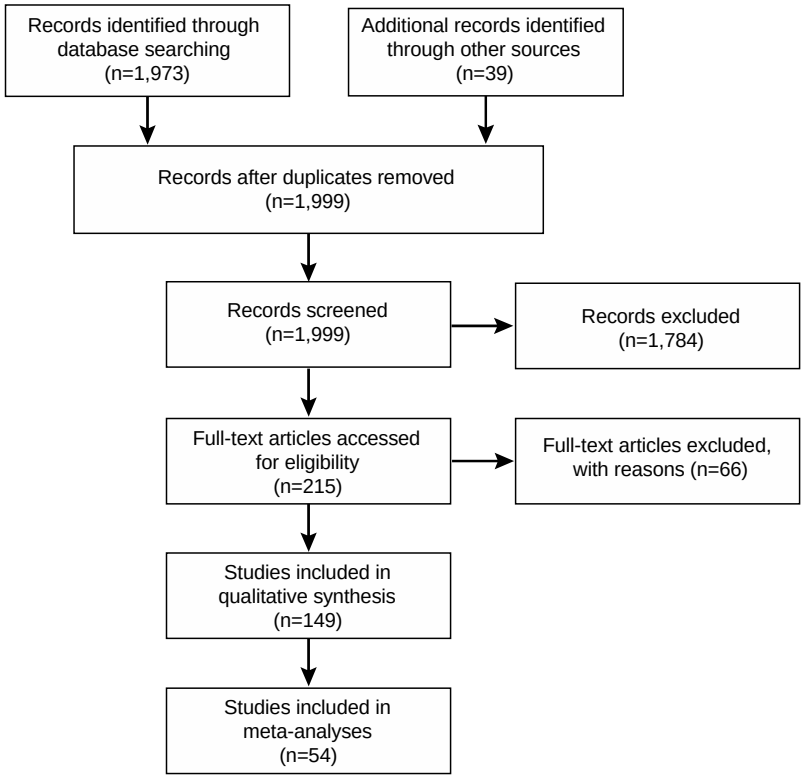
The results section presents the meta-analyses results, followed by a discussion of any pertinent findings of the subgroup analyses for population group and drug type. The remaining studies were examined through narrative synthesis and have been used to help explain or elaborate upon the findings from the meta-analyses.

2.5 Results

2.5.1 Searches

A total of 2,012 records were initially identified as potentially relevant from the database and website searches (Figure 2.1). Across the seven databases and manual searches, 215 records were deemed relevant and full-text were accessed. Of these, 66 were excluded primarily for being non-empirical or lacking information on the source or diversion of pharmaceutical drugs for NMU. Appendix 2D provides a list of all excluded articles with reasons. A total of 149 records were included in the narrative review and 54 studies were also synthesised using meta-analysis.

Figure 2.1. Search results



2.5.2 Study characteristics

Most studies were published post-2007 (73.8%) and conducted in the US (58.4%) and Australia (20.8%) (Appendix 2E). Two-thirds (65.8%) examined the source of pharmaceutical drugs for NMU, while under half (43.6%) studied diversion (Table 2.1). The vast majority of the source

studies focused on where pharmaceutical drugs are obtained by the end-user, with very few studies focusing on sources used by dealers. The diversion studies examined diversion by gifting, selling or trading pharmaceutical drugs among different population groups, the risk factors for diversion, and the criminality involved in diversion activities.

Table 2.1. Study characteristics

	Total studies (n=149)	Source studies (n=98)	Diversion studies (n=65)
	n (%)	n (%)	n (%)
Target population			
People who use drugs	65 (43.6)	55 (56.1)	22 (33.8)
Students	20 (13.4)	8 (8.2)	13 (20.0)
General population	17 (11.4)	15 (15.3)	3 (4.6)
Patients or prescription holders	17 (11.4)	7 (7.1)	10 (15.4)
Key experts or professionals	16 (10.7)	4 (4.1)	12 (18.5)
Prison population	5 (3.4)	3 (3.1)	2 (3.1)
Prescription drug dealers	4 (2.7)	2 (2.0)	2 (3.1)
Healthcare professionals [a]	4 (2.7)	-	4 (6.2)
No target population [b]	10 (6.7)	9 (9.2)	1 (1.5)
Drug class			
Opioids [c]	96 (64.4)	73 (74.5)	33 (50.8)
Stimulants	42 (28.2)	27 (27.6)	18 (27.7)
Sedatives [d]	37 (24.8)	32 (32.7)	9 (13.8)
Barbiturates	4 (2.7)	3 (3.1)	1 (1.5)
Benzodiazepines	36 (24.2)	30 (30.7)	8 (12.3)
Z-drugs	8 (5.4)	5 (5.1)	4 (6.2)
General [e]	27 (18.1)	10 (10.2)	17 (26.2)
Study type			
Cross-sectional survey	105 (70.5)	67 (68.4)	50 (76.9)
Qualitative / ethnography	32 (21.5)	19 (19.4)	2 (3.1)
Cross-sectional other [f]	16 (10.7)	13 (13.3)	16 (24.6)
Cohort	7 (4.7)	7 (7.1)	-

Notes: Populations, drug classes, methodologies and source/diversion studies are not mutually exclusive.

[a)] Involved in diversion or misappropriation from the workplace, not as key experts or informants

[b)] Includes studies that did not sample a specific population, such as observational studies of Internet forums

[c)] Full agonists (e.g. oxycodone) and partial agonists (e.g. buprenorphine)

[d)] Barbiturates (e.g., phenobarbital), benzodiazepines (e.g. alprazolam) and benzodiazepine-like drugs or 'Z-drugs'

[e)] Includes studies that examined the non-medical use or diversion, with no specification of drug type.

[f)] Includes other cross-sectional data such as information collected from Internet forums and websites.

2.5.3 Source of pharmaceutical drugs for non-medical use

Of the 98 studies that examined the source of pharmaceutical drugs for NMU, 67 (68.4%) included a cross-sectional survey component. Thirty-four (34.7%) surveyed people who misuse pharmaceutical drugs about all sources of obtainment and contained comparable data for meta-analysis (Table 2.2).

Table 2.2. Prevalence of pharmaceutical sourcing for non-medical use, studies included in the meta-analyses

	Author (Year)	Target population	Quality score	Drug class	Sample (n)	Source						
						Friend/ family (free) [a] (%)	Friend/ family (buy) (%)	Legitimate medical (%)	Illegitimate medical [c] (%)	Internet (%)	Dealer or street market (%)	Theft [b] (%)
1	Barrett et al. (2005)	Students (University)	9	Stimulant	36	78		11			17	4
2	Bazazi et al. (2011)	PWUD (Opioids, in treatment)	9	Opioid (BP)[d]	100	36					24	
3	Boyd (2006)	Students (Secondary)	13	Opioid	139	34				0		
4	Bruno (2007)	PWUD (Injecting, in treatment)	7	Sedative	81	65	37	64	5		21	0
5	Cassidy et al. (2015b)	General population (Adults 18 to 49 years)	13	Stimulant	224	91		11	5		20	10
6	Cassidy et al. (2015a)	PWUD (In treatment)	11	Opioid	29,253			50			28	
	Cassidy et al. (2015a)		11	Stimulant	1905	54		23			24	
7	Chen et al. (2014)	General population (Adolescents, adults)	13	Stimulant	4945	53	18	10	3	2	7	5

	Author (Year)	Target population	Quality score	Drug class	Sample (n)	Source						
						Friend/ family (free) [a] (%)	Friend/ family (buy) (%)	Legitimate medical (%)	Illegitimate medical [c] (%)	Internet (%)	Dealer or street market (%)	Theft [b] (%)
8	Cicero et al. (2008)	PWUD (Opioids, in treatment)	8	Opioid	1,116	59		59		6	65	21
9	Cicero et al. (2011)	PWUD (Opioids, in treatment)	13	Opioid	1,983	20		25			58	5
	Cicero et al. (2011)		13	Opioid	782	55		14	13		67	11
10	Daniulaityte et al. (2014)	PWUD (Opioids, out of treatment)	12	Opioid	383	88	80	47	10	1		21
11	Davis and Johnson (2008)	PWUD (Out of treatment)	8	Opioid (OXY)	80			38			63	
	Davis and Johnson (2008)		8	Opioid (MET)	55			14			75	
12	DeSantis et al. (2008)	Students (University)	9	Stimulant	585	87					8	
13	DeSantis et al. (2009)	Students (University)	9	Stimulant	170	100					9	
14	Dupont et al. (2008)	Students (University)	10	Stimulant	110	90						

	Author (Year)	Target population	Quality score	Drug class	Sample (n)	Source						
						Friend/ family (free) [a] (%)	Friend/ family (buy) (%)	Legitimate medical (%)	Illegitimate medical [c] (%)	Internet (%)	Dealer or street market (%)	Theft [b] (%)
15	Festinger et al. (2016)	PWUD (Pharmaceuticals, in treatment, adolescents and adults)	11	Opioid	970					2		
	Festinger et al. (2016)		11	Sedative	609					1		
	Festinger et al. (2016)		11	Stimulant	705					2		
16	Ibañez et al. (2013)	PWUD (Pharmaceuticals, in and out of treatment)	12	Sedative	1,207	52		11	3		65	6
17	Inciardi et al. (2010)	PWUD (Opioids, in treatment)	12	Opioid	4,008	52		41	6	3	62	15
	Inciardi et al. (2010)	PWUD (OST, in treatment)	12	Opioid	9,008	44		23	2	2	78	5
	Inciardi et al. (2010)	Students (University)	12	Opioid	116	53		39		2	20	6
18	Katz et al. (2008)	PWUD (Pharmaceuticals, out of treatment)	11	Opioid	896	60		20	5	5	80	15

	Author (Year)	Target population	Quality score	Drug class	Sample (n)	Source						
						Friend/ family (free) [a] (%)	Friend/ family (buy) (%)	Legitimate medical (%)	Illegitimate medical [c] (%)	Internet (%)	Dealer or street market (%)	Theft [b] (%)
19	Kaye et al. (2014)	PWUD (Psychostimulants, in and out of treatment)	11	Stimulant	83	71		7			16	
20	Levy (2007)	PWUD (In treatment)	7	Opioid	204	70	4	14				
21	Martins et al. (2009)	General population (Adolescents, adults)	13	Opioid	285	64	58	21	12	1	35	25
	Martins et al. (2009)		13	Opioid	2,954	61	15	23	5	3	8	10
22	McCabe et al. (2007)	Students (University)	13	Opioid	640	41				0	4	
23	McCabe et al. (2013)	Students (Secondary)	13	Opioid	647	55	38	37		1	19	22
24	Monte et al. (2009)	PWUD (Opioids, in treatment)	7	Opioid (BP)[d]	49	61					39	
25	Ng and MacGregor (2012)	Police detainees	7	Opioid (BP)[d]	44	48	18		2		39	5
	Ng and MacGregor (2012)		7	Opioid (MET)	22	41	27		14		27	5

	Author (Year)	Target population	Quality score	Drug class	Sample (n)	Source						
						Friend/ family (free) [a] (%)	Friend/ family (buy) (%)	Legitimate medical (%)	Illegitimate medical [c] (%)	Internet (%)	Dealer or street market (%)	Theft [b] (%)
	Ng and MacGregor (2012)		7	Opioid (MOR)	73	38	33		1		51	5
	Ng and MacGregor (2012)		7	Sedative	129	58	23		12		24	5
	Ng and MacGregor (2012)		7	Stimulant	25	68	28		0		12	4
26	Nielsen et al. (2013)	PWUD (Pharmaceuticals, in treatment)	9	Opioid	108	30	39	31	12		46	4
	Nielsen et al. (2013)		9	Sedative	144	44	19	72	22		17	6
27	Novak et al. (2007)	General population (Adults)	13	Stimulant	86	66	13		20	5		35
28	Novak et al. (2016)	General population (Adolescents, adults)	12	Opioid	949	44	13		16	4		27
	Novak et al. (2016)		12	Sedative	1,099	61	7		19	3		16
	Novak et al. (2016)		12	Stimulant	498	47	14		23	8		27

	Author (Year)	Target population	Quality score	Drug class	Sample (n)	Source						
						Friend/ family (free) [a] (%)	Friend/ family (buy) (%)	Legitimate medical (%)	Illegitimate medical [c] (%)	Internet (%)	Dealer or street market (%)	Theft [b] (%)
29	O'Reilly et al. (2007)	PWUD (Injecting, in treatment)	7	Opioid	101	37	39	25	1		24	2
	O'Reilly et al. (2007)		7	Sedative	101	26	22	9	8		11	1
30	Ross et al. (1996)	PWUD (Opioids or heroin, in and out of treatment)	10	Sedative	210			47				
31	Schepis and Krishnan-Sarin (2009)	General population (Adolescents)	13	Opioid	2,589	47	9	20	3	0	5	10
	Schepis and Krishnan-Sarin (2009)		13	Sedative	148	33	6	20	2	0	7	9
	Schepis and Krishnan-Sarin (2009)		13	Stimulant	740	50	12	11	2	2	7	11
32	Schulte et al. (2016)	PWUD (Opioids, in and out of treatment)	12	Opioid	177	53					81	
33	Smith et al. (2007)	PWUD (Injecting, in treatment)	7	Opioid	98	63		62	6			3
	Smith et al. (2007)		7	Sedative	102	87	27	80	13			8

	Author (Year)	Target population	Quality score	Drug class	Sample (n)	Source						
						Friend/ family (free) [a] (%)	Friend/ family (buy) (%)	Legitimate medical (%)	Illegitimate medical [c] (%)	Internet (%)	Dealer or street market (%)	Theft [b] (%)
34	Vivian et al. (2005)	PWUD (Other than alcohol or marijuana, out of treatment)	10	Opioid	52						58	
Number of studies for meta-analysis						30	24	21	29	13	25	19

Notes: BP = Buprenorphine, MET = Methadone, MOR = Morphine, OXY = Oxycodone.

[a)] Includes studies that indicated drugs were sourced from friends or family, but did not specify whether money was exchanged.

[b)] Includes theft from family, friends and others.

[c)] Includes faking symptoms, doctor shopping and prescription forgery practices.

[d)] Indicates partial agonist opioids (i.e. buprenorphine, buprenorphine-naloxone).

Source categories are not mutually exclusive. Quality assessment based on an adaptation of the tool developed by DuRant (1994) (see Appendix 2B). Maximum score = 14.

The remaining 33 (33.7%) cross-sectional studies were excluded from the meta-analyses for focusing only on sources involving monetary exchange (8), reporting on the most recent or usual source of pharmaceutical drugs (as opposed to any source) (6), not specifying drug type (6), surveying people about the price of pharmaceuticals (5), focusing only on illegal or high-risk sources (3), lacking adequate detail on sample size or method (4) and reporting the views of health practitioners (1).

Using the 34 (34.7%) comparable studies, individual meta-analyses were performed for the following seven source types: friends or family (free), friends or family (purchase), dealer or street market, legitimate medical source, illegitimate medical source, Internet and theft. The results indicate that pharmaceutical drugs are most commonly sourced for NMU from friends or family for free and least commonly via the Internet (Table 2.3).

Table 2.3. Results of source meta-analyses (random effects model)

	Prevalence (%)	LCI (95%)	HCI (95%)	Cochran's Q	I^2	Tau^2	No. of studies	No. of estimates	Total sample size
Friend or family (free)	57	53	62	2947.87	98.51	0.08	30	45	39,889
Dealer or street market	32	23	41	19335.68	99.80	0.38	25	39	65,661
Legitimate medical source	29	23	36	7830.83	97.35	0.16	21	32	64,592
Friend or family (buy)	23	18	29	1556.83	98.52	0.11	13	24	16,457
Theft	10	8	12	1403.28	97.65	0.04	19	34	35,727
Illegitimate medical source	7	6	10	1057.94	97.35	0.04	16	29	31,829
Internet	2	1	3	325.19	93.54	0.01	13	22	33,530

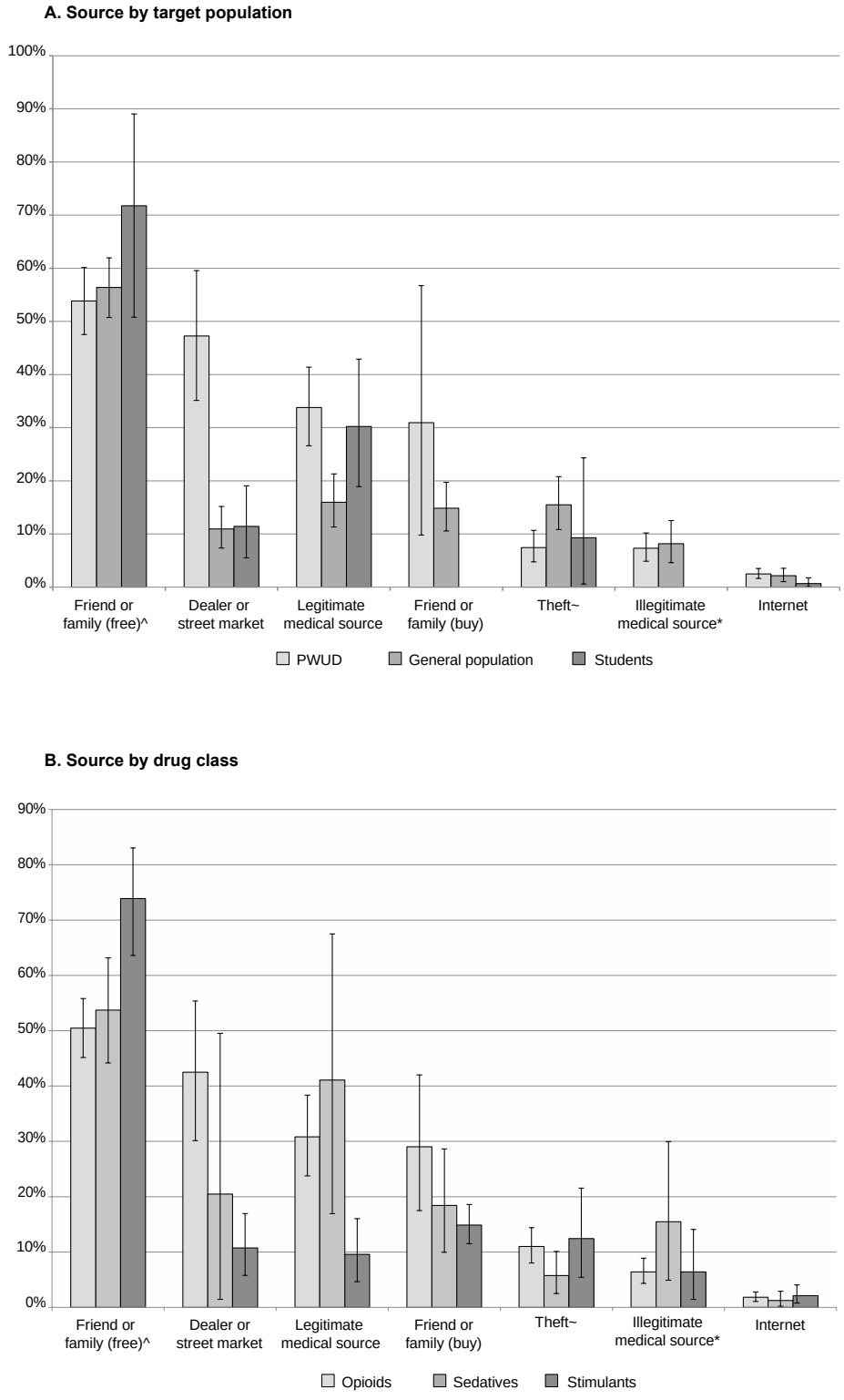
Notes: Source categories are not mutually exclusive. Studies included in each meta-analyses are listed in Table 2.2.
LCI = lower confidence interval, HCI = higher confidence interval, Cochran's Q = the weighted sum of squared differences between individual study effects and the pooled effect across studies, I^2 = the percentage of variation across studies that is due to heterogeneity rather than chance, Tau^2 = absolute value of true variance.

The influence of individual studies on the overall prevalence estimate for each source was explored by serially excluding each study in a sensitivity analysis. There were no studies that influenced the overall prevalence estimates by more than 3% (Appendix 2F).

In these meta-analyses there was a high level of heterogeneity as indicated by an I^2 of greater than 90%. Potential influences on prevalence estimates were investigated using subgroup analysis for date of publication, study quality, target population and drug class. There was minimal variation in the prevalence estimates for studies published between 2003 and 2009 compared with 2010 and 2017, and heterogeneity remained high. Likewise, patterns of sourcing were similar for the high and moderate quality studies, with heterogeneity slightly reduced but still high (Appendix 2G).

There were some differences in patterns of sourcing when analysed by target population and drug class (Figure 2.2).

Figure 2.2. Source of pharmaceutical drugs for non-medical use by target population and drug class, meta-analyses results



Notes: ^ Includes studies that indicated drugs were sourced from friends or family, but did not specify whether money was exchanged.

~ Includes theft from family, friends and others.

* Includes faking symptoms, doctor shopping and prescription forgery practices.

2.5.3.1 Non-medical or intermediary sourcing

2.5.3.1.1 Friends and family

The meta-analyses revealed that friends and family are the most prominent source of pharmaceutical drugs for NMU across all populations and drug classes (Figure 2.2). More often pharmaceutical drugs are obtained for free from friends or family, than they are purchased. Friends and family may be a preferred access point for convenience and because the scrutiny of health practitioners can be avoided (Anglin and White, 1999).

The majority of PWUD reported accessing pharmaceutical drugs for NMU from friends and family without payment (54%, 95% CI 48% - 60%). It is well known that PWUD regularly socialise with other users with ready access to medications through opioid substitution therapy (OST) and other treatment services (Bruno, 2007, Carise et al., 2007, Duffy and Baldwin, 2012, Fountain et al., 2000, Furst, 2014, Johanson et al., 2012, Mitchell et al., 2009, Nielsen et al., 2008, Vivian et al., 2005, Winstock and Lea, 2010, Winstock et al., 2008). Within these communities, informal medication sharing occurs and is often driven by altruistic motives or the desire to help another who may be experiencing the effects of withdrawal (Allen and Harocopos, 2016, Duffy and Baldwin, 2012, Johnson and Richert, 2015b, Kaye et al., 2014). More formal relationships involving the exchange of pharmaceutical drugs for money, other medications or illicit drugs may also take place between PWUD. One study found that these types of relationships were established to accommodate a regular or ongoing supply rather than occasional offerings (Johnson and Richert, 2015b). Australian research has shown that when pharmaceutical opioids or sedatives are purchased by PWUD for NMU, they are most often purchased from friends or family than acquaintances or dealers (Stafford and Breen, 2016, Stafford and Breen, 2017, Stafford and Burns, 2010, Stafford and Burns, 2011, Stafford and Burns, 2012, Stafford and Burns, 2013, Stafford and Burns, 2014, Stafford and Burns, 2015).

Almost three-quarters of students reported accessing pharmaceutical drugs for NMU from friends or family for free (72%, 95% CI 51% - 89%). This review found that stimulants used for the treatment of attention deficit hyperactivity disorder (ADHD) are often sourced from peers

with prescriptions (Barrett et al., 2005, DeSantis et al., 2010, DeSantis et al., 2008, Dupont et al., 2008, McCabe et al., 2006c, Vosburg et al., 2016). The excess supply of medications from patients not taking their required dosage facilitates sharing with other students, who then use the drugs as study aids or for recreational purposes (DeSantis et al., 2010, DeSantis et al., 2008, Vrecko, 2015). Parents are also a meaningful source of pharmaceutical drugs for students, particularly for opioids and sedatives (DeSantis et al., 2009, DeSantis et al., 2008, Dupont et al., 2008, Holloway and Bennett, 2012, McCabe et al., 2007, Schepis and Krishnan-Sarin, 2009). One study found that students who source opioids from parents were less likely to use the drugs recreationally (McCabe et al., 2007).

General population surveys have also showed a high prevalence of sourcing through friends and family (56%, 95% CI 51% - 62%). The AIHW National Drug Strategy Household Survey (NDSHS) found that friends and family are consistently reported as the usual source of sedatives for NMU in the past year (AIHW, 2001, AIHW, 2004, AIHW, 2007). Stimulant drugs are overwhelmingly accessed through social networks (Cassidy et al., 2015a, Cassidy et al., 2015b, Vuolo et al., 2014) and one study found that those sourcing stimulants from friends or family have a lower prevalence of NMU than those sourcing from dealers (Chen et al., 2014).

2.5.3.1.2 Dealers

The meta-analyses showed that access to pharmaceutical drugs for NMU via dealers is relatively common for PWUD (47%, 95% CI 35% - 60%) and more so than for the general population (11%, 95% CI 7% - 15%) and students (11%, 95% CI 6% - 19%) (Figure 2.2). Some research has found that often people who illegally sell pharmaceuticals also sell illicit drugs (Rigg et al., 2012, Vuolo et al., 2014) and in circumstances where dealers sell pharmaceutical drugs alone, they will often be present in illicit drug scenes (Firestone and Fischer, 2008, Fischer et al., 2009). Given that PWUD are likely to have regular contact with street-based drug markets as part of their own drug use, it is understandable that pharmaceutical drugs are also sourced in this way (Chan et al., 2016, Lankenau et al., 2007, Schulte et al., 2016). Moreover, it is well known that PWUD may substitute illicit drugs such as heroin for pharmaceutical drugs

depending on availability, which may explain their contact with both markets (Bruno, 2007, Smith et al., 2007).

As with illicit drugs, the pricing of pharmaceutical drugs varies according to supply and availability within the market (Sajan et al., 1998). The specific black market prices reported in the included studies varied depending on the drug or brand name under investigation and the dosage amount (Bazazi et al., 2011, Elwood, 2001, Furst, 2014, Inciardi et al., 2009a, Monte et al., 2009, Sajan et al., 1998, Winstock and Lea, 2010). Pharmaceutical drugs sold on the black market are reportedly more expensive than those available through medical sources (Bachhuber and Cunningham, 2013, Bazazi et al., 2011, Sajan et al., 1998), indicating that persons sourcing from dealers may be motivated to do so for reasons other than cost. There also may be pricing differences depending on the purchaser. For instance, one study found that people who inject drugs typically paid higher prices for black market buprenorphine than those who do not inject drugs (Bazazi et al., 2011).

2.5.3.1.3 Internet

Despite the apparent availability of pharmaceutical drugs online (Schepis et al., 2008, The National Center on Addiction and Substance Abuse, 2004, The National Center on Addiction and Substance Abuse, 2008), the meta-analyses revealed that sourcing via the Internet is uncommon across all populations and drug classes (less than 3% for all groups) (Figure 3) (Apantaku-Olajide and Smyth, 2013, Bachhuber and Cunningham, 2013, Dasgupta et al., 2013, Festinger et al., 2016, Forman et al., 2006, Frauger et al., 2012, Inciardi et al., 2010, Littlejohn et al., 2005, Martins et al., 2009, McGregor et al., 2011, Novak et al., 2016, Schepis and Krishnan-Sarin, 2009, Van Buskirk et al., 2013). A study of public web-forum discussions found that the Internet may be used as a backup for sourcing morphine during periods of withdrawal or when unable to access a pharmacy (Van Hout and Hearne, 2016). This review found that there may be several factors disincentivising the sourcing of drugs online including risk of detection and seizure by customs, shipping delays and costs, and the risk of purchasing

counterfeit products (Bachhuber and Cunningham, 2013, Cicero et al., 2008, Fischer et al., 2010, Inciardi et al., 2007a, Nielsen and Barratt, 2009, Van Hout and Hearne, 2016).

2.5.3.2 Medical sourcing

The meta-analyses showed that the medical system is a key access point for pharmaceutical drugs for NMU. Overall, sourcing via legitimate prescriptions is more common (29%, 95% CI 23% - 36%) than sourcing illegitimately through practices such as faking symptoms, doctor shopping and prescription forgery (7%, 95% CI 6% - 10%) (Figure 2.2, Table 2.3).

2.5.3.2.1 Legitimate medical sourcing

The meta-analyses found that accessing pharmaceutical drugs via legitimate medical sources is particularly common among PWUD (34%, 95% CI 27% - 41%). In an Australian sample of drug treatment clients, Nielsen et al. (2013) found that presenting to a health practitioner with a real symptom was the usual access point for benzodiazepines. This may reflect the regular contact that PWUD have with the medical system due to health issues or as part of formal treatment. Among PWUD, those with ready access to the medical system through health insurance are more likely to use medical than non-medical sources (Cicero et al., 2008, Ibañez et al., 2013).

When pharmaceutical drugs are accessed legitimately from the medical system, drugs are initially obtained for real symptoms, illness or injury (Harocopos and Allen, 2015). This suggests that the excess supply of medications may contribute to their NMU and diversion (Buykx et al., 2010, Inciardi et al., 2007a, Lewis et al., 2014, McCabe et al., 2013). Research has shown that medical sourcing is prominent among females (Cicero et al., 2011, Cicero et al., 2008, White et al., 2016a). The medical system may be a preferred access point because it is legal, lower in cost and potentially safer (Bouland et al., 2015, Ronka and Katainen, 2017).

2.5.3.2.2 Illegitimate medical sourcing

The meta-analyses indicated that illegitimately sourcing pharmaceutical drugs through the medical system by faking symptoms, prescription forgery or doctor shopping is relatively

uncommon among the general population (8%, 95% CI 5% - 13%) and PWUD (7%, 95% CI 5% - 10%), as well as for opioids (6%, 95% CI 4% - 9%), sedatives (15%, 95% CI 5% - 30%) and stimulants (6%, 95% CI 1% - 14%) (Figure 2.2). It is possible that the elevated risks associated with deceiving practitioners act as a deterrent, particularly in the context of prescription drug monitoring programs (PDMPs) that have proliferated in countries such as the US in recent years (Gabay, 2015). In fact, research has shown that successfully diverting drugs through these practices requires considerable time and effort in order to gather medical knowledge, identify the most amenable practitioners to target, develop a particular profile or appearance and build rapport with practitioners (Ronka and Katainen, 2017, Van Hout and Hearne, 2016, Worley and Thomas, 2014).

Contrary to the meta-analyses results, the review found that health practitioners perceive doctor shopping to be widespread (Inciardi and Cicero, 2009, Smith et al., 2007, The National Center on Addiction and Substance Abuse, 2005). Patient behaviours such as making direct and specific requests for medications, becoming forceful and bullying the prescriber are perceived to be common indicators of doctor shopping (Leukefeld et al., 2007, Novak et al., 2007, Worley et al., 2015). On the other hand, it has also been acknowledged that potential drug diversion by patients (Larance et al., 2011c) and prescription forgery in particular, can be difficult for practitioners to identify (Boeuf and Lapeyre Mestre, 2007), especially in countries with fewer regulations and incomplete patient records (Lapeyre-Mestre et al., 2014).

Seven cohort studies were identified that examined the prevalence of doctor shopping in large patient samples (Cepeda et al., 2014, Chenaf et al., 2016, Chilcoat et al., 2016, Delorme et al., 2016, Han et al., 2014, Morris et al., 2014, Simeone, 2017). Different definitions of doctor shopping were adopted in these studies, so no attempt has been made here to synthesise the estimates produced. Overall the prevalence of doctor shopping was low: 0.17% for opioids in a US sample (Simeone, 2017) and 7.2% in a French sample (Pauly et al., 2012), 0.12% for oxycodone (Chilcoat et al., 2016), 4.0% for codeine by chronic non-cancer pain patients (Chenaf et al., 2016), 8.4% for high-dosage buprenorphine (Delorme et al., 2016), 4.5% for

stimulant ADHD medications (Cepeda et al., 2014) and 1.9% for benzodiazepines (Pauly et al., 2012).

Illicit drug use is a key predictor of illegitimate medical sourcing (Novak et al., 2016, Stogner et al., 2014) and one study found that obtaining opioids from more than one doctor is more common among elderly patients (Gold et al., 2016). It has been reported that the majority of people who doctor shop for ADHD stimulant medications do so only once, suggesting that it may not be the primary mechanism for sourcing stimulants for NMU (Cepeda et al., 2014).

The other method of illegitimate medical sourcing that was explored in the literature involves health practitioners sourcing drugs for NMU directly from their workplace for their own use. In this setting, diversion occurs through a number of strategies including substitution or defrauding of patients, prescription forgery and manipulation, and the NMU and theft of medication samples and expired drugs (Cummings et al., 2011, Inciardi et al., 2006, Merlo et al., 2014). The overt presence of pharmaceuticals in the workplace of health practitioners facilitates their ease of diversion in this context (Merlo et al., 2014).

2.5.4 Diversion of pharmaceutical drugs for non-medical use

The review identified 65 studies that examined diversion. Of these, 24 (36.9%) surveyed different population groups about their involvement in gifting, selling or trading pharmaceutical drugs. The results of these individual studies are presented in Table 2.4.

Table 2.4. Prevalence of pharmaceutical diversion by gifting, selling or trading

	Author (Year)	Population	Quality score	Drug class	Sample size (n)	Gifting (%)	Selling (%)	Trading (%)	Combined (%)	Combined inclusions	Time scale
1	Aldridge et al. (2011)	Patients (ADHD)	11	Stimulant	513				17	Gift, sell	30 days
2	Ashrafioun et al. (2014)	Patients (Dental)	12	Opioid	338	5	2	1	7	Gift, sell, trade	12 months
3	Belcher et al. (2014)	Patients (Non-cancer pain)	10	Opioid	952	4	0		4	Offer, supply, sell	Lifetime
4	Cottler et al. (2013)	General population (Adolescents)	11	Stimulant	11,048	5	3	2	7	Gift, sell, trade	Lifetime
5	Darredeau et al. (2007)[b]	Patients (ADHD)	11	Stimulant	66	42	8		44	Gift, sell	Lifetime
6	Davis and Johnson (2008)	PWUD (Heroin, not from treatment)	8	Opioid	586		40				Lifetime
7	DeSantis et al. (2013)[b]	Patients (ADHD) Students (University)	10	Stimulant	120	53	39				Lifetime
8	Duffy and Baldwin (2012)	PWUD (Methadone, from treatment)	9	Opioid (MET)	854	13	5	3			12 months
	Duffy and Baldwin (2012)[a]	PWUD (Methadone, from treatment)	9	Opioid (MET)	854	4	2	1			4 weeks

	Author (Year)	Population	Quality score	Drug class	Sample size (n)	Gifting (%)	Selling (%)	Trading (%)	Combined (%)	Combined inclusions	Time scale
9	Gallucci et al. (2015)	Patients (Stimulant holders) Students (University)	12	Stimulant	151				59	Gift, sell	Lifetime
	Gallucci et al. (2015)[b]	Patients (Stimulant holders) Students (University)	12	Stimulant	151	31			32	Gift, sell	30 days
10	Goldsworthy et al. (2008)	General population (Adolescents, adults)	10	General	700	23					Lifetime
11	Holloway and Bennett (2012)	Students (University)	8	General	1,517	10	1	1	11	Gift, sell, trade	Lifetime
	Holloway and Bennett (2012)	University staff	8	General	458	10	< 1	< 1	10	Gift, sell, trade	Lifetime
12	Holloway et al. (2013)	Students (University)	8	General	437	16	1	1			Lifetime
13	Johnson and Richert (2015a)[a]	PWUD (OST, from treatment)	12	Opioid (BP, MET)[c]	411	16	14	3	24	Gift, sell, trade	30 days
	Johnson and Richert (2015a)	PWUD (OST, from treatment)	12	Opioid (BP, MET)[c]	411				9	Gift, sell, trade	Lifetime
14	Kaye et al. (2014)	PWUD (Psycho-stimulants, from	11	Stimulant	19				47	Gift, sell	Lifetime

	Author (Year)	Population	Quality score	Drug class	Sample size (n)	Gifting (%)	Selling (%)	Trading (%)	Combined (%)	Combined inclusions	Time scale
		treatment and not from treatment)									
15	Larance et al. (2011a)	PWUD (OST, from treatment)	11	Opioid (BP, BNX, MET)[c]	424				28	Gift, sell	6 months
16	Lasopa et al. (2015)	General population (Youth)	13	Stimulant	738	27	19	17			Lifetime
17	Launonen et al. (2015)	PWUD (OST, from treatment)	10	Opioid (BNX, MET)[c]	1,452		4				> 6 months ago
	Launonen et al. (2015)[a]	PWUD (OST, from treatment)	10	Opioid (BNX, MET)[c]	1,452		3				< 6 months ago
	Launonen et al. (2015)[a]	PWUD (OST, from treatment)	10	Opioid (BNX, MET)[c]	1,391	8					> 6 months ago
	Launonen et al. (2015)	PWUD (OST, from treatment)	10	Opioid (BNX, MET)[c]	1,391	5					< 6 months ago
18	Nielsen et al. (2008)[a]	PWUD (injecting, from treatment)	9	Opioid	232	37	12	21			30 days
19	Poulin (2007)	Students (Secondary)	14	Stimulant	264	24	19				30 days

	Author (Year)	Population	Quality score	Drug class	Sample size (n)	Gifting (%)	Selling (%)	Trading (%)	Combined (%)	Combined inclusions	Time scale
20	Poulin (2001)	Students (Secondary)	14	Stimulant	710	15	7				12 months
21	Rabiner et al. (2009)	Students (University)	10	Stimulant	115				26	Gift, sell	6 months
22	Ross et al. (1996)	PWUD (OST, from treatment and heroin, not from treatment)	10	Sedative	210				58	Gift, sell	6 months
23	Vuolo et al. (2014)	PWUD (Pharmaceuticals, not from treatment)	12	General	404		11				3 months
24	Wilens et al. (2006)	Patients (ADHD, adolescents, young adults)	10	General	55		11				Lifetime

Notes: Includes studies that estimated the prevalence of actual diversion, as opposed to practices where persons were 'approached' or 'asked' to divert. Diversion categories are not mutually exclusive. Quality assessment based on an adaptation of the tool developed by DuRant (1994) (Appendix 2B). Maximum score = 14.
BP = Buprenorphine, BNX = Buprenorphine-naloxone, MET = Methadone.
[a)] Denotes studies that were included in the meta-analyses for diversion of opioids by PWUD
[b)] Denotes studies that were included in the meta-analyses for diversion of stimulants by students
[c)] Indicates partial opioid agonists (i.e. buprenorphine, buprenorphine-naloxone)

Due to variations in the drug classes and target populations examined and the time scales adopted, only seven (29.2%) of these studies contained comparable data for meta-analysis. This comprised four studies that estimated the prevalence of opioid diversion by PWUD in the past three months (Duffy and Baldwin, 2012, Johnson and Richert, 2015a, Launonen et al., 2015, Nielsen et al., 2008) and three studies that estimated the lifetime prevalence of stimulant diversion by students (Darredeau et al., 2007, DeSantis et al., 2013, Gallucci et al., 2015). For these studies, individual random-effects meta-analyses were performed for each diversion mechanism and the results indicate that gifting may be more common than selling and trading for both groups (Table 2.5).

Table 2.5. Results of diversion meta-analyses (random effects)

	Prevalence (%)	LCI (95%)	HCI (95%)	Cochran's Q	I^2	Tau^2	No. of studies	No. of estimates	Total sample size
Opioids by PWUD (past 3 months)									
Gift	12	3	25	207.34	98.55	0.11	4	4	2,888
Sell	6	1	12	99.95	97.97	0.05	4	4	2,949
Trade	6	0	18	102.08	98.04	0.12	3	3	1,497
Stimulants by students (lifetime)									
Gift	52	44	60	4.63	56.81	0.01	3	3	337
Sell	25	9	45	27.82	92.81	0.12	3	3	337

Notes: LCI = lower confidence interval, HCI = higher confidence interval, Cochran's Q = the weighted sum of squared differences between individual study effects and the pooled effect across studies, I^2 = the percentage of variation across studies that is due to heterogeneity rather than chance, Tau^2 = absolute value of true variance.

The literature suggests that PWUD may be motivated to sell or trade pharmaceutical drugs to support their own drug use (Furst, 2014, Inciardi et al., 2009a, Johnson and Richert, 2015b). Pharmaceutical drugs are a valuable commodity among communities of PWUD, particularly in circumstances where others may be experiencing the effects of withdrawal or do not have access to treatment services (Allen and Harocopos, 2016, Duffy and Baldwin, 2012, Johnson and Richert, 2015b, Kaye et al., 2014). In prison environments, pharmaceutical drugs may be traded for other drugs, tobacco or toiletries (Tompkins et al., 2009).

To varying degrees, research has documented the diversion of supervised OST doses such as methadone whereby clients have removed all or part of their dose at the time of administration (Larance et al., 2011a, Larance et al., 2011c, Tompkins et al., 2009, Winstock et al., 2009a, Winstock et al., 2009b). While often such diversion may be for the purpose of saving for later personal use (Larance et al., 2011a), it has also been documented that others may coerce treatment clients to share or on-sell their doses (Allen and Harocopos, 2016, Bruno, 2007, Green et al., 2013). Such coercion has also been widely reported in prison-based treatment settings (Havnes et al., 2013, White et al., 2016b).

The relatively high prevalence of lifetime stimulant diversion by students may reflect the availability of surplus medications, as well as increased peer pressure in student environments (DeSantis et al., 2013, Gallucci et al., 2015). Gallucci et al. (2015) found that when money was exchanged between students, in 46.1% of reports it was for the financial gain of the supplier, but may also occur as a gesture of goodwill (38.5%) and to cover the costs of the medication (7.6%).

Among patient samples, results from the individual studies suggest that stimulants are more likely to be given away, sold or traded than opioids (Ashrafioun et al., 2014, Belcher et al., 2014, Darredeau et al., 2007, DeSantis et al., 2013, Wilens et al., 2006). Research has shown that a minority of patients appropriately disposes of leftover medications, which may facilitate their diversion for NMU (Inciardi et al., 2007a, Lewis et al., 2014).

2.5.4.1 Risk factors for diversion

This review identified a substantial evidence base examining the risk factors for diversion among various populations.

For PWUD, risk factors include the injection of illicit and pharmaceutical drugs (Launonen et al., 2015, Winstock and Lea, 2010, Winstock et al., 2008), lower treatment satisfaction (Johnson and Richert, 2015a, Johnson and Richert, 2015c), higher on average alcohol consumption (Johnson and Richert, 2015b), and consumption of a lower dosage of medication (irrespective of the prescribed amount) (Johnson and Richert, 2015b, Launonen et al., 2015).

For students, previous NMU was most commonly found to be associated with diversion (DeSantis et al., 2013, Gallucci et al., 2015, McCabe et al., 2014, Poulin, 2001, Rabiner et al., 2009, Stogner et al., 2014), followed by sorority/fraternity membership (in university populations) (DeSantis et al., 2013, DeSantis et al., 2008, Stogner et al., 2014) and being a current prescription holder (Boyd et al., 2007, McCabe et al., 2006b). In a sample of high school students, females and students without college plans were more likely to be approached to divert their medications (McCabe et al., 2004). Other less commonly identified risk factors were the use of alcohol and other illicit drugs (DeSantis et al., 2013), association with non-medical using peers (DeSantis et al., 2013), lower incomes and unemployment (Stogner et al., 2014).

Finally, patients with a greater supply of medication (Belcher et al., 2014), those engaged in NMU (Ashrafioun et al., 2014, Darredeau et al., 2007, DeSantis et al., 2013, Gallucci et al., 2015) and more aberrant or 'off-label' medication behaviours (Belcher et al., 2014, DeSantis et al., 2013) are reportedly more likely to participate in diversion. Substance use disorders were also positively associated with diversion among patient groups (Walker and Webster, 2012, Wilens et al., 2006).

2.5.4.2 Organised criminal involvement

The literature indicates that while a black market for pharmaceutical drugs exists, it operates at the lowest level of distribution and there is little to no organised crime or involvement by

criminal gangs or networks (Allen and Harocopos, 2016, Fountain et al., 2000, O'Reilly et al., 2007, Smith et al., 2007, Vuolo et al., 2014, Yearwood, 2012). That said, coordinated operations have been uncovered in the US involving 'pill brokers' who proactively develop relationships with patients and the elderly to assist them to fill their prescriptions (Green et al., 2013, Inciardi et al., 2009a, Inciardi et al., 2007a, Rigg et al., 2010, Worley and Thomas, 2014). The brokers buy the medications from the patients for a considerably lower cost than the black market price and then work directly with users to distribute them (Inciardi et al., 2009a, Rigg et al., 2012, Rigg et al., 2010). In the US, drug tourism involving American citizens travelling to Mexico, South America and the Caribbean for pharmaceutical supplies has also been uncovered (Elwood, 2001, Inciardi et al., 2007a, Valdez and Sifaneck, 1997).

2.6 Discussion

To our knowledge, this is the first review to consolidate what is known about the source and diversion of pharmaceutical opioids, sedatives and stimulants for NMU in Australia, Canada, Europe, the UK and the US. This is a topic of increasing importance as international data indicate that NMU is escalating, along with associated health and economic consequences including mortality (UNODC, 2017b). An understanding of source and diversion is critical for developing effective prevention and treatment interventions (Ritter, 2005).

This review identified a large evidence base examining the source of pharmaceutical drugs for NMU. From this literature, it is clear that friends and family are the most prominent source reported by end-users. Moreover, giving medications away for free is the most commonly reported diversion mechanism. Together these findings confirm that medication sharing is common and widely perceived to be socially acceptable (Beyene et al., 2013, Goldsworthy et al., 2008). These informal exchanges are reminiscent of the social supply of illicit drugs, which has been described in the broader literature (see for example Grigg et al. (2015), Hough et al. (2003) and Coomber et al. (2016)). Social supply is based upon friendships and commonly occurs in closed settings, rather than in street-based drugs markets involving dealers (Grigg et al., 2015).

There are several factors that may contribute to the social supply of pharmaceutical drugs. First, few patients report receiving information from their treating practitioners about appropriate storage and disposal practices for leftover medications (Kennedy-Hendricks et al., 2016) and consequently, patients regularly retain surplus medications that then become susceptible to NMU and diversion (Daniulaityte et al., 2014, Lewis et al., 2014, McCabe et al., 2013). Second, people may not be aware of the risks associated with diversion and NMU (Johnston et al., 2015, U.S. Food and Drug Administration, 2015). Potential risks may be mitigated due to the routine prescription of controlled medications, the purity of pharmaceutical drugs compared with illicit drugs and the reduced legal risks associated with supply and possession (Topp, 2006). There may be a lack of information provided by health practitioners on the potential risks of diversion (Kennedy-Hendricks et al., 2016). In fact, the challenges in communicating such risks to patients have been acknowledged by practitioners themselves (Chen et al., 2014, Childers and Arnold, 2012).

The extant literature provides a comprehensive profile of people involved in diversion. Individuals who gift, sell or trade pharmaceutical drugs tend to endorse or participate in NMU. For PWUD and patients, those involved in diversion exhibit less compliant medication behaviours and tend to be more vulnerable in terms of substance use and social disadvantage. In American student populations, affiliation with 'Greek' societies elevates the risk of diversion, which is unsurprising given the strength of social networks in these types of groups. These findings may be used to inform risk assessment processes, which is likely to be particularly valuable given that research has shown that some practitioners face difficulties in identifying patients at risk of diversion (Larance et al., 2011c).

Despite the prominence of social supply, policies to date have largely focused on reducing access to pharmaceutical drugs for NMU from the medical system via practices such as doctor shopping. For example, PDMPs have been implemented widely throughout the US (Gabay, 2015) and plans for the roll-out of real-time prescription monitoring are currently underway in

Australia (State Government of Victoria, 2017)[7]. While such programs may have important deterrent effects, this review has found that sourcing pharmaceutical drugs for NMU illegitimately via the medical system is relatively uncommon. In fact, an important US study that linked medical and PDMP records, found that a majority of persons in the study who died from methadone-related overdoses were not flagged in the PDMP prior to death (Weimer et al., 2011), which echoes the findings of another recent study (Hawk et al., 2017). In order to reduce the risks of pharmaceutical NMU, including mortality, it is pertinent that practitioners and policy makers turn their attention to developing strategies for addressing the social supply of pharmaceutical drugs.

This review also found that the dealing and trading of pharmaceutical drugs occurs and street-based drug markets are a particularly common access point for PWUD. The black market for pharmaceutical drugs is a potentially lucrative industry with black market prices typically a lot higher than those in the legitimate market (Bachhuber and Cunningham, 2013, Bazazi et al., 2011, Elwood, 2001, Sajan et al., 1998, Winstock et al., 2009a)[8]. Pharmaceutical drugs are valuable commodities and particularly so in communities where people are experiencing the effects of withdrawal and may have inadequate access to treatment services (Allen and Harocopos, 2016, Duffy and Baldwin, 2012, Johnson and Richert, 2015b, Kaye et al., 2014). Evidence to date suggests that the pharmaceutical black market is dominated by small-scale dealers rather than organised criminal networks or gangs (Fountain et al., 2000, O'Reilly et al., 2007, Smith et al., 2007, Yearwood, 2012), though it will be important to continue to monitor this over time particularly as 'pill brokerage' and sponsorship arrangements have emerged in parts of the US (Green et al., 2013, Inciardi et al., 2009a, Inciardi et al., 2007a, Rigg et al., 2010, Worley and Thomas, 2014).

It is relevant to acknowledge the variable risks and harms associated with the NMU and diversion of different types of pharmaceutical drugs. There is evidence that opioids used in OST

[7] Subsequent to the publication of this paper, in October 2018 Victoria launched its real-time PDMP – ScriptWise.
[8] The profits from pharmaceutical black market supply were examined as part of this thesis – see **Chapter Five.**

such as methadone and buprenorphine are subject to NMU and diversion, with motivations ranging from the pursuit of euphoria, insufficient dosing, affordability, withdrawal management and in substitute of other drugs (Allen and Harocopos, 2016, Bazazi et al., 2011, Yokell et al., 2011). However, the highly regulated environment in which these drugs are prescribed for pharmacotherapy treatment (such as the use of supervised dosing) means that their diversion occurs infrequently and tends to involve only single doses (Johnson and Richert, 2015a, Larance et al., 2011a, Launonen et al., 2015, Winstock et al., 2008) and overall their use if associated with a substantial reduction in mortality risk (Sordo et al., 2017). It is when methadone is prescribed for pain that it is overrepresented in overdose deaths (Kuehn, 2012), which is likely to reflect the more flexible regulatory environment and thus, the elevated risk of diversion with limited oversight of take-home medication. Importantly, the NMU of opioids not used in treatment such as oxycodone and fentanyl are more commonly attributed to the risk in overdose deaths (UNODC, 2017b).

It has been acknowledged elsewhere that our understanding of pharmaceutical drug diversion reflects only the answers provided by the people whom we have asked (Inciardi and Cicero, 2009, Inciardi et al., 2009b). Indeed, this review has clearly demonstrated that research to date has overwhelming focused on populations of end-users and from these studies we consistently conclude that supply is largely driven by informal exchanges between persons known to one another. However, it is possible that other sourcing routes such as doctor shopping and online purchasing are more prevalent among pharmaceutical dealers who obtain the drugs for the purpose of distributing to others (Festinger et al., 2016, Inciardi et al., 2009b, Inciardi et al., 2010). It will be important for future research to seek to better understand the source of pharmaceutical drugs for those involved in supplying them, as this will contribute to a more complete understanding of the supply chain.[9]

[9] Research with people involved in pharmaceutical diversion and supply was conducted as part of this thesis – see **Chapter Three** and **Four.**

The broad scope of this review may be both a strength and limitation of the approach. It is strength because, to our knowledge, this is the first review to consolidate the evidence base from Australia, Canada, Europe and the US regarding the source and diversion of opioids, sedatives and stimulants for NMU. However, the broadness of the search strategy may have resulted in the inadvertent omission of key literature relating to specific source types or diversion mechanisms. Literature from non-English speaking European countries are likely to have been underrepresented in this review due to the restriction of records to English, which has potentially limited our ability to comment on pharmaceutical sourcing and diversion in these countries. Regarding the meta-analyses, the data were derived from studies that used different survey instruments, which limited our ability to precisely estimate the prevalence of pharmaceutical sourcing and diversion.

2.6.1 Conclusion

Despite the current policy focus on reducing access to pharmaceutical drugs via the medical system, this review finds that pharmaceutical opioids, sedatives and stimulants for NMU are primarily sourced through informal exchanges between friends and family, while doctor shopping and prescription forgery are relatively uncommon. Policy efforts should be targeted towards addressing the social supply of pharmaceutical drugs and people at particular risk of diversion, including patients displaying aberrant medication behaviours, people with substance use issues and students in fraternity/sorority environments. It will be important to continue monitoring the pharmaceutical black market, which is often argued to be a lucrative industry particularly among communities of PWUD. Future research should seek to better understand sourcing and diversion from the perspective of those involved in supplying pharmaceutical drugs for NMU.

3 Chapter Three: Diversion from the medical system and the role of health practitioners

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I certify that this publication was a direct result of my research towards this PhD, and that reproduction in this thesis does not breach copyright regulations.

Hulme, S., Hughes, C.E. & Nielsen, S. 2019. What factors contributed to the misconduct of health practitioners? An analysis of Australian cases involving the diversion and supply of pharmaceutical drugs for non-medical use between 2010 and 2016. *Drug & Alcohol Review*, 38, 366-376.

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3.2 Preamble

Chapter Three builds upon the findings of the systematic review and meta-analysis presented in **Chapter Two.** The review and meta-analysis identified that around one-third of end-users report accessing their pharmaceutical drugs for non-medical use (NMU) legitimately from the medical system via a prescription from a health practitioner and an additional one in ten access multiple prescribers through doctor shopping. As gatekeepers of the medical system, health practitioners have an important role to play in identifying and preventing pharmaceutical diversion, such as through appropriate prescribing practices and handling of drugs. Despite the apparent importance of this source in servicing the market for NMU, no prior research in Australia has systematically examined the circumstances surrounding diversion from the medical system or the role of health practitioners in this process. This means that opportunities for intervention are limited or not known. This paper aimed to fill this gap by identifying factors that contributed to problematic prescribing/supply and misappropriation of pharmaceutical drugs by Australian health practitioners. This study involved a comprehensive search of Australia's most serious and detected cases of health practitioner misconduct between 2010 and 2016. In doing so, this study provides the first indication as to the scale of this type of misconduct and its contribution to pharmaceutical diversion as a whole in Australia and any differences by practitioner type (e.g. nurses, pharmacists, doctors).

3.3 Abstract

Introduction and Aims: Increasing quantities of pharmaceutical drugs are used non-medically around the world, including in Australia, resulting in rising harms. This study examines the role of health practitioners in diversion and the circumstances surrounding their misconduct in Australia.

Design and Methods: Tribunal decisions were obtained from the Australasian Legal Information Institute for 117 complaints against health practitioners for inappropriately prescribing/supplying or misappropriating drugs, representing a comprehensive search of cases from 2010 to 2016. Bivariate and multivariate logistic regressions were used to examine patterns of misconduct by demographics, drug type, scale and contributors.

Results: Cases involving inappropriate prescribing/supply (73%) had greater odds of involving doctors (adjusted odds ratio (AOR) 48.18, 95% confidence interval (CI) 3.63-640.11) and pharmacists (AOR 85.59, 95% CI 5.08-1443.05) and health practitioners over 50 years (AOR 16.54, 95% CI 2.80-97.60) and lower odds of being attributed to individual circumstances (AOR 0.06, 95% CI 0.01-0.57). Cases involving misappropriation (31%) had greater odds of involving nurses (AOR 19.86, 95% CI 2.50-157.93), health practitioners under 40 years (AOR 5.08, 95% CI 1.24-20.90) and being attributed to individual circumstances (AOR 7.96, 95% CI 1.52-41.75). Subgroup analyses indicated that doctors were more likely to inappropriately prescribe pharmaceutical opioids, sedatives and Schedule 8 drugs, and their misconduct was attributed to lacking the skills and temperament to manage complex patient groups, while pharmacists were more often involved in pseudoephedrine supply for financial reasons.

Conclusion: Strategies to reduce diversion should be multifaceted and may include better supporting health practitioners to manage complex patient groups and removing barriers to substance use treatment for health practitioners.

Key words: Pharmaceutical diversion, prescription drug misuse, health practitioner misconduct, overprescribing, supply

3.4 Introduction

Pharmaceutical drugs are being increasingly diverted from the medical system and used non-medically around the world including in Australia, Canada, Europe, the United Kingdom (UK) and the United States (US) (UNODC, 2018). Non-medical use (NMU) involves the consumption of a prescription or over-the-counter (OTC) drug for non-therapeutic purposes or other than directed by a health practitioner (Barrett et al., 2008, Larance et al., 2011b). Pharmaceutical NMU is a major public health issue. In 2016, there were over 17,000 deaths attributed to pharmaceutical opioids in the US (Centers for Disease Control and Prevention, 2017b). In Australia, a drug-related death was more likely to result from a pharmaceutical than an illicit drug – a trend that has been rising steadily over the past decade (ABS, 2017, Roxburgh et al., 2018).

A recent international review found one-third (29%) of people engaged in NMU access pharmaceuticals from a health practitioner for the treatment of legitimate symptoms (Hulme et al., 2018) (**Chapter Two**). A further 7% access pharmaceuticals illegitimately from the medical system through doctor shopping (Hulme et al., 2018). Another Australian study found that doctor shopping represents an important source of drugs accessed by people involved in the unlawful supply of large quantities of pharmaceuticals (Hulme et al., 2019b) (forthcoming in **Chapter Four**), echoing research from the US that indicates the high utilisation patterns of people involved in doctor shopping (McDonald and Carlson, 2013). Clearly the medical system is a key access point for pharmaceutical drugs for NMU.

Problematic prescribing by health practitioners has been identified as a key driver of overdose deaths in the US (Pacula and Powell, 2018, Rose et al., 2018). A recent US study examined prescribing practices from 2006 to 2015 and found that in 28.5% of visits where opioids were prescribed, no pain diagnosis was recorded (Sherry et al., 2018). The authors called for clearer documentation to justify the clinical necessity of opioid prescribing (Sherry et al., 2018). The liberal prescribing practices of ‘script doctors’ in pain clinics or ‘pill mills’ in the US, is attributed to the profitability of the medications and pressure from patients (Inciardi et al., 2006,

Rigg et al., 2010). The challenges for health practitioners in identifying patients at-risk of diversion (Blanchard et al., 2016, Childers and Arnold, 2012, Sheridan and Butler, 2011) and negotiating with 'drug-seekers' (James, 2016), as well as increases in prescribing rates (Centers for Disease Control and Prevention, 2017a), have provided the basis for the widespread implementation of prescription drug monitoring programs (PDMPs) (or real-time prescription monitoring/tracking) in the US (Gabay, 2015, Hawk et al., 2017, Pardo, 2016, Pradel et al., 2009, Worley, 2012). Other jurisdictions have begun to follow suit, including Australia (State Government of Victoria, 2017)[10].

In addition to problematic prescribing, diversion of pharmaceutical drugs by health practitioners from the workplace has been identified (Berge et al., 2012, Drugs and Crime Prevention Committee, 2007, Inciardi et al., 2006, Pilgrim et al., 2016). An Australian study found that one-fifth of health practitioners who died from drug-related deaths between 2003 and 2013, sourced the medications directly from their workplace (Pilgrim et al., 2016). Diversion via substitution or tampering poses serious risks to patients including under-treatment of pain, as well as infection (Berge et al., 2012).

While diversion appears to be growing in Australia, to our knowledge, there have been no attempts to systematically examine the circumstances surrounding diversion from the medical system and the role of health practitioners in this process. Thus, challenging the development of effective and targeted solutions. This is a difficult area to research and quantify due to the covert nature of the conduct and potential privacy issues. The purpose of this study was twofold. First, to identify in what ways Australian health practitioners are involved in the diversion and supply of pharmaceutical drugs for NMU and second, to better understand what factors contributed to their involvement.

[10] Subsequent to this publication, a PDMP was launched in Victoria.

3.5 Methods

3.5.1 Data source

In Australia, anyone can voluntarily complain or raise a concern about the health, conduct or performance of a registered health practitioner. Registered health practitioners, employers and education providers also have professional and ethical obligations to make mandatory notifications in some circumstances (AHPRA, 2018a). The Australian Health Practitioner Regulation Agency (AHPRA) in partnership with 14 National Boards manages the complaints process. The most serious allegations that may warrant the suspension or cancellation of the health practitioner's registration are referred to jurisdictional tribunals for a hearing. Tribunal decisions are published and freely available via the Australasian Legal Information Institute (AustLII), summarising the particulars of the complaint and reasons for the decision (AustLII, 2017).

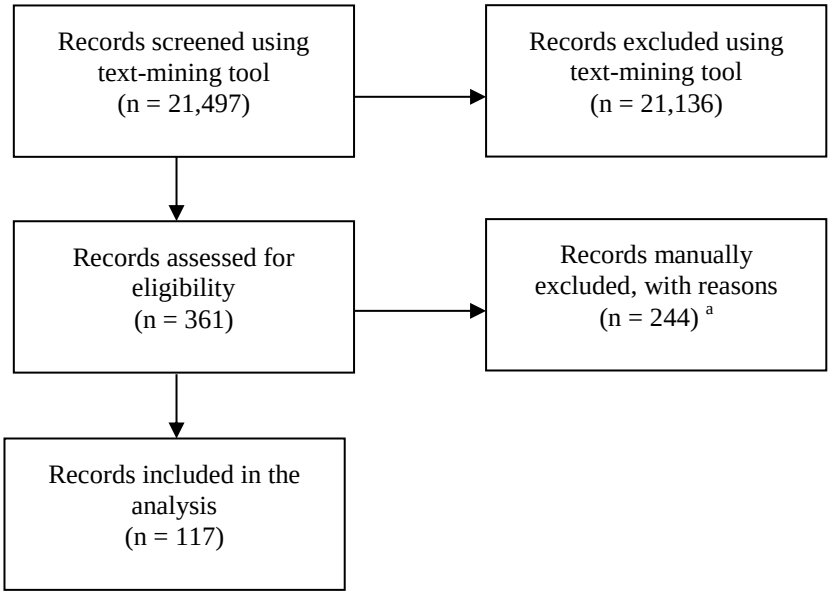
3.5.2 Search process and case selection

We accessed tribunal decisions for complaints against health practitioners for the inappropriate prescribing/supply or misappropriation of drugs, using a purpose-built text mining tool that allowed for the automated searching of the AustLII website. Two sets of search terms were developed following a review of a selection of relevant cases from each jurisdiction. The first included the name of each National Board (e.g. 'Medical', 'Pharmacy') and the second related to the nature of the complaint (e.g. 'drug', 'misuse', 'controlled substance') (see Appendix 3A for details). Two of the jurisdictions were manually searched and the results were compared with that of the text-mining tool, to confirm that all the relevant cases were captured.

As shown in Figure 3.1, the text-mining tool returned 361 decisions for cases heard between 1 July 2010 and 31 December 2016. After screening, 244 were excluded (see Appendix 3B for reasons) and a final sample of 117 remained. Each case represents the conduct of a unique practitioner, though may involve multiple complaints. There were 11 cases for which more than one record was retrieved for the same health practitioner. These were matched using the health practitioner's demographic information and analysed as one case. The start date coincided with

the regulation of health practitioners under the National Registration and Accreditation Scheme and the commencement of the National Law *(Health Practitioner Regulation National Law Act 2009)* (AHPRA, 2015). This study received ethical approval from the University of New South Wales (UNSW) (#HC17122).

Figure 3.1. Search results from Australasian Legal Information Institute



Notes: Exclusions with reasons are provided in Appendix 3B.

3.5.3 Data extraction

A standardised coding form was developed to extract consistent information from each case, including demographics, complaint particulars and reasons for the decision – that is, factors deemed by the tribunal to have contributed to the misconduct based on facts of the case, statements from respondents, witnesses and experts (see Appendix 3C for codebook and Appendix 3D for missing values). The codes were developed using an inductive approach, whereby a sample of cases were initially coded and the categories were refined based on emergent themes (Fereday and Muir-Cochrane, 2006).

In the absence of a standardised approach for classifying the scale of misconduct, a proxy variable was created using information available from each case on the number of patients affected and the duration of misconduct. Additionally, cases were 'flagged' if the tribunal

specified that high quantities of drugs were involved. The classification of scale employed a 'cascading principle' – an approach that has been used elsewhere, including for the assignment of drug schedules (TGA, 2018d) – in which the conduct was first assessed using the criteria for low scale. If all the criteria applied, the misconduct remained at that level, if not, the conduct was assessed against the moderate scale criteria, and, if warranted, subsequently against the large-scale criteria. Additionally, cases with a quantity 'flag' were classified as large scale, irrespective of the number of patients and duration of misconduct. The criteria are provided in Table 3.1 and Appendix 3F classifies a sample of cases.

Table 3.1. Criteria for classification of scale of misconduct

Criteria	Low	Moderate	Large
Patients affected	0 – 5 patients	6 – 10 patients	> 10 patients
Duration of misconduct	< 1 year	1 – 5 years	> 5 years
Misconduct classified as:	Small if all in this category; otherwise assess against higher level	Moderate if all in this category; otherwise assess against higher level	Large if any in this category or large quantity 'flag' identified[a]

Notes: [a)] Cases were 'flagged' if the tribunal remarked that high quantities of drugs were involved (either through an extensive list of substances or remarks in relation to their high monetary value or weight).

3.5.4 Analysis

First, frequency distributions were used to examine health practitioner demographics, nature of conduct and contributing factors. Second, bivariate logistic regressions were used to examine the association between the health practitioner's involvement in inappropriate prescribing/supply and misappropriation (dependent variables) and the following independent variables:

- demographics (gender, age (proxy), profession, overseas trained, prior misconduct)
- drug type (opioids, sedatives, stimulants, performance and image enhancing drugs (PIEDs))
- drug class (Schedule 3, 4/4D, 8)
- scale of misconduct (low, moderate, large)
- contributing factors.

There were four cases involving both inappropriate prescribing/supply and misappropriation, so these groups are not mutually exclusive and separate analyses were undertaken for each. Third, multivariate logistic regressions were performed to control for potential confounders. To assess whether overfitting was an issue the optimism bias was estimated using bootstrapping (50 repetitions) and a bias-corrected confidence interval (CI) for the area under the curve (AUC) presented. Hosmer-Lemeshow (Hosmer and Lemeshow, 2013) tests examined model fit and associations were set for statistical significance at the $p < 0.05$ level. Finally, subgroup analyses using Pearson's chi-square examined differences in conduct between doctors and pharmacists involved in inappropriate prescribing/supply. There was one case involving a dentist, which was omitted from the bivariate and multivariate analyses. All analyses were conducted using Stata Version 15.0 (StataCorp, 2017).

3.6 Results

3.6.1 Description of cases

There were a total of 117 cases identified from 2010 to 2016, with over half (62%, n=72) heard between 2014 and 2016 (Table 3.2). Most of the cases were from New South Wales (NSW) and Queensland. Three-quarters (74%, n=87) of the health practitioners were male and half each were aged under 50 (51%, n=59) and over 50 years (49%, n=57). The cases primarily involved doctors (52%, n=61), followed by pharmacists (32%, n=37) and nurses (15%, n=18). In the 60 cases where it was mentioned, two-thirds (67%, n=40) gained their primary qualifications in Australia and one-third (33%, n=20) were initially trained overseas, primarily in Asia.

Table 3.2. Sample characteristics

	n (%)
Jurisdiction of hearing	
ACT	4 (3.4)
NSW	52 (44.4)
QLD	28 (23.9)
SA	9 (7.7)
TAS	2 (1.7)
VIC	21 (18.0)
WA	1 (0.85)
Year of hearing	
2010	7 (6.0)
2011	16 (13.7)
2012	14 (12.0)
2013	8 (6.8)
2014	28 (24.0)
2015	25 (21.4)
2016	19 (16.2)
Demographics	
Male	87 (74.4)
Female	30 (25.6)
Age (proxy) [a]	
25 to 30 years	9 (7.7)
31 to 40 years	30 (25.9)
41 to 50 years	20 (17.2)
51 to 60 years	25 (21.6)
Over 60 years	32 (27.6)
Profession	
Doctor	61 (52.1)
Pharmacist	37 (31.6)
Nurse	18 (15.4)
Dentist	1 (0.9)
Continent where qualified	
Australia	40 (34.2)
Asia	12 (10.3)
Europe	5 (4.3)
Africa	2 (1.7)
New Zealand	1 (0.9)
Not stated	57 (48.7)
Prior disciplinary action	
Yes	26 (22.2)
No	29 (25.0)
Not stated	61 (53.0)

Notes:

[a)] Includes the 13 cases where age not known, and these cases assigned to the median category for that profession (i.e. doctors (51 to 60 years), pharmacists and nurses (31 to 40 years)). See Appendix 3C for further detail. N = 117.

Almost three-quarters of the cases (73%, n=85) involved inappropriate prescribing/supply and just under one-third (31%, n=36) involved the misappropriation of drugs from the workplace (Table 3.3). The supply cases mainly involved the prescribing/supply of drugs in greater quantities than clinically required or before the prescription ought to have depleted. Of the 85 prescribing/supply cases, 66% (n=56) involved multiple types of problematic supply. Most commonly, oversupply to: persons with a substance use disorder (27%, n=31), involved in the manufacture of illicit substances (14%, n=16) and in the image enhancement community (13%, n=15). Where drugs were misappropriated, this most commonly involved the direct theft of workplace supplies (28%, n=32) and there were six cases where drugs were taken or substituted from a patient.

Over half the cases involved pharmaceutical opioids (56%, n=65), mainly oxycodone (n=38), morphine (n=30) and pethidine (n=10). Just under half involved sedatives (43%, n=50), mainly diazepam (n=29), temazepam (n=16) and alprazolam (n=13). Nearly two-thirds (62%, n=72) involved Schedule 4/4D drugs and over half (56%, n=65) involved Schedule 8 drugs.

Half of the cases (50%, n=59) were classified as large-scale, whereby there was more than 10 patients affected (maximum of 140 patients), the misconduct extended for a period of more than five years (maximum of 12 years) or there were large quantities of drugs involved (e.g. $10,000 value, 1,600 prescriptions).

In 40% (n=47) of cases the health practitioner's registration was cancelled. In 21% (n=24) of cases the health practitioner's registration was suspended for a specified period and of these, 23 had conditions imposed on their registration when they resumed practice. In 28% (n=33) of cases the health practitioner was able to continue practicing, but a series of health (e.g. attend education, treatment, counselling) or practice conditions (e.g. reporting, prohibiting the possession, administration, prescribing or supply of certain medications) were imposed.

Table 3.3. Nature of misconduct

Nature of misconduct	n (%)
Inappropriate supply [a]	85 (72.6)
Oversupply	69 (59.0)
To patient with known substance use disorder	31 (26.5)
To person for manufacture of illicit substances	16 (13.7)
To image enhancement community	15 (12.8)
To family or friend	8 (6.8)
Pre / post-dating prescriptions	5 (4.3)
Supply from illegitimate or invalid prescriptions	4 (3.4)
Unauthorised supply [b]	31 (36.5)
Misappropriation [a]	36 (30.8)
Theft	32 (27.4)
Direct theft of workplace supplies	24 (20.5)
Misappropriation from a patient	6 (5.1)
Theft of leftover or discarded drugs	2 (1.7)
Forgery	16 (13.7)
Creating false patient records / prescriptions	11 (9.4)
Forging another practitioners information	5 (4.3)
Self-prescribing	1 (0.9)
Drug class [a]	
Opioids	65 (55.6)
Sedatives	50 (42.7)
PIEDs	29 (24.8)
Pseudoephedrine	18 (15.4)
Stimulants [c]	10 (8.5)
Antidepressants/antipsychotics	5 (4.3)
Drug schedule [a]	
Schedule 2	1 (0.9)
Schedule 3	19 (16.2)
Schedule 4/4D	72 (61.5)
Schedule 8	65 (55.6)
Scale of misconduct	
Small	30 (25.6)
Moderate	28 (23.9)
Large	59 (50.4)
Sanction imposed [a]	
Pay costs of tribunal	64 (54.7)
Reprimand	51 (43.6)
Health or practice conditions	56 (47.9)
Registration cancellation or disqualification	47 (40.2)
Registration suspension	24 (20.5)
Nil	4 (3.4)
Pay fine	3 (2.6)

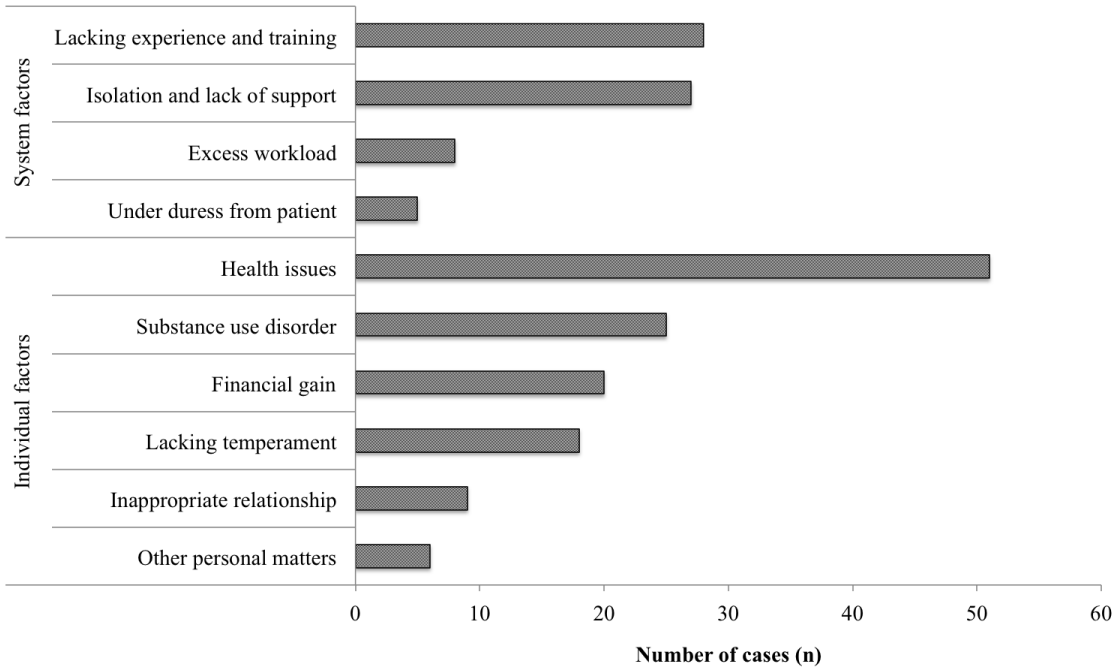
Notes: [a)] Not mutually exclusive, totals do not add to 100%.
[b)] Unauthorised supply cases only included if this conduct co-occurred with another problematic supply practice.
[c)] Excluding pseudoephedrine. N = 117.

3.6.2 Contributing factors

The factors deemed by the tribunal to have contributed to the misconduct of the health practitioner fell into two broad categories: individual or system-level (Figure 3.2). In under half of the cases (44%, n=51), the misconduct was attributed to personal health issues, such as chronic pain, sleep disorders and mental health problems. Substance use disorders also affected health practitioners in just under one-quarter of cases (21%, n=25). There were 20 cases (17%) where the misconduct was financially motivated.

The most common system-level factor was a lack of experience and training (24%, n=28), most notably in relation to prescribing regulations, the management of challenging patient groups and the identification of medication diversion. Lack of support was also a common contributor (23%, n=27), due to geographical remoteness, as well as inadequate mentoring and oversight within a practice environment.

Figure 3.2. Factors attributed to misconduct



Notes: There may be multiple contributing factors, so the categories are not mutually exclusive. N=117.

3.6.3 Factors contributing to inappropriate supply

The bivariate regressions examined what factors impacted on the likelihood of health practitioners being involved in inappropriately prescribing/supplying drugs compared with those not involved in supply (Table 3.4). Specifically, being male rather than female (OR 5.00, 95% CI 2.03, 12.29), a doctor (OR 46.22, 95% CI 9.04, 236.25) or pharmacist (OR 34.29, 95% CI 6.36, 184.80) rather than nurse, and older; aged over 50 years rather than under 40 years (OR 8.075, 95% CI 2.82, 23.16) increased the likelihood of being involved in problematic prescribing/supply. These cases were also more likely to be large scale (OR 8.49, 95% CI 2.92, 24.66) rather than low scale and involve PIEDs (OR 4.33, 95% CI 1.21, 15.52) or Schedule 3 medications (OR 8.46, 95% CI 1.08, 66.23). System-level factors (OR 6.72, 95% CI 1.49, 30.26), namely a lack of training (OR 14.68, 95% CI 1.90, 113.30) and isolation or a lack of support (OR 3.87, 95% CI 1.08, 13.90) were more likely than not to be attributed to the prescribing/supply cases.

The multivariate model was statistically significant ($\chi^2(7)=71.73$, $p<0.001$) and correctly classified 87.07% of cases (Table 3.4). Being older; aged 50 years or over rather than under 40 years (AOR 16.54, 95% CI 2.80, 97.60), a doctor (AOR 48.18, 95% CI 3.63, 640.11) or pharmacist (AOR 85.59, 95% CI 5.08, 1443.05) rather than nurse remained significant in the multivariate model. The latter is perhaps unsurprising given that it is these health practitioners that are primarily responsible for prescribing/supplying drugs to the public. Inappropriate prescribing/supply was less likely than not to manifest due to individual-level factors (AOR 0.06, 95% CI 0.01, 0.57).

Table 3.4. Logistic regression predicting involvement in inappropriate supply [a]

Independent variables		Bivariate			Multivariate		
		OR	**95% CI**	***p***	**AOR**	**95% CI**	***p***
Demographics							
Gender (ref = female)	Male	5.000	2.033, 12.294	0.00**	3.307	0.692, 15.799	0.134
Age (ref = under 40 years)	41 to 50 years	1.764	0.580, 5.369	0.32	1.292	0.255, 6.538	0.757
	Over 50 years	8.075	2.816, 23.156	0.00**	16.536	2.802, 97.596	0.002**
Profession (ref = nurse)	Doctor	46.222	9.043, 236.247	0.00**	48.177	3.626, 640.112	0.003**
	Pharmacist	34.286	6.361, 184.798	0.00**	85.593	5.077, 1443.045	0.002**
Overseas trained (ref = no)	Yes	1.473	0.497, 4.368	0.49			
Prior misconduct (ref = no)	Yes	0.818	0.315, 2.126	0.68			
Nature of misconduct							
Drug class (ref = no)	Opioids	0.549	0.236, 1.280	0.17			
	Sedatives	0.81	0.357, 1.826	0.61			
	Stimulants [b]	0.538	0.141, 2.050	0.97			
	PIEDs	4.333	1.210, 15.516	0.01**			
Drug schedule (ref = no)	Schedule 3	8.455	1.079, 66.228	0.01**			
	Schedule 4/4D	1.588	0.696, 3.626	0.27			
	Schedule 8	0.477	0.201, 1.128	0.09			
Scale of misconduct (ref = low)	Moderate	2.286	0.780, 6.694	0.13			
	Large	8.49	2.923, 24.661	0.00**			

Independent variables		Bivariate			Multivariate		
		OR	**95% CI**	***p***	**AOR**	**95% CI**	***p***
Contributors							
Ref = no	Individual	0.119	0.0337, 0.422	0.00**	0.06	0.006, 0.573	0.015*
	Personal and health issues	0.098	0.036, 0.267	0.00**			
	Substance use disorder	0.017	0.004, 0.066	0.00**			
	Financial gain	2.453	0.667, 9.021	0.15			
	System	6.724	1.494, 30.264	0.00**	3.487	0.423, 28.735	0.246
	Lacking training	14.684	1.903, 113.303	0.00**			
	Isolation and lack of support	3.867	1.076, 13.900	0.02*			

Notes:

[a)] Excludes one case involving a dentist.

[b)] Excluding pseudoephedrine. All the pseudoephedrine cases were supply-related, so this variable has been omitted from the analyses.

PIED = performance and image enhancing drugs, CI = confidence interval, OR = odds ratio, AOR = adjusted odds ratio, p = p-value, * $p < 0.05$ ** $p < 0.01$.

Multivariate model $X^2(7) = 71.73$, $p < 0.001$. Pseudo R Squared = 0.5249. Hosmer–Lemeshow goodness of fit test, $p = 0.5303$, AUC = 0.9306, Bias-corrected 95% CI 0.821, 0.966, N = 116.

Subgroup analyses revealed that the drug class, schedule and factors contributing to inappropriate prescribing/supply varied for doctors (n=52) and pharmacists (n=30) (see Appendix 3G). Compared with pharmacists, doctors involved in inappropriate prescribing were significantly more likely to involve opioids ($\chi^2(1)=19.96$, $p<0.01$), sedatives ($\chi^2(1)=13.09$, $p<0.01$) and Schedule 8 drugs ($\chi^2(1)=19.96$, $p<0.01$), and the conduct was more likely to be attributed to them lacking the temperament for managing the demands of drug-seeking patients ($\chi^2(1)=6.45$, $p<0.05$). Whereas supply cases involving pharmacists were more likely to involve pseudoephedrine ($\chi^2(1)=16.87$, $p<0.01$) and Schedule 3 drugs ($\chi^2(1)=16.87$, $p<0.01$), and their conduct was significantly more likely to be financially motivated ($\chi^2(1)=22.21$, $p<0.01$).

3.6.4 Factors contributing to misappropriation

The bivariate regressions examined what factors impacted on the likelihood of health practitioners being involved in the misappropriation of drugs from the workplace compared with those not involved in misappropriation (Table 3.5). Specifically, being female rather than male (OR 4.61, 95% CI 1.91, 11.16), a nurse rather than doctor (OR 32.67, 95% CI 6.60, 161.77) and younger; aged under 40 years rather than over 50 years (OR 4.47, 95% CI 1.77, 11.29) increased the likelihood of misappropriation. These cases were more likely to be small (OR 9.71, 95% CI 3.33, 28.31) or moderate scale (OR 5.94, 95% CI 1.99, 17.76) rather than large scale. Individual circumstances (OR 7.24, 95% CI 2.34, 22.37), namely personal and health issues (OR 14.05, 95% CI 5.13, 38.50) and substance use disorders (OR 69.0, 95% CI 14.51, 328.24) were more likely than not to be attributed to misappropriation cases.

The multivariate model was statistically significant ($\chi^2(7)=58.79$, $p<0.001$) and correctly classified 83.62% of cases (Table 3.5). Being a nurse rather than doctor (AOR 19.86, 95% CI 2.50, 157.93), younger; aged less than 40 years rather than over 50 (AOR 5.08, 95% CI 1.24, 20.90) and individual-level contributors (AOR 7.96, 95% CI 1.52, 41.75) remained significant in the multivariate model.

Table 3.5. Logistic regression predicting involvement in misappropriation [a]

Independent variables		Bivariate			Multivariate		
		OR	**95% CI**	***p***	**AOR**	**95% CI**	***p***
Demographics							
Gender (ref = male)	Female	4.610	1.906, 11.159	0.00**	2.658	0.726, 9.728	0.14
Age (ref = over 50 years)	Under 40 years	4.470	1.766, 11.288	0.00**	5.081	1.235, 20.904	0.02*
	41 to 50 years	2.530	0.806, 7.950	0.112	4.208	0.941, 18.824	0.06
Profession (ref = doctor)	Pharmacist	1.126	0.412, 3.079	0.82	0.634	0.161, 2.490	0.514
	Nurse	32.667	6.597, 161.766	0.00**	19.856	2.496, 157.934	0.01*
Overseas trained (ref = no)	Yes	0.741	0.265, 2.070	0.56			
Prior misconduct (ref = no)	Yes	1.235	0.490, 3.116	0.66			
Nature of misconduct							
Drug class (ref = no)	Opioids	1.683	0.749, 3.780	0.20			
	Sedatives	0.918	0.414, 2.036	0.83			
	Stimulants [b]	3.800	1.001, 14.424	0.05*			
	PIEDs	0.275	0.088, 0.861	0.01*			
Drug schedule (ref = no)	Schedule 3	0.098	0.013, 0.769	0.03*			
	Schedule 4/4D	0.602	0.271, 1.339	0.21			
	Schedule 8	1.902	0.838, 4.319	0.12			
Scale of misconduct (ref = high)	Small	9.714	3.333, 28.310	0.00**			
	Moderate	5.943	1.988, 17.763	0.00**			

Independent variables		Bivariate			Multivariate		
		OR	**95% CI**	***p***	**AOR**	**95% CI**	***p***
Contributors							
Ref = no	Individual	7.238	2.342, 22.368	0.00**	7.959	1.517, 41.747	0.02*
	Personal and health issues	14.048	5.126, 38.497	0.00**			
	Substance use disorder	69.000	14.505, 328.242	0.00**			
	Financial gain	0.337	0.092, 1.233	0.07			
	System	0.122	0.027, 0.548	0.00**	0.227	0.362, 1.429	0.114
	Lacking training	0.056	0.007, 0.432	0.00**			
	Isolation and lack of support	0.212	0.059, 0.759	0.01**			

Notes:

[a)] Excludes one case involving a dentist.

[b)] Excluding pseudoephedrine. None of the pseudoephedrine cases were supply-related, so this variable has been omitted from the analyses.

PIED = performance and image enhancing drugs, CI = confidence interval, OR = odds ratio, AOR = adjusted odds ratio, p = p-value, * $p < 0.05$ ** $p < 0.01$.

Multivariate model $X^2(7) = 58.79$, $p < 0.001$, Pseudo R Squared = 0.4091, Hosmer-Lemeshow goodness of fit test, $p = 0.2958$, AUC = 0.8927, Bias-corrected 95% CI 0.780, 0.962, N = 116.

3.7 Discussion

To our knowledge, this is the first Australian study, and one of only a few internationally, to systematically examine the misconduct of health practitioners who have been involved in the diversion and supply of pharmaceutical drugs and to contextualise the circumstances surrounding this misconduct. The findings of this study may be used to inform the development of strategies to better identify and support health practitioners at risk of misconduct and thus, reduce the harms associated with diversion and NMU.

This study examined 117 Australian cases of misconduct between 2010 and 2016. Importantly, the health practitioners in these cases represent less than 0.001% of Australia's health workforce as of 2015, when there were approximately 437,276 medical or dental practitioners, nurses or midwives, and pharmacists employed (Department of Health, 2017a). This suggests that known cases of unethical handling and supply of pharmaceutical drugs by Australian health practitioners is infrequent, which is consistent with what is known internationally (Stein et al., 2015). However, the true extent of misconduct is reliant on accurate detection and reporting. Although the conduct of health practitioners represents one important intervention point, approaches to reduce diversion should be multifaceted (Pacula and Powell, 2018, RAND Corporation, 2018) and comprehensively address the range of medical and non-medical sources used, including social networks and black market dealers.

Almost three-quarters of the cases involved the inappropriate prescribing/supply of drugs, most commonly in greater quantities than clinically required. In these cases, health practitioners were often detected overprescribing drugs to specific patient groups, namely people with a substance use disorder, in the image enhancement community and involved in the manufacture of illicit drugs. Multivariate analyses showed that the factors contributing to problematic prescribing/supply were less likely to be related to the health practitioner's individual circumstances.

The nature of inappropriate prescribing/supply differed by profession. Compared with pharmacists, cases involving doctors were more likely to involve opioids, sedatives and

Schedule 8 drugs. While doctors and other health practitioners have a responsibility to manage patient demands, those implicated were described as lacking the adequate skills and training to do so. The tendency to overprescribe was exacerbated in isolated work environments without adequate supports, and which may also have contributed to delays in the detection of these cases. Notably, just under half (47%) of all the cases resulted in conditions being imposed on the practitioner's registration. This often-included education or training, such as a medical ethics course or a period of supervised practice and mentoring, highlighting the need for early intervention to ensure ethical prescribing and prevent serious instances of misconduct and potentially significant harms. The lack of training and support for health practitioners in relation to the management of drug dependency and chronic pain, the identification and prevention of diversion and the availability of non-opioid alternatives, have been discussed in other contexts, including the US, Canada and New Zealand (Childers and Arnold, 2012, Leong et al., 2016, Pacula and Powell, 2018, RAND Corporation, 2018, Sheridan and Butler, 2011). There are some similarities here to the 'script doctors' described in the US (Inciardi et al., 2006, Rigg et al., 2010), only there is limited evidence in our sample that the supply practices by doctors were profit-driven.

As with other countries, Australia has guidelines for prescribing drugs of dependence in general practice (RACGP, 2015) that are intended to assist health practitioners and ensure that the quality and integrity of the treatment system is maintained (Bell, 2010). However, the tribunals routinely highlighted that in these misconduct cases, prescribing patterns deviated from the recommended practice. The implementation of comprehensive and real-time PDMPs may strengthen the decision-making tools available to health practitioners, whilst also enhancing accountability (Moyo et al., 2017, Pacula and Powell, 2018, Pardo, 2016). Additionally, state-based advisory services, such as the St Vincent's Hospital Drug & Alcohol Specialist Advisory Service in NSW, may further support health practitioners to adequately manage patients with complex needs.

In a different manner of conduct, pharmacists were more likely than doctors to inappropriately supply Schedule 3 drugs including codeine and pseudoephedrine. The high frequency of cases involving Schedule 3 drugs may reflect the time period of this analysis from 2010 to 2016, which was prior to the up-scheduling of codeine to a Schedule 4 drug in 2018 (TGA, 2018b). Pseudoephedrine holds considerable value on the black market for its use as a precursor to meth/amphetamine production (Ritter et al., 2012). *Project STOP*, an electronic monitoring system designed to reduce pseudoephedrine diversion, was implemented nationally in Australia in 2008 via a mixture of compulsory and voluntary schemes. Most of the pseudoephedrine cases in our sample occurred in Queensland where the use of *Project STOP* is mandatory and were classified as large scale. Typically, these cases involved pharmacists selling pseudoephedrine, sometimes at inflated prices, despite *Project STOP* notifications arising. While mandatory schemes improve uptake among pharmacies (Devaney et al., 2015, Ferris et al., 2016), even so, *Project STOP* was not found to impact on the production possession, distribution or importation of meth/amphetamine up until 2011 (Mazerolle et al., 2016). Further research on the efficacy of *Project STOP* is needed to assess whether outcomes have improved over time and the potential role of these cases in deterring misconduct by other health practitioners.

Around one-third of the cases involved health practitioners misappropriating drugs from their workplace, usually via direct theft. These cases were mainly low or moderate scale and the drugs were typically misappropriated for personal use in relation to health problems or a substance use disorder. This is consistent with evidence that health practitioners are at an elevated risk of mental health problems and substance use disorders (Breen, 1998, Kaufmann, 2002). Mandatory reporting may act as a disincentive to health practitioners seeking help (The Australian Medical Association, 2018) and the removal of such barriers may improve outcomes for health practitioners and reduce harms for patients who are at-risk of having their medications diverted or tampered with.

3.7.1 Limitations

There are several caveats to consider with these findings. First, our sample comprised the most serious, detected incidents of misconduct in Australia and omitted cases that were unreported or less serious and heard in private panels and for which case summaries were not publicly available. Thus, our sample may not be representative of all misconduct by health practitioners of this nature. Second, the tribunal decisions varied in length and detail. The omission of key information from the decisions may have influenced the patterns of conduct identified herein. An absence of information does not necessarily suggest non-existence of that factor, which should be borne in mind in interpretation of the results. Finally, it is unclear to what extent the tribunal hearings were shaped by legal direction aimed at mitigating the perception of risk posed by the health practitioner. Future research may examine the circumstances of misconduct from the perspective of health practitioners themselves.

3.7.2 Conclusion

A small proportion of health practitioners contribute to the growing problem of pharmaceutical diversion in Australia through both intentional and unintentional misconduct. Analysis of a comprehensive sample of tribunal decisions indicates that in cases involving the inappropriate prescribing of drugs by doctors, the misconduct typically manifests due to gaps in the training and support systems for managing drug dependency and chronic pain and identifying and preventing diversion. In our sample, problematic supply by pharmacists more often involved the deliberate diversion of precursors, namely pseudoephedrine. Misappropriation by health practitioners from the workplace was typically smaller scale and attributed to the complex needs of the health practitioner, including health and substance use problems. Misconduct of this nature is diverse, warranting nuanced and multifaceted policy responses.

4 Chapter Four: Drug sources and motivations for pharmaceutical diversion and supply

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I certify that this publication was a direct result of my research towards this PhD, and that reproduction in this thesis does not breach copyright regulations.

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4.2 Preamble

Chapter Four builds upon the findings of **Chapter Two** that identified an abundance of research on pharmaceutical sourcing and diversion for non-medical use (NMU) from the perspective of end-users and a concomitant lack of research that has captured the perspective of suppliers. This has meant that while there is now a solid evidence base connecting end-users to drugs, with the exception of some limited research in the US (see for example Inciardi et al. (2009a), Rigg et al. (2012)), the chain of supply beyond this is not known. The absence of research with people involved in diversion and supply is likely to partly reflect the challenges associated with accessing this hidden population (Caulkins, 2007).

Chapter Three went someway to addressing this gap by exploring the circumstances surrounding diversion and supply from the medical system and the role of health practitioners. **Chapter Four** furthers these efforts by accessing a sample of active suppliers to understand diversion and supply from other avenues such as between friends and family and by illicit dealers. In doing so, this study captures the breadth of access routes and drivers, as well as the interrelationships between source, motives and supply practices, including the quantity and frequency supplied. This study is important for understanding how pharmaceutical drugs are supplied on the black market and to what extent the methods and motivations differ to the supply of illicit drugs like cannabis, cocaine, heroin and meth/amphetamine, where the evidence base is much more established.

4.3 Abstract

Background: The NMU of pharmaceuticals is increasing internationally, along with mortality. Previous research indicates that end-users access pharmaceuticals through social networks, however little is known about supplier sources particularly outside the US. This study examined sourcing and motivations among a sample of people involved in pharmaceutical diversion and supply in Australia.

Methods: Semi-structured, telephone interviews were conducted with 51 people involved in supplying pharmaceuticals in the previous six months. Multi-stage recruitment involved the distribution of flyers to participants of two Australian drug-monitoring programs: the Ecstasy and related Drugs Reporting System (EDRS) (capturing regular psycho-stimulant users) and the Illicit Drug Reporting System (IDRS) (capturing people who regularly inject drugs), followed by a screening of interested participants. Interviews were audio-recorded, transcribed and analysed using a mixed methods approach. First, correlates of drug sourcing and motivations were examined including demographics, frequency and quantity of supply. Second, thematic analysis of the qualitative data was undertaken on strategies for obtaining the drugs and motivating factors.

Results: Drug supplies were sourced from a variety of medical and non-medical sources, primarily legitimately obtained prescriptions (47%), friends or family (18%) and dealers (14%). Suppliers using medical sources were more likely to be unemployed/retired and reported supplying for therapeutic purposes, while suppliers using non-medical sources were more likely to be employed/students, earned higher incomes and reported supplying for recreational purposes. Those who sourced via doctor shopping (incidence rate ratio (IRR) = 47.50) and friends and family (IRR = 10.08) distributed higher quantities, while those who sourced legitimately obtained prescriptions (IRR = 0.13) and from illicit drug dealers (IRR = 0.02) distributed lower quantities. Similar proportions supplied for financial (65%) and altruistic (61%) reasons, however the latter supplied lower quantities (IRR = 0.14).

Conclusion: This study offers novel insight into the diversion of pharmaceuticals from the supplier perspective. A nuanced policy approach is required to address varied supply practices by source and motive.

Key words: Pharmaceutical misuse, pharmaceutical diversion, non-medical use, pharmaceutical black market, drug dealing, social supply

4.4 Introduction

Pharmaceutical non-medical use (NMU) involves the consumption of a prescription drug for non-therapeutic purposes or other than directed by a registered healthcare professional (Barrett et al., 2008, Larance et al., 2011b). The process of accessing pharmaceutical drugs for NMU involves diversion, whereby pharmaceuticals are channelled from legal sources to the black market (Inciardi et al., 2007b). As rates of pharmaceutical NMU rise around the world including in Australia (AIHW, 2017a), Canada (Health Canada, 2012) and the United States (US) (Center for Behavioral Health Statistics and Quality, 2015), so too do the associated harms including morbidity and mortality (ABS, 2017, Canadian Institute of Health Information, 2017, Office for National Statistics, 2017, UNODC, 2018). An understanding of the mechanisms of diversion and supply has thus become a key priority.

There is now a large evidence base examining the source and diversion of pharmaceutical drugs for NMU. Recently Hulme et al. (2018) (**Chapter Two**) consolidated evidence from 149 studies from Australia, Canada, Europe and the US and found that pharmaceutical drugs are overwhelmingly sourced by end-users through friends and family and illicit drug dealers, and the NMU of legitimately obtained prescriptions is also common. Online purchasing and doctor shopping are less common access points reported by end-users (Hulme et al., 2018). However, the majority of research to date has been conducted with end-users so the sources used by people involved in diversion and supply remains largely unknown (Hulme et al., 2018, Inciardi and Cicero, 2009, Inciardi et al., 2009b).

Research that has focused on people involved in diversion and supply is mainly of US origin. Rigg et al. (2012) conducted research in South Florida with 50 pharmaceutical drug dealers and found that pain clinics were a major source of drugs. The liberal prescribing practices of physicians were targeted by dealers who falsified their symptoms in order to acquire large quantities of drugs (Rigg et al., 2010). In Delaware, Inciardi et al. (2009a) uncovered pill brokerage operations involving patients partnering with suppliers to distribute their medications. Similar practices have also been identified elsewhere in the US (Green et al., 2013, Worley and

Thomas, 2014). While these studies have been useful in highlighting localised issues, supply-focused research extending beyond the US is lacking. Moreover, these studies were conducted when emerging access points such as the dark net were only in their infancy (UNODC, 2017b) and before more recent increases in harms due to pharmaceuticals (ABS, 2017, UNODC, 2018).

While our understanding of the dynamics and structures of the pharmaceutical black market remains limited, international research examining illicit drug markets is growing (Bichler et al., 2017, Caulkins et al., 2016, Hughes et al., 2016a, Hughes et al., 2016b, Malm and Bichler, 2011, Reuter and Trautmann, 2009). Illicit drug markets are hugely profitable (Caulkins et al., 2009, Gong et al., 2012, Matrix Knowledge Group, 2007), however scholars have identified various dealer types (Nicholas, 2008, Potter, 2009). This can be broadly categorised to include 'user-dealers' who operate to support their own use, 'social suppliers' who distribute to non-strangers for minimal profit and 'real dealers' who are motivated by financial gain (Coomber and Moyle, 2014, Coomber et al., 2016, Hough et al., 2003, Lenton et al., 2016, Murphy et al., 2018, Potter, 2009, Taylor and Potter, 2013). It has also been shown that the demographics, motives and modus operandi of suppliers may differ (Caulkins et al., 2016, Coomber and Turnbull, 2007, Hughes et al., 2016b, Matrix Knowledge Group, 2007, Nicholas, 2008, Tzvetkova et al., 2016). For instance, suppliers who are driven by profit motives tend to occupy a higher-level position in the market and seldom use drugs, while lower-level dealers are more likely to operate for the purpose of amassing social capital and engage in use (Desroches, 2007, Johnson, 2003, Nicholas, 2008). Some scholars have argued for lower penalties for social suppliers compared with those who are financially motived (Coomber et al., 2018, Murphy et al., 2018). In all Australian jurisdictions excepting Queensland, threshold quantities for each drug are the key marker of the seriousness of the offence and motive is not an explicit consideration at sentencing (Hughes et al., 2014a).

The pharmaceutical black market is under researched and it remains unclear to what extent its structure and operations differ to that of the illicit drug market. In order to inform effective policies that do not inadvertently result in displacement to black markets and do not jeopardise

therapeutic benefits for complaint populations, supply-focused research is needed (Pacula and Powell, 2018). An understanding of the Australian context is particularly important at a time when governments are planning or implementing new policies to curb diversion and NMU, including real-time prescription drug monitoring programs (PDMPs) (ACT Health, 2018, State Government of Victoria, 2017) and the up-scheduling of codeine to a prescription-only medication (TGA, 2018b). The purpose of this study was twofold. First, to identify the sources used by people involved in pharmaceutical diversion and supply in Australia and their motivations to supply. Second, to explore correlates of drug sourcing and motivations including demographics, quantity and frequency of supply.

4.5 Methods

A mixed methods approach was employed in this study, involving quantitative and qualitative data collection and analysis.

4.5.1 Data collection

Semi-structured, telephone interviews were conducted in Australia with 51 people involved in supplying prescription drugs to another person in the previous six months. In this study, supply included the process of giving away, selling or trading prescription drugs, to allow for the capture of exchanges that were not commercially driven.

Participants were recruited through a multi-stage process that was used to successfully recruit ecstasy dealers in previous research (Bright and Ritter, 2011). First, flyers were distributed to participants of two Australian drug monitoring programs coordinated annually by the National Drug and Alcohol Research Centre (NDARC) at the University of New South Wales (UNSW) – the EDRS, which involves interviews with approximately 800 regular ecstasy and psycho-stimulant users (Uporova et al., 2018) and the IDRS, which involves interviews with around 900 people who regularly inject drugs (Karlsson and Burns, 2018). Recruitment occurred Australia-wide, except for Victoria where no flyers were distributed. Notably, using the EDRS and IDRS meant that our sample primarily comprised user-dealers. While we utilised the EDRS

and IDRS to raise awareness of our research, the data collection processes were separate and it was not a requirement of our study that participants had completed the EDRS or IDRS interviews, with recruitment also possible through snowballing. Second, interested participants contacted the researchers and answered five screening questions to confirm eligibility. Eligible participants were those who met the following criteria: (i) English-speaking; (ii) currently living in Australia; (iii) over 18 years old; (iv) involved in giving away, selling or trading a prescription drug on more than two occasions in the prior six months; and (v) able to identify the type of prescription drug supplied. Participants were reimbursed for their time ($40 AUD).

Telephone interviews were undertaken because research has shown that participants may be more likely to disclose sensitive information over the telephone compared with face-to-face, possibly due to a greater sense of anonymity (Novick, 2008) and there is lower non-response to drug and alcohol related questions (Aquilino, 1992, Aquilino, 1994). Moreover, other methods such as direct observation were not appropriate given the covert nature of the behaviours of interest (Desroches, 2007, Pearson et al., 2001).

4.5.2 Interview protocol

A semi-structured interview protocol was administered to capture consistent information from each participant, whilst allowing for the exploration of emergent themes. The protocol was adapted from a study undertaken by Bright and Ritter (2011) on ecstasy supply and is provided in Appendix 4A. Information was collected on participant demographics, drug and alcohol use, supply practices, motivations, and perceptions of pharmaceutical NMU and diversion. Data collection took place between March and June 2017. Interviews were audio-recorded and transcribed verbatim. This study received ethical approval from UNSW (#HC16926).

4.5.3 Analysis

Semi-structured questions on demographics, source, motive, drug type, quantity and frequency of supply were captured quantitatively and coded. The quantitative analyses involved first, examining frequency distributions for sample characteristics and supply practices. Second, Fischer's exact tests and independent samples t-tests were used to explore correlates of drug

sourcing and motivations that included: demographics (gender, age, criminal history, employed/student, unemployed/retired, income), drug type (opioids, sedatives, stimulants, other), intended purpose of drugs supplied (recreational, therapeutic) and frequency of supply (once or twice monthly, daily to weekly). Additionally, the relationship between source and motivations were explored using Fischer's exact tests. There was no significant relationship for drug class, so the results are in Appendix 4B.

In order to standardise the quantity of drugs supplied by participants, given the variety of drug types, we calculated the number of defined daily doses (DDD) supplied by participants in the six months prior to interview. The DDD is not a recommended prescription dose, but rather a technical unit of measurement allocated by the World Health Organisation (WHO) that corresponds to the assumed average maintenance dose per day for a drug used for its main indication in adults (WHO Collaborating Centre for Drug Statistics Methdology, 2018). The DDD is commonly used to assess trends in drug utilisation and to perform comparisons across population groups (see for example Berterame et al. (2016)) (Appendix 4C presents the DDDs for the drugs supplied by participants). Because DDD data were skewed and over dispersed, negative binomial regressions were used to examine the relationship between the number of doses supplied and source and motivations. To avoid contaminating the analyses due to suppliers' tendencies to use repeat sources to access multiple drugs, comparisons focused on the drug most often supplied by participants (rather than all drugs supplied). The source and motivation categories were not mutually exclusive; hence separate bivariate regression analyses were carried out for each sub-category. That is, a binomial regression model was constructed for each source category (i.e. medical, legitimate medical, illegitimate medical, non-medical, friends/family, illicit dealer, online, third-party) and for each motive (i.e. altruism, financial) to examine whether each sub-category individually predicted the number of doses supplied in the prior six months. All statistical analyses were performed using Stata version 15.0 (StataCorp, 2017).

In addition to the quantitative data, the interviews also collected qualitative responses to a series of open-ended questions and prompts aimed at eliciting further information on drug sourcing and motivations. Responses to these questions were initially extracted from the transcripts using in-vivo or verbatim coding (Manning, 2017) and were then analysed for key themes to identify strategies for obtaining the drugs and factors driving their supply activity (Terry et al., 2017). An inductive approach was undertaken to allow for the linking of themes with the data themselves (Fereday and Muir-Cochrane, 2006, Terry et al., 2017). The qualitative data has been used in this paper to contextualise the findings from the quantitative analysis.

4.6 Results

4.6.1 Sample characteristics

A total of 51 participants were interviewed, with a mean age of 34 years. Two-thirds (63%) were male, around half (53%) were unemployed and the median income of participants was less than $20,000 per annum (AUD). There were only three participants from rural or regional areas, reflecting the recruitment methods for the EDRS and IDRS (Karlsson and Burns, 2018, Uporova et al., 2018). Just over half (51%) of the sample had a criminal history, the majority of which involved possession (n=18) or supply (n=5) related drug offences. Almost two-thirds (61%) indicated that they had supplied an illicit drug in the previous six months, in addition to pharmaceutical drugs. Of those who also supplied illicit drugs, 65% indicated they supplied to the same people as who they supplied pharmaceuticals to, 36% supplied to different people and 8% supplied to a combination of both. All but one participant (98%) reported the recent use of illicit drugs and around half of the sample (51%) reported recently misusing a pharmaceutical drug that they had also supplied (Table 4.1).

Table 4.1. Sample characteristics

Characteristic	n (%)
EDRS	26 (51)
IDRS	25 (49.1)
Gender	
Male	32 (62.7)
Female	19 (37.3)
Age (mean)	34 years
Employment status	
Employed / student	23 (45.1)
Unemployed / retired	28 (54.9)
Highest year of school (mean)	11
Further education or training	26 (51)
Personal annual income (before tax)	
Mean	$26,108
Median	$19,000
State / territory	
ACT	10 (19.6)
NSW	9 (17.6)
NT	7 (13.7)
QLD	8 (15.7)
SA	12 (23.5)
TAS	3 (5.9)
VIC	-
WA	2 (3.9)
Capital city	48 (94.1)
Regional / rural area	3 (5.9)
Recent illicit drug use [a]	50 (98)
Recent illicit drug supply [a]	31 (60.8)
Recent pharmaceutical NMU [a,b]	26 (51)
Treatment status	
Previously in treatment	12 (23.5)
Currently in treatment	13 (25.5)
Criminal history	26 (51.0)
Drug-related criminal history [c]	21 (41.2)
Possession	18 (35.3)
Supply	5 (9.8)
Driving under the influence	2 (3.9)
Cultivation	1 (2.0)
Not stated	1 (2.0)

Notes: [a)] Past six months

[b)] NMU of a pharmaceutical drug that the participant also reported supplying.

[c)] Participants may have multiple drug-related past offences, so totals do not add to 100. N=51.

4.6.2 Supply practices

The supply practices reported by participants are presented in Table 4.2. Almost half (49%) of the sample reported most often supplying hypnotic-sedative drugs, mainly diazepam (e.g. Valium) and alprazolam (e.g. Xanax). Equal proportions reported most often supplying pharmaceutical opioids (24%) and stimulants (24%). There were two participants who primarily supplied anti-psychotic medications (4%). The single drug type most often supplied was diazepam (37%), followed by dexamphetamine (10%) and oxycodone (8%) (Appendix 4D provides a list of all the drugs supplied).

Over half of the sample (59%) reported accessing the drugs directly from the medical system – either through legitimately obtained prescriptions (47%) or less commonly, through practices such as doctor shopping, prescription forgery or faking symptoms (12%). Just under half of the sample (41%) used non-medical sources for accessing their drugs, most commonly friends or family (18%), followed by illicit drug dealers (14%), third parties (10%) and online (10%). Third parties were distinct because they were considered neither friends nor family of the participant, nor did they supply illicit drugs. Where online purchases were made, this included both surface-level (n=3) and dark net (n=2) websites. Participants that sourced their drugs through other non-medical sources were asked to provide information on where they believed the drugs were initially obtained. Where stated, the most commonly cited source used by intermediaries was the medical system via legitimate prescriptions (n=6), followed by illegitimate prescriptions obtained via doctor shopping (n=5) and online (n=4).

Four in five (78%) reported supplying to friends or family, while one in five (10%) reported supplying to strangers. Moreover, three in five (61%) reported they supplied for altruistic reasons. A similar proportion (65%) reported they were motivated for financial reasons, including nine (18%) who supplied to generate resources to support their own substance use and five (10%) who reported supplying to procure illicit drugs, most commonly meth/amphetamine, cannabis and ecstasy. There were eight participants (16%) who indicated both altruistic and financial motives.

The majority reported that they were involved in supplying directly to end-users (96%), with only two participants reportedly supplying to people who they believed where involved in on supply. Almost equal proportions believed that the drugs they supplied were being used for therapeutic purposes (41%) – to assist with pain relief, anxiety and sleep, and recreational purposes (39%) – to facilitate a high or in combination with alcohol or other drugs. Other reasons for use of the drugs supplied included as a study aid (16%) and to mitigate the effects of withdrawal (14%).

The median number of doses supplied by participants in the six months prior to interview was 30, equating to approximately a one-month supply of medication. However, the number of doses supplied by participants ranged widely from less than one[11] to 50,000, and there were a small number (12%) of participants who supplied over 1,000 doses in the last six months. Three in five (61%) participants supplied once or twice per month, while two in five (39%) supplied on a daily or weekly basis.

[11] Those involved in supplying less than one DDD still met the eligibility criteria for this study because they were involved in supplying a prescription drug, albeit a low dosage pharmaceutical opioid (i.e. five milligram Oxycodone tablets, less than one DDD), on more than two occasions in the last six months.

Table 4.2. Supply practices

	n (%)
Supplied to	
Friend or family	40 (78.4)
Acquaintance	25 (49.0)
Stranger	5 (9.8)
Perceived use of drugs supplied [a]	
Therapeutic	21 (41.2)
Recreational	20 (39.2)
Study aid	8 (15.7)
To mitigate withdrawal	7 (13.7)
Supply	2 (3.9)
Manufacture illicit drugs	2 (3.9)
Unknown	3 (5.9)
Primary drug supplied	
Opioid	12 (23.5)
Sedative	25 (49.0)
Stimulant	12 (23.5)
Other	2 (3.9)
Source of primary drug [a]	
Medical	30 (58.8)
Legitimate medical source	24 (47.1)
Illegitimate medical source [b]	6 (11.8)
Non-medical / intermediary	
Friend or family	9 (17.6)
Illicit drug dealer	7 (13.7)
Third-party [c]	5 (9.8)
Online	5 (9.8)
Motivation for supply [a]	
Financial	33 (64.7)
Altruistic	31 (60.8)
Number of doses supplied [d]	
Mean	1447
Median	30
Frequency of supply	
Daily to weekly	20 (39.2)
Fortnightly to monthly	31 (60.8)

Notes: [a)] Categories are not mutually exclusive, so totals do not add to 100%.
[b)] Includes doctor shopping, prescription forgery or faking symptoms.
[c)] Third parties were unique from other sources because they were not known to the supplier (i.e. not friends/family), nor were they involved in supplying illicit drugs (e.g. cocaine or ecstasy).
[d)] Number of doses supplied in the prior six months, has been calculated using the DDD for each drug (WHO Collaborating Centre for Drug Statistics Methdology, 2018). N = 51.

4.6.3 Correlates of drug sourcing and motivations

Correlates of drug sourcing are presented in Table 4.3. Suppliers who accessed their drugs directly from the medical system were more likely to be unemployed/retired. In contrast, suppliers who accessed their drugs through non-medical sources were more likely to be employed/students and to earn on average, a higher annual income ($35,304 cf. $18,554 per annum, $t(25.5) = -2.2938$, $p < 0.05$). The drugs supplied from legitimate medical sources were reportedly more likely to be for therapeutic purposes, whereas drugs supplied from non-medical sources were reportedly more likely to be for recreational purposes. The frequency of supply varied across the sources. Those sourcing through doctor shopping and friends and family were more likely to supply on at least a weekly basis, whereas those supplying legitimately obtained prescriptions were more likely to supply once or twice per month.

Table 4.3. Factors associated with drug sourcing

Source	Medical [a]			Legitimate medical			Illegitimate medical			Non-medical/intermediary [b]		
	Yes	**No**	***p***	**Yes**	**No**	***p***	**Yes**	**No**	***p***	**Yes**	**No**	***p***
Number	30	21		24	27		6	45		23	28	
Demographics												
Gender: male	56.7	71.4	0.381	58.3	66.7	0.659	50.0	64.4	0.649	69.6	57.1	0.398
Age (mean, years)	37.6	30	0.071							30	38	0.055
Age (SD, years)	14.4	14.7								3	2.75	
Employed / student	30.0	66.7	0.012*	62.5	48.1	0.400	0.0	51.1	0.027*	65.2	28.6	0.012*
Unemployed / retired	70.0	33.3	0.012*	37.5	51.9		100.0	48.9		34.8	71.4	
Income (mean, per annum)	$19,450	$35,619	0.052							$35,304	$18,554	0.03*
Income (SD, per annum)	$11,647	$34,885								$7,031	$1,975	
Criminal history: yes	50.0	52.4	1.000	45.8	55.6	0.579	66.7	48.9	0.668	52.2	50	1.000
Motivation												
Financial: yes	60.0	71.4	0.553	58.3	70.4	0.396	66.7	64.4	1.000	73.9	57.1	0.251
Altruistic: yes	60.8	66.7	0.566	66.7	55.6	0.567	16.7	66.7	0.029*	65.2	57.1	0.580
Purpose of drugs supplied												
Therapeutic: yes	60.0	14.3	0.001**	66.7	18.5	0.001**	33.3	42.2	1.000	17.4	60.7	0.004*
Recreational: yes	30.0	52.4	0.148	20.8	55.6	0.021*	66.7	35.6	0.195	52.2	28.6	0.149
Frequency of supply												
Fortnightly to monthly	70.0	47.6	0.148	83.3	40.7	0.004**	16.7	66.7	0.029*	47.8	71.4	0.149
Daily to weekly	30.0	52.4		16.7	59.3		83.3	33.3		52.2	28.6	

Source	Friend or family			Illicit drug dealer			Third-party			Online		
	Yes	**No**	***p***	**Yes**	**No**	***p***	**Yes**	**No**	***p***	**Yes**	**No**	***p***
Number	9	42		7	44		5	46		5	46	
Demographics												
Gender: male	55.6	64.3	0.711	57.1	63.6	1.000	80	60.9	0.639	100	58.7	0.143
Age (mean, years)				`								
Age (SD, years)												
Employed / student	66.7	40.5	0.268	71.4	40.9	0.221	60	43.5	0.647	80	41.3	0.162
Unemployed / retired	33.3	59.5		28.6	59.1		40	56.5		20	58	
Income (mean, per annum)												
Income (SD, per annum)												
Criminal history: yes	66.7	47.6	0.465	42.9	52.3	0.703	60	50	1.000	40	52.2	0.668
Motivation												
Financial: yes [(c)]	66.7	64.3	1.000	85.7	61.4	0.398	80	60	0.645	60	65.2	1.000
Altruistic: yes	88.9	54.8	0.072	57.1	61.4	1.000	60	60.9	1.000	60	60.9	1.000
Purpose of drugs supplied												
Therapeutic: yes	33.3	42.9	0.72	14.3	45.5	0.217	20	43.5	0.391	0	45.7	0.069
Recreational: yes	55.6	35.7	0.289	71.4	34.1	0.096	20	41.3	0.636	80	34.8	0.071
Frequency of supply												
Once or twice per month	22.2	69.1	0.020*	71.4	59.1	0.690	40	63	0.369	60	60.9	1.000
Daily to weekly	77.8	31		28.6	40.9		60	37		40	39.1	

Notes: Significance levels * $p < 0.05$, ** $p < 0.01$. SD = standard deviation. All monetary values are in 2017 Australian dollars.

Participants may use multiple sources to access their primary drug supplied.

[a)] Includes the obtainment of drugs for the treatment of legitimate illness or injury, as well as illegitimately via doctor shopping, prescription forgery or faking symptoms.

[b)] Includes friends or family, illicit drug dealers and third-parties (who are neither friends, family nor involved in the supply of illicit drugs).

Correlates of supplier motives are presented in Table 4.4. Suppliers who indicated that they were altruistically motivated were more likely than those not altruistically motivated to be employed/students and less likely to have a criminal history. Those who supplied for financial reasons were less likely than those without financial incentive to report that they supplied drugs for therapeutic purposes.

Table 4.4. Factors associated with supplier motives

Motivation	Altruistic			Financial [a]		
	Yes	No	*p*	Yes	No	*p*
Number	31	20		33	18	
Demographics						
Gender: male	54.8	75.0	0.235	66.7	55.6	0.547
Age (mean, years)	31.7	39.7	0.1041	31.8	39.2	0.093
Age (SD, years)	14.7	14.4		14.4	15.0	
Employed / student	61.3	20.0	0.005**	45.5	44.4	1.000
Unemployed / retired	38.7	80.0		54.5	55.6	
Income (mean, per annum)	$27,016	$24,700	0.751	$27,000	$24,272	0.735
Income (SD, per annum)	$21,080	$30,870		$28,959	$16,436	
Criminal history: yes	38.7	70.0	0.045*	54.6	44.4	0.565
Purpose of drugs supplied						
Therapeutic: yes	48.4	30.0	0.250	24.2	72.2	0.001**
Recreational: yes	35.4	45.0	0.565	45.5	27.8	0.247
Frequency of supply						
Once or twice per month	71.0	45.0	0.083	57.6	66.7	0.565
Daily to weekly	29.0	55.0		42.4	33.3	

Notes: Significance levels * $p < 0.05$, ** $p < 0.01$. SD = standard deviation. All monetary values are in 2017 Australian dollars. There were eight participants who indicated that they were motivated both altruistically and financially.

[a)] Includes where drugs are supplied for the purpose of obtaining resources, including other drugs.

The regression analyses examining quantity supplied by source and motive are presented in Table 4.5. Overall those sourcing from the medical system distributed on average, a higher number of doses (IRR = 21.54, standard error (SE) = 12.63) in the prior six months than those not using medical sources. Those involved in illegitimately obtaining prescriptions through doctor shopping supplied significantly higher average quantities (IRR = 47.50, SE = 38.27), than those supplying legitimately obtained prescriptions (IRR = 0.13, SE = 0.08). There was further variation in the mean number of doses supplied from non-medical sources. Participants who sourced through friends or family supplied on average a higher number of doses than those

not sourcing from friends or family (IRR = 10.08, SE = 7.86) and those sourcing through illicit drug dealers supplied on average the lowest average number of doses (IRR = 0.15, SE = 0.16). Finally, suppliers who indicated that they were altruistically motived supplied on average a lower number of doses than those not altruistically motivated (IRR = 0.15, SE = 0.09), while those financially motivated supplied on average a higher number of doses than those not financially motivated (IRR = 6.94, SE = 4.45).

Table 4.5. Negative binomial regression for predictors of doses^ supplied in the last six months

	Mean doses supplied		IRR	SE	*p*
	Yes	No			
Source [a]					
Medical	2382	111	21.54	12.63	0.000**
Legitimate	322	2446	0.13	0.08	0.001**
Illegitimate [b]	10620	224	47.50	38.27	0.000**
Non-medical	2276	765	2.97	1.87	0.083
Friend or family	5604	556	10.08	7.86	0.003**
Illicit drug dealer	39	1671	0.02	0.02	0.000**
Third-party [c]	120	1590	0.08	0.08	0.014*
Online	237	1578	0.15	0.16	0.073
Motive [a]					
Altruistic	435	3013	0.14	0.09	0.002**
Financial	2073	299	6.94	4.45	0.003**

Notes: Number of doses has been calculated using the DDD for each drug, allocated by the WHO.
Significance levels ** p < 0.01, * p < 0.05
IRR = incidence rate ratio, SE = standard error
a) Participants were able to indicate multiple sources and motivators, so totals do not add to 100%. Because the sub-categories were not mutually exclusive, separate bivariate regressions have been carried out for each. Thus, each line of the table represents a separate binomial regression model.
b) Illegitimate medical includes doctor shopping, prescription forgery and faking symptoms.
c) Third parties were unique from other sources because they were not known to the supplier (i.e. not friends/family), nor were they involved in supplying illicit drugs (e.g. cocaine or ecstasy).

4.6.4 Contextualising supply practices

We present here the findings from the thematic analysis on strategies for supply via medical and non-medical sources and purported supplier motives. In regards to medical sources, a key theme that emerged was the availability of legitimately obtained, leftover drugs and that created an opportunity for supply. Participants cited a number of reasons for their surplus drug supplies

including that the medications had not achieved the desired result or that they experienced unpleasant side effects. As two participants explained:

> "I tried them [diazepam] to help with my issues and they didn't help me so much and I didn't want to abuse them myself for no reason and get hooked, so I thought I'd just keep them and give them to someone who might need it" (Interviewee 30792).

> "I didn't need all the ones [methylphenidate] I had and it's a nice thing to do" (Interviewee 62596).

Other suppliers who accessed through medical sources explained how they exploited previous illness or injury to continue receiving prescriptions, even though they no longer suffered symptoms or required the medication. This was a common strategy among people involved in doctor shopping, as one participant explained:

> "You need to be diagnosed with depression or something in order to get the drugs in the first place" (Interviewee 23973)

While another described how they "have had injuries" and this allowed them "to get what you want" (Interviewee 00947). Participants involved in doctor shopping also highlighted the importance of maintaining a clean and well-presented appearance to reduce suspicion and targeting practitioners with a 'soft touch' who would be more likely to prescribe the drugs out of compassion. As one participant explained:

> "I go to ten different doctors…you have to find a good doctor. It still is hard to get Valium, but you just gotta find a doctor. Because a lot of doctors aren't allowed to write any medications like that, you see on the outside of their doctor's office 'we do not sell [prescribe] benzos'...I get a lot of that, but they do sell [prescribe] to me if I get the right doctor.... Cause I look like a normal person. I take good care of myself and so they never question me" (Interviewee 18497).

Among participants supplying from legitimate medical sources, it was common for their supply practices to be described in the context of the suffering or pain of the end-user. For instance, one participant described supplying oxycodone to his wife "to relieve her pain and because I love

her" (Interviewee 43758), while another participant explained supplying pregabalin to his friend because "I could see that he wasn't well, he was suffering." (Interviewee 23849). These suppliers highlighted that strict regulations and treatment stigmas, precluded access and shifted these end-users to the black market. For instance, one participant explained how changes in availability via the medical system was a motivation to supply:

> "Mainly [I supply because] I feel sorry for people, because drugs and alcohol [services] nowadays are very strict on their medications, the last five years especially. They've had people on high doses and then all of a sudden, instead of weaning them off, they just cut them, cut them in half or to a third" (Interviewee 14149).

Another participant justified their supply because of the stigma surrounding access to mental health treatment in some communities:

> "Some of my friends, they actually have real mental conditions like ADHD [attention deficit hyperactivity disorder], OCD [obsessive compulsive disorder] and depression, but their families refuse to allow them to get further treatment…for fear of stigma. I am actually kind of glad I can supply a few drugs to help my friends, because they really need it" (Interviewee 95728).

Supply practices via non-medical sources differed. Of note, suppliers who sourced from non-medical sources discussed that the drugs they supplied were often used recreationally including in pursuit of a high or in combination with other substances, as one participant explained:

> "If you have the Xannies [Xanax] 10 to 20 minutes before you have heroin, it makes the heroin so much better" (Interviewee 18497).

There was evidence of convergence of the pharmaceutical black and illicit drug markets. Participants who sourced their drugs from illicit drug dealers described how the procurement of pharmaceutical drugs often arose opportunistically when they were visiting their dealer for illicit drugs. Most of the drugs sourced through dealers were sedatives that were often given to participants for free or at a minimal cost in conjunction with illicit drugs such as ecstasy and meth/amphetamine to aid with comedown. As two participants explained:

> "I didn't actually pay for the Valium, but I did pay for the MDMA pills. He [the dealer] just chucked in a couple of Valium and then a bunch of people just came up to me…and I sold them" (Interviewee 47298).

> "A guy we go to for other stuff [illicit drugs]…was talking about the Xannies [Xanax] and how cheap they are each…A few times he would just give away a lot in bulk, pharmaceuticals…I didn't pay for them" (Interviewee 22315).

The small number of participants who accessed their drugs online consistently highlighted the convenience and variety of products available. One participant described their preference for sourcing drugs online:

> "It's like eBay. You can go on there and shop at your pleasure. There are different sellers, different prices, different delivery methods" (Interviewee 32080).

Another explained how dark net dealers guaranteed the replacement of goods if the shipments were seized, which mitigated the risks of sourcing online.

Suppliers who indicated that they were financially motivated highlighted the minimal costs associated with obtaining the drugs and thus the high potential for profit. Given that the majority of our sample were PWUD, it was also common for participants to talk about how the money they earned from supplying could help them to support their own use. One participant discussed the monetary aspects of supply:

> "It's so cheap to get a prescription…take out your $6.20 for your prescription costs and then you can pay for your own and make a bit extra. The money that you're making, you get to pay for your own habit. I never give them away. There are a lot of people that deal drugs just to enable them to pay for their own habit, it makes sense" (Interviewee 19357).

4.7 Discussion

To our knowledge, this is the first Australian study to examine drug sourcing and motivations among a sample of people involved in the diversion and supply of pharmaceuticals. This study found that drugs are accessed for supply from a variety of medical and non-medical or intermediary sources, primarily legitimately obtained prescriptions, friends or family and illicit

drug dealers. Less commonly cited sources included online purchasing and doctor shopping or prescription forgery. This study also found that supply practices, including the quantity and frequency supplied, differed significantly by supplier source and motive.

Drugs sourced through the medical system were distributed on average in higher quantities than those not sourced directly from the medical system. However, this was driven by the high quantities distributed by those involved in illegitimately obtaining prescriptions though practices such as doctor shopping, rather than those supplying legitimately obtained prescriptions. Moreover, those involved in doctor shopping distributed more frequently. Suppliers who accessed their drugs via the medical system typically did so for the treatment of legitimate symptoms of illness or injury. Even when the drugs were illegitimately obtained, the participants highlighted that a history of illness or injury was a requisite for successfully obtaining the drugs, in addition to presenting with a well-kept appearance to ameliorate any risk of suspicion. This presents a considerable challenge for practitioners in trying to prevent potential diversion, because those at-risk are not necessarily clearly identifiable or absent of observable symptoms.

This study found that while the drugs sourced legitimately from the medical system were reportedly more likely to be used for therapeutic purposes, such as the treatment of pain or mental health problems, suppliers who accessed their drugs via non-medical sources were more likely to report that these were supplied for recreational purposes. The absence of observable symptoms of illness or injury to enable the obtainment of drugs via the medical system, may explain some participants access via non-medical or intermediary sources. Suppliers using non-medical sources were more likely to be employed/students and earned higher incomes. In part, this may reflect the higher cost of drugs obtained through intermediaries in the absence of subsidised drugs available from the medical system under the Pharmaceutical Benefits Scheme (PBS).

The most commonly cited non-medical source was friends and family who on-supplied their legitimately or illegitimately obtained prescriptions. Interestingly, these suppliers distributed 10

times as many doses than those not using friends or family and also supplied more frequently, suggesting that there are reasonable quantities of prescription drugs being exchanged within social networks. Where illicit drug dealers were used, these transactions typically involved the poly-supply of pharmaceutical drugs in conjunction with other illicit drugs, most commonly ecstasy and meth/amphetamine. Here, pharmaceuticals were often provided for free by dealers, as an offering to mitigate the negative effects of illicit drug consumption. Only a small proportion of participants cited the Internet as a source of drugs, suggesting this is still an emerging access point in Australia, at least among user-dealers who comprised the bulk of our sample.

Almost two-thirds indicated that their supply practices were altruistically motivated, and these suppliers distributed lower quantities than those who were not altruistically motived. Most of our sample supplied to friends, family or acquaintances. In contrast, one in five reported supplying to strangers. Much of the supply activity was sporadic, with three in five reporting monthly distribution. These supply practices are consistent with conceptualisations of social supply that has been widely discussed in the context of illicit drugs (Bright and Ritter, 2011, Coomber and Moyle, 2014, Coomber et al., 2018, Coomber et al., 2016, Coomber and Turnbull, 2007, Grigg et al., 2015, Lenton et al., 2016, Lenton et al., 2015, Murphy et al., 2018, Potter, 2009, Taylor and Potter, 2013, Werse and Bernard, 2016) and less frequently, for pharmaceuticals (Daniulaityte et al., 2014, Murphy et al., 2018, van de Ven and Mulrooney, 2017). This study revealed that a minority of the sample sourced their drugs through illegitimate practices such as doctor shopping, however these suppliers were less likely to be altruistically motived and their distribution patterns were more frequent and in higher quantities. These practices are less consistent with notions of social supply.

4.7.1 Limitations

This study had several limitations. First, while this is the first Australian study to examine sources used by people higher in the supply chain than end-users, recruiting via the EDRS and IDRS meant that we primarily sampled PWUD, thus limiting our ability to comment on supply

by people who do not use drugs. This is a relevant limitation as studies of illicit drug markets have shown that high-level drug traffickers seldom use drugs (Desroches, 2007, Johnson, 2003), thus future research is warranted with such populations. Second, while telephone interviews were the most practical mode for data collection and may have improved responses to sensitive questions (Aquilino, 1992, Aquilino, 1994, Novick, 2008), as with all self-report data, there may be social desirability biases. Third, while the DDD is the best available metric for comparing the quantity of prescription drugs supplied by participants in this study, previous research suggests there are limitations with DDDs for opioids that do not have 'typical' doses (Nielsen et al., 2017). Fourth, the sample size restricted our ability to conduct multivariate analyses. Fifth, these data are largely drawn from capital cities, limiting generalisability. Future research may consider exploring pharmaceutical diversion in regional and rural areas where there are indications of burgeoning NMU (ACIC, 2018b, AIHW, 2019). Finally, participants were self-selecting, potentially biasing the sample.

4.7.2 Implications for research and policy

Unlike end-users who mainly source their drugs for NMU from friends and family (Hulme et al., 2018), most of the suppliers in our sample accessed their drugs directly from the medical system and this is consistent with what is known internationally (Green et al., 2013, Inciardi et al., 2009a, Rigg et al., 2012, Rigg et al., 2010, Worley and Thomas, 2014). However, unlike the prominent role of pain clinics in the US context, we found that most of the participants interviewed were involved in distributing leftover medications. This draws parallels to the motivations of cannabis growers described in a Finnish study, whereby cannabis was shared and traded with friends when production exceeded the quantity desired for personal use (Hakkarainen and Perala, 2011). The supply of leftover drugs might be a unique aspect of cannabis and pharmaceutical black markets, differentiating them from the supply of other drugs such as meth/amphetamine, ecstasy and cocaine.

The susceptibility of leftover drugs to diversion and the high proportion of suppliers who distributed for therapeutic purposes raise some important implications. First, there may be a

need for further education among the general population in relation to the risks associated with medication sharing and self-diagnosis (Beyene et al., 2013). Second, it highlights the importance of prescribing quantities that better align with therapeutic needs as a strategy to prevent diversion (RACGP, 2015, The Royal Australasian College of Physicians, 2009). Finally, demand may reflect stigma-related treatment barriers among marginalised populations, which adds to previous research on the stigmas associated with substance use disorders and medication assisted treatment (Digiusto and Treloar, 2007, Luoma et al., 2007, Room, 2005). In fact, our research suggests that there is a perceived undersupply of pharmaceutical drugs among some people, which is paradoxically being met by an oversupply among others.

Our study has highlighted the prominence of social supply for pharmaceutical drugs. Many involved in social supply justified their behaviour on the basis that they were providing medication to those that did not have access to the drugs. This adds to what is already known about buprenorphine-naloxone diversion from people in treatment to others in need of the drugs for therapeutic purposes, such as to mitigate the effects of withdrawal (Johanson et al., 2012, Johnson and Richert, 2015b, Kenney et al., 2017). This finding encourages further discussion in Australia around whether an explicit acknowledgement of supplier intent should be used in conjunction with threshold quantities for determining appropriate penalties for drug supply, including pharmaceuticals (Coomber et al., 2018, Hughes et al., 2014a).

Connotations from participants of altruism and therapeutic use of the drugs, suggest that friendship can give rise to the supply of pharmaceutical drugs, particularly in the context of known or perceived barriers to legitimate access routes including regulation and stigma. This further contributes to the social supply discourse and conceptualisations of friendship in the context of cannabis markets, whereby friendship has been found to exist to sustain the distribution chain and "compensate for the risks of the market" in the context of prohibitive drug policy and law enforcement (Belackova and Vaccaro, 2013). Other scholars have discussed the concept of the social supply buffer – that is, a preference for distribution and purchasing within social networks rather than street-based markets because it insulates against

the unsavoury and more risky aspects of the drug trade, such as violence and crime (Coomber et al., 2016, Coomber and Turnbull, 2007, Murphy et al., 2018, Nicholas, 2008, Potter, 2009). Future research may further unpack preferences for social supply in the context of pharmaceutical drugs.

This study also adds to the international and domestic literature on illicit drug markets. It shows that consistent with the illicit drug markets, demographics, motivations and modus operandi also affect the supply of pharmaceuticals (Caulkins et al., 2016; Coomber & Turnbull, 2007; Matrix Knowledge Group, 2007; Nicholas, 2008; Tzvetkova et al., 2016). Indeed, the finding that the small number of suppliers (n=6) who reported sourcing their drugs through doctor shopping distributed 47 times as many doses as other suppliers, demonstrates the importance of examining trafficker motivations and modus operandi both for understanding the behaviour and for developing more targeted policy responses (particularly to target the most harmful forms of behaviour).

In Australia, there has been ongoing discussion of a reduction of pack sizes for some drugs with high abuse potential (TGA, 2018c). Moreover, Victoria recently launched a real-time PDMP (State Government of Victoria, 2017), the ACT will launch a similar program in 2019 (ACT Health, 2018) and there have also been calls for a nationally coordinated system (Hendrie, 2018). Such regulations are one lever for reducing diversion through doctor shopping and providing accountability and support for health practitioners (Buchmueller and Carey, 2018, Pacula and Powell, 2018). However, caution should be exercised to ensure that reducing supply through further regulation does not inadvertently result in displacement to the black market for those with unmet needs and jeopardise therapeutic access (Powell, 2019). Importantly, where PDMPs have been introduced in the US, their effects on overdose have been mixed (Buchmueller and Carey, 2018, Fink et al., 2018). This highlights that if such policies are implemented, that they should be delivered in conjunction with the expansion of drug treatment and alternative pain management therapies targeted at people with substance use disorders (Buchmueller and Carey, 2018, Pacula and Powell, 2018). Moreover, Australian evidence has

shown a shift from domestic production to the importation of amphetamine-type stimulants following the introduction of *Project STOP* – an electronic monitoring system targeted at reducing pseudoephedrine diversion (Hughes et al., 2016b). Moreover, restrictions on opioid supply in the US have coincided with increased importation of high potency opioids, which has had drastic public health consequences (Pacula and Powell, 2018).

The high proportion of poly-drug suppliers in our sample is consistent with US research about pharmaceutical suppliers (Rigg et al., 2012), and more generally with illicit drug market research that has shown an increasing trend towards the trade in multiple illicit drugs at once (Hughes et al., 2016b, Malm and Bichler, 2011, Rubin et al., 2013). The trend for dealers to promote the NMU of pharmaceuticals in conjunction with illicit drugs is worthy of continued monitoring given the increased harms associated with poly-drug use. This is one of the first studies to identify the Internet as a source of pharmaceutical drugs used by people involved in diversion and supply, albeit a small proportion of the sample. The convenience, variety and low cost of drugs available online were the key factors influencing suppliers to use this source, which is consistent with drug market preferences described elsewhere (Barratt et al., 2013). Previous research has also shown that online marketplaces, specifically the dark net, are utilised by younger suppliers who have enhanced technological literacy (Winstock et al., 2017). As both crypto markets and the younger generation age, it will be important to monitor the purchasing of pharmaceutical drugs online.

This study reinforces the importance of undertaking further research examining pharmaceutical diversion and supply at all levels, both within and beyond Australia. This should include an examination of all market levels including diversion prior to the drugs reaching the medical system (such as from manufacturing sites), the role of health practitioners[12] and the emergence of online marketplaces.

[12] This was explored as part of this thesis – see **Chapter Three**.

4.7.3 Conclusion

A multifaceted and nuanced approach is crucial for addressing the myriad of sources used by people involved in pharmaceutical diversion and supply. However, this study revealed some important differences in supply practices depending on where the drugs are sourced and supplier motivations that may be used to inform targeted strategies. The high volume associated with medical sourcing, particularly doctor shopping, and the challenge for practitioners in identifying diversion may warrant compulsory and real-time PDMPs. However, to mitigate potential unintended impacts such as displacement, supply-reduction policies should be implemented in conjunction with strategies to identify and reduce barriers to treatment including stigma and address demand for NMU. This study provokes further consideration of social supply within the Australian legal framework, which may reduce disproportionate sentencing for those not commercially motivated, while still enabling serious sanctions for those who are. This study paves the way for further research to better understand the diversion and supply of pharmaceutical drugs, which remains a vastly under researched area despite evidence of increasing harms in Australia and internationally.

5 Chapter Five: Price and mark-up of pharmaceutical drugs supplied on the black market

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Shann Hulme 15 August 2019

5.2 Preamble

The systematic review presented in **Chapter Two** identified prior assumptions that have been made about the potentially lucrative nature of pharmaceutical diversion and supply. **Chapter Three** explored factors contributing to diversion and supply by health practitioners and found that with the exception of deliberate oversupply of pseudoephedrine by pharmacists – most of this type of misconduct is not financially motivated. **Chapter Five** builds upon this work to quantify the revenue, profit and mark-up of pharmaceutical diversion and supply in Australia. This study uses the same methodology for data collection as described in **Chapter Four** (i.e. interviews with active suppliers), however a separate dataset was created at the cycle rather than participant level – that is, from the point of acquisition to distribution whereby each drug type acquired by a supplier represents a separate cycle. This is the first study to quantify the gross revenue, gross profit and mark-up of pharmaceutical drugs supplied on the pharmaceutical black market. Differences in price and mark-up by drug class, drug schedule and source are examined. In doing so, this study provides useful information about the distribution of profits within this market.

In addition, this study builds upon the extensive work that has been conducted to understand the price of illicit drugs. Price is an important metric in drug policy analysis because price changes are known to influence consumption and in turn, drug-related health and social harms (Caulkins and Reuter, 1996, Caulkins and Reuter, 1998, Gallett, 2014, Hughes et al., 2019a). Understanding how much drugs are sold for and the factors that influence this are important for informing enforcement and related interventions. This study provides novel comparisons between what is known about the economics of illicit drug supply compared with pharmaceutical diversion and supply and provides a solid basis for the replication of similar research in other contexts with different healthcare systems.

5.3 Abstract

Background: Research examining illicit drug markets has shown that price affects consumption and mark-ups are extremely high. However, the economics of black market pharmaceutical supply remains unknown, despite increasing harms due to pharmaceuticals.

Methods: Semi-structured, telephone interviews were conducted in Australia with 51 people involved in supplying pharmaceuticals in the previous six months. Interviews were audio-recorded, transcribed and quantitative information on costs, sale price, quantity and frequency of supply were coded and used to calculate the mark-up ratio for each drug transaction 'cycle', accounting for distribution via selling, gifting and trading. Mixed effects gamma regressions were used to identify predictors of price and mark-up, clustering by participant.

Results: There were 33 unique drug types supplied over 111 cycles, including hypnotic-sedatives (38%), pharmaceutical opioids (32%), stimulants (18%) and others (12%). Sedatives were sold at lower prices than opioids and there was a negative relationship between unit price and transaction size, consistent with a discount effect. For every dollar spent acquiring the drugs, the supplier earned a median of $3.19. Cycles involving the distribution of drugs sourced via intermediaries (e.g. friends/family) had lower mark-up than drugs sourced directly from the medical system.

Conclusion: To our knowledge, this is the first attempt internationally to analyse economic aspects of the pharmaceutical black market from a supply perspective. There were a small number of cycles that realised large profits that may warrant different types of policy responses, however for most suppliers in our sample gross revenue and gross profit was modest.

Key words: pharmaceutical drugs, pharmaceutical diversion, black market, supply, price, Australia

5.4 Introduction

A large international evidence base has examined the economics of illicit drug supply (Caulkins et al., 2016, Caulkins et al., 2009, Caulkins et al., 1999, Caulkins and Pacula, 2006, Caulkins and Reuter, 1996, Gong et al., 2012, Matrix Knowledge Group, 2007, Pardal et al., 2014, Reuter and Haaga, 1989, Reuter and Trautmann, 2009). From this research we have learned that the price of illicit drugs far exceeds that of legal commodities. For instance, Caulkins and Reuter (1998) identified that cocaine and heroin are worth more than their weight in gold. It was estimated that the price of cocaine increases by more than $100 (US) per gram at each distribution level, whereas silver and coffee beans increase by less than $0.10 (US) per gram (Caulkins, 2014). The high prices are partially compensatory for the risky aspects of the drug trade to suppliers including enforcement, detection, seizures, violence and related crimes (Reuter and Kleiman, 1986). Caulkins and Reuter (1996) estimated that over 50% of the retail price of cocaine was attributable to risk compensation.

Illicit drug prices are also related to the quantity supplied. Specifically, unit sales prices decreases as transaction size increases (Caulkins and Padman, 1993). It has been confirmed that quantity discounts are applied in Australian (Clements, 2006, Gong et al., 2012, Pen, 2012) and international markets (Caulkins et al., 2016, Caulkins et al., 2009, Caulkins and Pacula, 2006, Lahaie et al., 2016, Matrix Knowledge Group, 2007, Pardal et al., 2014) for cannabis, cocaine, heroin and meth/amphetamine. To suppliers, the inverse of a quantity discount is a mark-up. Research from North America and Europe has shown that mark-up is highest at the retail level where drugs are repackaged into the smallest quantities for distribution (Caulkins et al., 2016, Caulkins et al., 2009, Pardal et al., 2014). For instance, interviews with a sample of Italian drug traffickers estimated a 121% mark-up at the retail-level, 57% at the wholesale-level and 26% for high-level, multi-kilogram traffickers (Pardal et al., 2014). Conversely in Australia, mark-up has been found to decrease as one moves further down the distribution chain (McFadden et al., 2014, Moore et al., 2005). For example, McFadden et al. (2014) estimated that retail-level dealers earned $2 to $3 (AUD) for every dollar invested in the drug trade, compared with $5 for

wholesale distributors and $16 to $17 for importers/producers. In any case, the profitability of illicit drugs, while varying by market level, drug type and location, can be substantial and mark-ups are generally much higher than for licit goods.

In addition to changes in the nominal price of drugs in relation to quantity, illicit drug prices are also a reflection of their purity (Fries et al., 2008, Moore et al., 2005, ONDCP, 2004). Illicit drug prices are rarely negotiated at the purchase point, as prolonged transactions may increase the risk of detection (Moore et al., 2005). Instead, prices may be manipulated during production through the addition of diluents or adulterants that serve to decrease the purity of the drugs supplied. However, price per pure gram data has shown significantly variability and often, purity may not be known by suppliers, particularly at the retail level, nor by PWUD. Thus, price is determined by expected purity more so than actual purity (Caulkins, 1994).

To date, economic aspects of pharmaceutical black markets are yet to be examined. This is warranted given that many countries around the world have observed rising diversion, use and harms due to pharmaceutical drugs (Ciccarone, 2019). For instance, in Australia in 2016, the number of drug-induced deaths were at their highest in twenty years and the average decedent was a person using prescription drugs (ABS, 2017). In 2017 in the US, there were over 17,000 overdose deaths due to commonly prescribed opioids – a rate of 5.2 per 100,000 population (Scholl et al., 2019).

Prior research with end-users has shown that pharmaceutical drugs may be diverted from the medical system and sold on the black market for prices that far exceed their cost when obtained medically (Elwood, 2001, Furst, 2014, Inciardi et al., 2009a, Leukefeld et al., 2007, O'Reilly et al., 2007, Sajan et al., 1998, Winstock and Lea, 2010), which has led to the assumption that the practice is financially lucrative. That said, research has also revealed motivations for diversion and supply other than financial gain, including altruism, reciprocity and the pursuit of a shared cultural and social experience (Hulme et al., 2019b, Murphy et al., 2018, Rigg et al., 2012, van de Ven and Mulrooney, 2017). However, a lack of supply-side research has meant that the drivers and material benefits from pharmaceutical diversion have not been thoroughly examined

nor quantified. This study contributes to the lacking knowledge by using information obtained from a sample of people involved in pharmaceutical diversion and supply in Australia to: (1) provide an overview of the pharmaceutical black market in terms of price, revenue and mark-up; (2) examine supply-side factors influencing the price and mark-up; and (3) explore the practice of 'gifting' and quantify the non-realised revenue from gifts. This research will help to contextualise the motives of suppliers including to what extent pharmaceutical diversion to end-users is profitable in Australia, and any similarities and differences to illicit drug markets.

5.5 Method

5.5.1 Data source

The data collection processes have been described in full elsewhere (Hulme et al., 2019b) (**Chapter Four**). In brief, telephone interviews were conducted with 51 people involved in selling, giving away or trading a pharmaceutical drug on more than two occasions in the prior six months. A multi-staged recruitment process involved the distribution of flyers to participants of two Australian drug-monitoring programs coordinated by the National Drug and Alcohol Research Centre (NDARC) – the Illicit Drugs Reporting System (IDRS) and the Ecstasy and related Drugs Reporting System (EDRS), followed by a screening of interested participants. Participants were also invited to pass on study information to others that might be interested. Sampling via the IDRS and EDRS resulted in a sample of people who use illicit drugs. Interviews were conducted with participants from all Australian jurisdictions, excepting Victoria where no flyers were distributed.

Those eligible participated in a semi-structured telephone interview that collected a range of individual and transaction information (see Appendix 4A for the interview protocol). This study uses data collected on supply practices, drug sourcing, quantity and frequency of supply, purchase value and sales price. Data collection took place between March and June 2017. Interviews were audio-recorded and transcribed verbatim. This study received ethical approval from the University of New South Wales (UNSW) (#HC16926).

While telephone interviews have been shown to be useful in promoting anonymity and response to sensitive drug and alcohol-related questions (Aquilino, 1992, Aquilino, 1994), this study may be subject to the biases typical of self-report data including the tendency for participants to provide socially desirable responses. The validity of the analyses presented herein is reliant upon accurate reporting by participants. That said, previous research with people involved in drug trafficking has proven useful for understanding the economic aspects of the illicit drug trade (see for example, Caulkins et al. (2009), Caulkins et al. (1999), Matrix Knowledge Group (2007), Pardal et al. (2014)). Moreover, this study is the first internationally to examine the price and mark-up of pharmaceutical drugs supplied on the black market and so despite these potential biases, is an important contribution and basis for future research.

5.5.2 Unit of analysis

As used in previous research, the unit of analysis in this study is a drug transaction 'cycle' from the point of acquisition to distribution. That is, the process whereby the supplier obtains a drug and divides the drugs into smaller quantities (if applicable) for distribution (Caulkins et al., 2016, Caulkins et al., 2009, Caulkins et al., 1999, Pardal et al., 2014). The 51 interviews yielded information on 121 drug transaction cycles, of which 111 contained 'complete' or adequate information for inclusion in the analyses. Six were excluded for providing inadequate information on the quantity supplied and four were excluded because purchase price could not be inferred.

5.5.3 Distribution mode

The supply of both illicit (Bright and Sutherland, 2017, Caulkins and Pacula, 2006, Coomber, 2003, Coomber et al., 2016, Werse and Bernard, 2016) and pharmaceutical drugs (Hulme et al., 2018, Murphy et al., 2018) do not always involve monetary transactions. This is particularly evident at the lower end of the market, where sharing and trading between friends and family occurs and may replace or accompany dealing motivated by financial gain. These practices have implications for revenue flows and profitability. The approach used in this study accounts for the impact of non-monetary transactions on revenue and mark-up.

Across our sample, two in three cycles (66%) involved the distribution of drugs via a singular mode (e.g. sale, gift or trade), and one in three (34%) involved distribution via multiple modes (e.g. sale and gift). For the latter, we estimated the quantity of drugs distributed via each mode, which was then accounted for in calculations of overall revenue and mark-up for each drug transaction cycle. For cycles without adequate information on the relative quantities distributed by gifting, selling and trading, we analysed the transcripts for indicators of the primary mode of supply and used this information to infer the proportional quantities. Specifically, participants who indicated they were motivated to supply for monetary gain were designated as primarily sellers and 75% of the quantity of drugs they obtained were assumed to be for the purpose of selling, whereas those who mentioned they were mainly involved in trading pharmaceuticals were designated as primarily traders and 75% of the quantity obtained were assumed to be for the purpose of trading. Where the transcripts provided no indication of the primary mode of supply (n=3), the quantity was equally divided by each mode used (e.g. 50% selling and 50% trading). By way of example, if a supplier indicated they obtained 100 tablets to supply by selling and gifting and indicated that they were mainly motivated for commercial profit – we assumed 75 of the tablets were obtained for sale and 25 were given away. For robustness, we also conducted sensitivity testing, whereby 65% and 85% were allocated to the primary mode with the remainder allocated to the secondary mode (see Appendix 5A). The quantities exclude those obtained for personal use.

5.5.4 Dependent variables

The two outcome variables of interest are unit sales price and mark-up.

Unit sales price refers to the price charged to the buyer for a single unit (i.e. tablet, pill, vial). Where the unit price was not explicitly stated, this was inferred by dividing the quantity distributed by the total sales price. For example, if the supplier indicated they sold 20 tablets for $10, the unit sales price was deemed to be $0.50 (i.e. $10 / 20). Where the cycle involved gifting only (n=23), the unit sales price was designated as $0. For the cycles that involved trading only (n=7) and in the absence of detailed information on the quantity of incoming

trades, we assumed the value was equivalent to the black-market value of outgoing pharmaceuticals. As such, we imputed the median sales price of the pharmaceutical drug traded as reported by others within the sample. For example, if a cycle involved trading diazepam for cannabis, we imputed $2.50, which is the median unit sales price of one diazepam tablet.

Mark-up is expressed as the ratio of the sales revenue to the amount the supplier paid to acquire the drugs (Caulkins et al., 1999, McFadden et al., 2014). This allowed us to examine how much the supplier earned for every dollar spent acquiring the drugs. This variable was constructed by first estimating the gross revenue and total purchase value of the drugs obtained per cycle:

- Gross revenue was calculated by multiplying the unit sales price by the quantity of drugs obtained for distribution by selling and trading in a single cycle.
- Total purchase value was calculated by multiplying the unit purchase price by the quantity obtained for distribution (by all modes, including gifting). The purchase value was dependent on source. Where the supplier reported that they had obtained their drugs through the medical system and no information was provided on cost (n=60), we imputed cost data from the Australian Pharmaceutical Benefits Scheme (PBS) (2018) drugs register. For those participants that indicated they were currently receiving Centrelink[13] payments (n=12), we imputed a total cost price of $6.20 (AUD) to reflect the rate for concessional patient co-payments for 2017, the same year that the data was collected. For those participants who did not indicate that were receiving Centrelink payments (n=39), we imputed the general patient charge for that drug as listed on the PBS (see Appendix 5B for a full list of the drugs supplied and their PBS listings). The cost price of drugs sourced non-medically or through an intermediary such as through friends or family, illicit drug dealers and online, was solely reliant upon information provided by participants.

[13] Centrelink is the Australian social welfare system. Eligible Centrelink recipients are provided with a Healthcare Card that substantially subsidises prescriptions.

Unfortunately, data were not available on other overhead costs incurred by the supplier such as transport, search time and medical fees[14], thus the purchase value reflects only the cost of the drugs themselves. Previous researchers facing similar limitations have noted that illicit drug traffickers may have limited knowledge and willingness to discuss operating costs (Caulkins et al., 2009, Matrix Knowledge Group, 2007, Pardal et al., 2014).

5.5.5 Independent variables

Six independent variables were coded and included in the analyses as follows:

- ***Drug class*** – pharmaceutical opioids, hypnotic-sedatives, stimulants or other drugs (including antipsychotics, performance and image enhancing drugs (PIEDs)).
- ***Drug schedule*** – Schedule 3, 4 or 8 drugs as per the Therapeutic Goods Administration (TGA (2018d). Schedule 3 drugs are available over-the-counter from a pharmacy and Schedule 8 drugs are the most strictly controlled pharmaceutical drugs in Australia.
- ***Source of drugs distributed*** – medical (legitimate or illegitimate prescription including via doctor shopping) or non-medical/intermediary (friends/family, illicit dealer, third-party[15], online).
- ***Transaction size*** – the number of units distributed in an ordinary transaction. There were 13 cycles in our sample that omitted this information.
- ***Potency*** – high or low. Opioids with an Oral Morphine Equivalent (OME) of one or higher were classified as high potency, while opioids with an OME under one were classified as low potency (Nielsen et al., 2016). For sedatives with an Oral Diazepam Equivalent (ODE) of one or over were classified as high potency, while sedatives with an ODE under one were classified as low potency (Nielsen, n.d.) (Further information

[14] Australia has a publicly funded healthcare system known as Medicare. This means that people can visit health practitioners free of charge, or they may choose to visit private practitioners and be charged a fee, which is partially subsidised by Medicare.

[15] Third parties were unique from other sources because they were not known to the supplier (i.e. not friends/family), nor were they involved in supplying illicit drugs (e.g. cocaine or ecstasy) (Hulme et al. 2019) (**Chapter Four**).

provided in Appendix 5C). There is no consensus on classifying stimulants or other pharmaceutical drugs such as PIEDs by potency, so these 35 cycles were excluded from the potency analyses.

- ***Cycle frequency*** – number of cycles in the prior six months, or the number of visits to the source to obtain a drug for distribution. There were 38 cycles that omitted this information.

5.5.6 Analytical framework

A generalised linear mixed model (GLMM) was used to estimate the relationship between unit sale price and mark-up and the aforementioned predictors. This model was selected because the frequency distribution of our data was positively skewed and non-linear – as is typical of cost data (Deb et al., 2017). Participant identifier was used as a random intercept, as this models a dependency structure among observations of the same participant. Fixed covariates were the independent variables identified above. These analyses excluded the 23 cycles where drugs were gifted only.

5.5.6.1 Diagnostics

A Box-Cox transformation test was used to determine the appropriate specification of the dependent variables (as per Caulkins and Pacula (2006), Deb et al. (2017)). The estimated coefficient for each model was only slightly greater than 0 (as shown in Table 4) meaning that the log link function was preferable (Deb et al., 2017). A modified Park test was used to test for the relationship between the predicted mean and variance and thus, specify the appropriate distribution family (as per Deb et al. (2017) and Pacula et al. (2007)). The coefficient for each model was near to two (see Table 4), thus a gamma distribution was selected (Blough et al., 1999, Deb et al., 2017). Variables that were significant at the bivariate level were included in the multivariate model. Additionally, the Akaike Information Criterion (AIC) was used to assess goodness-of-fit for each multivariate model with only the final model presented.

5.5.6.2 Gifting

In order to estimate the non-realised revenue from drugs gifted, we imputed the expected sales price reported by that participant (where the drug was also sold, n=25) or the median sales price of others within the sample (where the drugs were gifted only, n=23). A logistic GLMM was used to estimate what factors influenced the likelihood of drugs being given away versus not given away, with results presented in Appendix 5D.

Statistically significant differences were assessed at $P < 0.05$; all P values are two-sided. All analyses were performed using STATA software, Version 15.0 (StataCorp, 2017). Monetary figures are in 2017 Australian dollars. As is typical of research with drug traffickers (Caulkins et al., 2009, Caulkins et al., 1999), our analysis is limited insofar as the sample size is concerned. Caution should be exercised in interpreting particularly the multivariate results, because the small sample size may enhance the likelihood of Type II error.

5.6 Results

5.6.1 Overview of supply activity

The supply activity is summarised in Table 5.1. There were 33 unique drug types supplied over the 111 cycles (Appendix 5B). The most common class supplied was hypnotic-sedatives (36%), followed by pharmaceutical opioids (32%), stimulants (18%) and other drugs, including gabapentin, antipsychotics and PIEDs (14%). Less than half the drugs supplied were Schedule 8 (44%) – the most strictly controlled pharmaceutical drugs in Australia (TGA, 2018d). Of the 76 cycles involving the distribution of opioids or sedatives, 76% (n=58) were classified as high potency (Appendix 5C).

In over half the cycles, the drugs were sourced directly from the medical system (n=60, 54%) either through legitimate prescriptions (n=48, 80%) or illegitimate practices like doctor shopping (n=12, 20%). Of the drugs sourced non-medically or through intermediaries (n=51, 46%), illicit drug dealers (n=21, 41%) were the most common, followed by friends/family (n=17, 33%), a third party (n=9, 18%) and online (n=4, 8%).

Seventy-one per cent of cycles (n=78) involved the sale of drugs, whereby money was exchanged with the buyer even if the sale was not for profit. Two in five cycles (43%, n=48) involved drugs being given away for free and one in three (32%, n=36) involved drugs being traded for other goods or services – namely, other illicit drugs (n=26), other pharmaceutical drugs (n=7), alcohol (n=1) or sexual acts (n=2). There were approximately 3,446 units obtained for distribution over the 111 cycles, of which it was estimated that 65% were sold (n=2,230), 20% were gifted (n=678) and 15% were traded (n=538).

Table 5.1. Summary statistics of supply activity

	N (%)
Class	
Opioids	36 (32.4)
Sedatives	40 (36.0)
Stimulants	20 (18.0)
Other [a]	15 (13.5)
Schedule	
Schedule 3	4 (3.6)
Schedule 4	58 (52.3)
Schedule 8	49 (44.1)
Opioid potency	
High	22 (19.8)
Low	14 (12.6)
Sedative potency	
High	36 (32.4)
Low	4 (3.6)
Source	
Medical	60 (54.1)
Non-medical	51 (46.0)
Distribution mode	
Sold only	43 (38.7)
Gift only	23 (20.7)
Sold, trade	13 (11.7)
Gift, sold, trade	13 (11.7)
Gift, sold	9 (8.1)
Trade only	7 (6.3)
Gift, trade	3 (2.7)

Notes: Potency not available for stimulants and 'other drugs'.
[a)] Includes gabapentin, antipsychotics and PIEDs. N = 111.

5.6.2 Cost and sale price

Table 5.2 provides the mean and median unit cost, total purchase value and unit sale price by drug class, schedule and source.

Table 5.2. Mean and median unit cost, purchase value and sale price

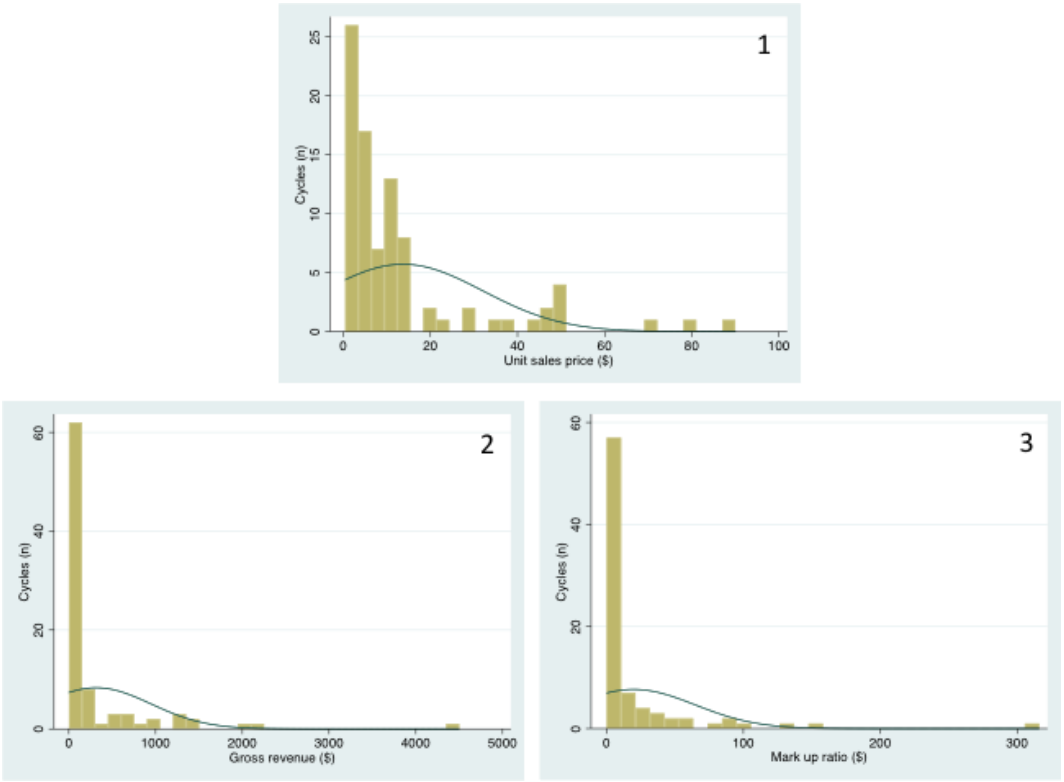
	Unit cost price [a]		Total purchase value per cycle [a]		Unit sale price [b]	
	Mean	**Median**	**Mean**	**Median**	**Mean**	**Median**
Opioids	$9.60	$0.97	$113.14	$16.03	$25.80	$15.00
Sedatives	$1.25	$0.43	$48.59	$10.28	$8.19	$5.00
Stimulants	$3.11	$1.40	$29.85	$16.80	$7.42	$8.00
Other [c]	$0.69	$0.37	$8.40	$6.20	$10.12	$2.50
Schedule 4	$2.07	$0.43	$67.45	$7.19	$8.73	$3.50
Schedule 8	$6.94	$1.50	$52.19	$15.65	$19.36	$10.00
Medical source	$0.65	$0.43	$11.18	$6.20	$13.71	$5.00
Non-medical source	$8.42	$2.00	$118.98	$22.50	$13.66	$7.50
Total	**$4.22**	**$0.77**	**$60.71**	**$10.00**	**$13.69**	**$7.50**

Notes: All monetary figures are expressed in 2017 Australian dollars.
[a)] N=111
[b)] N=88, excluding 23 cycles where drugs were gifted only (therefore, sale price = $0).
[c)] Includes gabapentin, antipsychotics and PIEDs.

Approximately three-quarters of cycles (77%) involved the obtainment of drugs at a unit cost price of $2 or less. The cost of drugs obtained from the medical system was lower than those obtained from non-medical sources. The maximum cost price reported was $90 per unit for a high potency opioid (i.e. morphine) sourced on the black market via an illicit dealer. The median total purchase value per cycle was $10.

Figure 5.1 presents the frequency distribution for unit sale price, showing that the distribution is positively skewed. The unit sales price of drugs distributed ranged from $0 (where drugs were given away freely) to $90, and 76% of cycles involved the distribution of drugs for $10 or less per unit. Excluding 23 cycles where drugs were only given away freely, the median per unit sales price of the remaining 88 cycles was $7.50. Pharmaceutical opioids and Schedule 8 drugs had the highest median unit sale price (Table 5.2).

Figure 5.1. Sales price, gross revenue and mark-up ratio



Notes: N = 88, each distribution excludes 23 cycles where drugs were gifted for free.
Mark-up excludes 11 cycles where costs or revenue were nil, thus calculations not possible.

The bivariate and multivariate results presented in Table 5.3 examine predictors of (log) real sales price per unit, excluding the 23 cycles where drugs were gifted only. As shown, sedatives and 'other' pharmaceutical drugs were sold at lower prices than pharmaceutical opioids. This remained significant in the multivariate model for sedatives, holding transaction size constant. Schedule 4 drugs were sold at lower prices than Schedule 8 drugs – the more heavily controlled in Australia. Drug schedule was excluded from the multivariate model due to collinearity with drug class.

The bivariate and multivariate analyses identified a negative relationship between unit sales price and transaction size (number of units supplied in an ordinary transaction). This means that the unit price is lower when distributing higher quantities. The model yields a statistically significant coefficient of -0.21 (p = 0.000) suggesting that unit price falls by 2.1% for every 10% increase in transaction size. The coefficient is slightly lower after controlling for drug class

(i.e. β = -0.18 or a 1.8% decrease in price is met with a 10% increase in transaction size (p = 0.000)).

Potency was excluded from the multivariate model, as it was only available for two of the four drug classes, however the bivariate regressions found no relationship between unit sales price and drug potency for either sedatives or opioids.

Table 5.3. Gamma GLMM regression predicting log unit sales price

Covariate	N	β		SE	β		SE
		Bivariate			Multivariate		
ln(Transaction size)	81	-0.21	**	0.04	-0.18	**	0.04
Drug class (ref = opioids)	27						
Sedatives	33	-0.42	**	0.12	-0.34	**	0.12
Stimulants	17	-0.27		0.15	-0.18		0.15
Other [a]	11	-0.46	**	0.17	-0.32		0.19
Drug schedule (ref = Schedule 4)[b]	44						
Schedule 8	41	0.47	**	0.10			
Opioid potency (ref = low)	13						
High	44	0.22		0.18			
Sedative potency (ref = low)	11						
High	44	-0.20		0.20			
Source (ref = medical)	43						
Non-medical	45	0.08		0.12			
Cycle frequency (6mos)	67	0.00		0.00			
Constant					1.13	**	0.11
N					81		
Wald X2					34.23		
p					0.00		
Box Cox					0.002		
Modified Park Test					2.500		
AIC					205.30		
BIC					222.06		

Notes: [a)] Includes gabapentin, antipsychotics and PIEDs.
[b)] Excludes four cycles that involved the supply of Schedule 3 drugs. Drug schedule was excluded from multivariate model due to collinearity with drug class.
All models estimated using GLMM with link(log) and family(Gamma).
Significant clustering effects were observed, whereby the standard deviation (SD) of the random intercept (participant ID) for the final model is not equal to zero: SD = 0.29, SE = 0.22, LR test chibar2(01) = 2.64, p < 0.05. N = available sample (number of cycles), SE = standard error, p = p-value, ** p < 0.01, AIC = Akaike Information Criterion, BIC = Bayesian information criterion.

5.6.3 Revenue, gross profit and mark-up

Figure 5.1 presents the frequency distributions for gross revenue and mark-up ratio. Table 5.4 provides the mean and median for each of these variables, by drug class, schedule and source.

Table 5.4. Gross revenue, gross profit and mark-up per cycle

	Gross revenue		Gross profit		Mark-up ratio		Mark-up (%)	
	Mean	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**
Number of cycles	88		88		82		82	
Opioids	$359.10	$100.00	$212.02	$30.00	$28.01	$2.50	2701	150
Sedatives	$321.92	$100.00	$264.03	$98.76	$19.14	$3.30	1814	232
Stimulants	$134.20	$60.00	$100.13	$16.05	$7.48	$1.50	648	51
Other	$465.61	$75.00	$455.08	$68.80	$21.84	$10.44	2084	944
Schedule 4	$323.30	$80.00	$230.34	$54.47	$11.98	$2.72	1098	172
Schedule 8	$313.71	$96.00	$253.37	$42.00	$27.64	$3.19	2664	219
Medical source	$402.15	$96.00	$389.98	$80.35	$36.09	$13.49	3509	1249
Non-medical source	$231.78	$80.00	$97.26	$7.50	$2.89	$1.23	189	23
Total	**$315.03**	**$90.00**	**$240.29**	**$57.56**	**$19.90**	**$3.19**	**1890**	**219**

Notes: All monetary figures are expressed in 2017 Australian dollars. All calculations exclude 23 cycles where drugs were gifted only. Mark-up excludes six cycles where costs or revenue = $0.

The quantity sold or traded in an ordinary transaction ranged from one to 100 units (i.e. tablets, pills, vials) with a median of five (n=81). The median transaction value was $30, ranging from $0.43 (for one diazepam) to $630 (where 14 tapentadol were supplied for $45 per unit) (n=81). The gross revenue per cycle ranged widely from $0.83 to $4,500, with a median of $90 and the median gross profit per cycle was $58. Two in five cycles (40%) resulted in negligible profit – that is, 23% had a nil or negative gross profit and 17% had profit of greater than $0 but less than $20. While as noted above pharmaceutical opioids had the highest unit sale price, sedatives and other drugs had the highest median gross profit. Gross revenues are also influenced by the frequency with which a supplier conducts their cycle or the number of times the supplier visits the source for additional drug supplies (Pardal et al., 2014). In the 67 cycles[16] where it was reported, the median number of cycles in the prior six months was three, ranging from one to 150. For these cycles, we estimated gross revenues over a six-month period by multiplying

[16] Excluding six cycles where cycle frequency was reported, but distribution was only via gifting.

gross revenue by cycle frequency. The median gross revenue was $180 in six months, which is the equivalent of $30 per month.[17]

For every dollar spent acquiring the drugs, the supplier earned a median of $3 and the median percentage mark-up was 219%.[18] Mark-up was highest for drugs sourced medically, with median earnings of $13 for every dollar invested. Table 5.5 presents the bivariate results examining predictors of mark-up. Only one factor was significant at the bivariate level, thus multivariate analyses were not undertaken. The results show that where the drugs were sourced influenced mark-up in a significant way. That is, cycles involving the distribution of drugs sourced non-medically or through intermediaries had significantly lower mark-ups than drugs sourced directly from the medical system.

Table 5.5. Gamma GLMM regression predicting mark-up[a]

Covariates	N	β		SE
		Bivariate		
ln(Transaction size)	75	0.00		0.15
Drug class (ref = opioids)	25			
Sedatives	31	0.07		0.36
Stimulants	16	0.00		0.48
Other [b]	10	0.04		0.49
Drug schedule (ref = Schedule 4) [c]	44			
Schedule 8	38	0.47		0.29
Drug potency (ref = low)	12			
High	44	-0.29		0.46
Source (ref = medical)	42			
Non-medical	40	-1.94	**	0.34
Cycle frequency (6mos)	61	0.01		0.01

Notes:

[a)] The ratio of the sales revenue to the amount the supplier paid to acquire the drugs (McFadden et al., 2014).

[b)] Includes gabapentin, antipsychotics and PIEDs.

[c)] Excludes cycles involving the supply of Schedule 3 drugs.

All models estimated using GLMM with link(log) and family(Gamma). Participant ID used as a random intercept. N = available sample (number of cycles), SE = standard error, p = p-value, ** $p < 0.01$. Excludes 23 cycles that involved only gifting and 6 cycles where revenue or costs were nil, thus profitability cannot be calculated.

[17] There was an extreme outlier with estimated monthly revenue of $9,500 (i.e. $57,200 / six months). This cycle involved the obtainment and distribution of 200 units of alprazolam on a weekly basis, sold in lots of three units at $11 per unit (i.e. $33 transaction value).

[18] There was one cycle where the supplier earned $316 for every dollar spent acquiring morphine tablets from the medical system under Centrelink and distributed at a sale price of $70 per unit.

5.6.4 Non-realised revenue from gifting

There were a total of 679 units distributed for free over 48 cycles. This ranged from one to 98 units in a single cycle, with a median of six units. The total costs to the supplier for drugs gifted ranged from $0 (where the drugs were obtained and distributed for free) to $54 per cycle, with a median of $11. After imputing the expected sales price of the drugs gifted based on market value reported across the sample, the total estimated non-realised revenue of the drugs gifted over the 48 cycles was $3,527, with a median of $28 per cycle. These estimates include one cycle where 28 morphine tablets with an expected sales price of $70 were given away for free. Excluding this outlier, the total non-realised value of drugs gifted over the 47 cycles was $2,408, with a median of $25 per cycle.

5.7 Discussion

To our knowledge, this is the first study internationally to examine the economic aspects of pharmaceutical drugs supplied on the black-market using data collected from a sample of people involved in diversion and supply. In doing so, this study provides novel insight into the price, revenue and mark-up of pharmaceutical drugs distributed on the black market, supply-side predictors of price and mark-up, and the practice of gifting.

5.7.1 Key findings

The 111 drug transaction cycles in our sample comprised the supply activity of 51 people who were involved in diverting pharmaceutical drugs to end-users. At the bivariate level, Schedule 8 drugs were found to have significantly higher prices than Schedule 4 drugs. One possible explanation may be the more restricted availability and potential risks associated with accessing Schedule 8 drugs, or it could reflect their higher potency and dependence liability (Babalonis et al., 2013). There were price variations by drug class. Specifically, pharmaceutical opioids had higher prices than sedatives. Moreover, transaction size was inversely related to unit price, whereby a 1.8% decrease in price was met with a 10% increase in transaction size, holding drug class constant.

For every dollar invested acquiring the drugs, the suppliers in our sample earned a median of $3.19 or mean of $19.90 per cycle. The only significant predictor of mark-up was source, whereby medically sourced drugs had a significantly higher mark-up ratio than drugs sourced through non-medical sources or intermediaries (median earnings of $13.49 cf. $1.23 for every dollar spent). This reflects the lower cost of drugs obtained and subsidised via the Australian medical system, where the median purchase value was $6 per cycle, compared with $23 for drugs not sourced directly from the medical system. Interestingly, drug class and drug schedule were not predictors of mark-up, indicating that it is where the drugs are accessed that influences earnings, rather than what drug or how much is being supplied.

Most of the cycles occupied the lower end of the distribution in terms of gross revenue and gross profit. Specifically, three-quarters of the cycles had gross revenue of $150 or less and a gross profit of $118 or less. However, there were a few large transactions that accounted for a significant share of the total earnings across the sample, which seems to be consistent with the distribution of profits reported in illicit markets (Hughes et al., 2016b, Nicholas, 2008, Reuter et al., 1990). The maximum gross profit was $4,466 per cycle and the maximum mark-up ratio was $316 for every dollar invested.

The practice of gifting was common among our sample, with two in five cycles involving drugs being given away for free – either as an isolated practice (n=23) or in combination with their sale or trade (n=25). The median value of the drugs gifted was $11 and the non-realised revenue from gifts was $25 per cycle. There were no significant differences between the cycles that did and did not involve gifting, suggesting that certain drug classes, schedules or potencies were not more or less likely to be given away.

5.7.2 Implications for research and practice

This research has identified some similarities and differences with illicit drug markets. First, we found that price varied by drug type, however mark-up did not. Price variations by drug type are consistent with illicit drug markets. For example, in Australia cannabis has a median retail-price of $20 per gram, compared with $350 per gram for cocaine and $210 per gram for

meth/amphetamine (Peacock et al., 2018b). The price differentials of illicit drugs can be affected by a number of factors including the ease of production and supply, as well as the risk of detection and other market players (Caulkins and Reuter, 1996, Reuter and Kleiman, 1986). In the context of pharmaceuticals, price differences by drug type may reflect distinct user populations and motivations for use. For instance, pharmaceutical opioids are common substitutes for illicit opioids such as heroin among people who use and inject drugs and who tend to have high rates of drug dependency (Larance et al., 2011a). Benzodiazepines have been used for self-management of anxiety, stress and psychological problems and to mitigate the effects of over-stimulation or withdrawal from other drugs (UNODC, 2017a). Whereas stimulants are used for study or recreation purposes particularly among student populations (Lucke et al., 2018). The influence of such demand-side factors on the price of black market pharmaceuticals could be explored with future research.

The lack of influence of drug type on mark-up is inconsistent with illicit drug markets. For instance, McFadden et al. (2014) found that ecstasy has a mark-up ratio of $2.80 compared with heroin at $10.60. In our study, the source of drugs was the only predictor of mark-up, whereby a significant decrease in mark-up was observed as one moved away from the medical system and accessed drugs at a higher cost via non-medical or intermediary sources. It remains to be seen to what extent these differences manifest in other markets, such as North America and Europe, where access to health insurance and other characteristics of the health care system may result in different costs.

Second, consistent with illicit drug markets we identified that quantity discounts were offered whereby suppliers charged lower per unit prices when supplying in bulk. We found a 1.8% discount in price for a 10% increase in transaction size, which is comparable to the discount coefficients identified for illicit drugs sold on the Australian market, specifically 1.5% for meth/amphetamine (Gong et al., 2012) and 2.5% for cannabis (Clements, 2006). We also found that gifting was common. Providing discounts, credit and ‘freebies’ has also been identified in illicit markets as a strategy employed by dealers to secure a stable customer base (Pardal et al.,

2014). Research on pharmaceutical markets has shown that drugs may be gifted, shared or traded with others for altruistic reasons and to build social capital (Hulme et al., 2019b, Murphy et al., 2018). These findings contribute to the growing discourse challenging traditional notions of 'drug dealing' as a highly profitable venture (Bright and Ritter, 2011, Bright and Sutherland, 2017, Coomber and Moyle, 2014, Coomber et al., 2018, Coomber et al., 2016, Coomber and Turnbull, 2007, Grigg et al., 2015, Lenton et al., 2016, Lenton et al., 2015, McKetin et al., 2005, Murphy et al., 2018, Potter, 2009, Taylor and Potter, 2013, Werse and Bernard, 2016), and implies that people may become involved in supply for reasons other than financial gain.

Indeed, the median gross revenue from diversion and supply in our sample was merely $30 per month, which comparatively is considerably lower than the Australian minimum wage that is currently $3,117 per month (Australian Government, 2019). Furthermore, revenue from pharmaceutical diversion and supply estimated in our study seems to be much lower than revenue from illicit drug trafficking where earnings can be in the order of tens of thousands (Caulkins et al., 2009, Caulkins et al., 1999, Pardal et al., 2014). The frequency at which most suppliers in our sample returned to the source for additional drug supplies (i.e. once every two months), also seemed to be lower than has been reported for retail-level suppliers in illicit markets (i.e. daily to weekly) (Caulkins et al., 2009, Pardal et al., 2014). That said, illicit drug market research has also shown that low-level dealers may retain little of their earnings (Babor et al., 2018). For most of those interviewed in our study, diversion and supply was not the primary means of income and given that our sample comprised mainly user-dealers, the revenues received may have been used to cover the costs of their personal supply.

The small number of highly profitable cycles should not be overlooked. Indeed, the key finding from our study that some cycles are more profitable than others, contributes to discourse around the diversity of the illicit drug trade with regards to mechanisms, drivers and consequences of supply. For example, the work of Hughes et al. (2016b) identified that the quantity of drugs supplied, size of networks, criminal history and involvement in other types of crime differed between mono-traffickers and poly-traffickers in Australian illicit markets, whereby the latter

occupied a smaller proportion of the market, yet posed greater risks. Moreover, Hughes et al. (2019b) found no universal relationship between drug trafficking and serious and organised crime types. This prior work along with the findings of our study, suggest that nuanced policy responses are needed to address the range of supply activities and that identifying and targeting the most harmful adaptations is likely to be a useful approach (Hughes et al., 2019b, Hughes et al., 2016b).

5.7.3 Limitations

There are several caveats to consider with these findings, some of which we acknowledged in our earlier work with this dataset (see Hulme et al. (2019b)) (**Chapter Four**). The data itself may be subject to biases due to the self-selection of participants, social desirability and recall. Recruitment via NDARC's drug monitoring programs meant that our resultant user-dealer sample likely operated toward the lower end of the market, where profits are likely to be more modest. Future research may seek to explore diversion and supply at higher levels, including those involved in diverting drugs prior to them reaching the medical system. This analysis was reliant upon some level of estimation. For instance, inferences were drawn from the PBS drugs register to estimate the cost of drugs obtained from the medical system for distribution. Similarly, the quantity of drugs obtained for distribution by each mode was estimated based on participants verbal indicators of motive, with sensitivity testing undertaken for robustness. This may expose the analyses to some degree of error, which should be borne in mind in interpretation. The limited sample size, while typical of research with drug traffickers, has limited our ability to further disaggregate by source type; include multiple variables in the models; and may have inflated the risk of Type II error. The study did not collect data on overhead costs incurred by suppliers and as such, the true profitability of the drug transaction cycle cannot be reliably estimated. Unfortunately, no reliable data was available on the perceived risks of diversion and supply by participants. This will be an important avenue for future research given the importance of risk in determining price on illicit drug markets (Reuter and Kleiman, 1986). Other factors not modelled in this study and that may influence price and

cost include police enforcement, regulation, substitutes and complements. These could be explored with future research.

5.7.4 Conclusion

This is the first study internationally to examine the economics of black-market pharmaceutical supply. In our sample, the price of pharmaceutical drugs varied by drug type and transaction size, consistent with a discount effect. Drugs sourced directly from the medical system had a higher mark-up than drugs sourced through intermediaries such as friends or family, illicit drug dealers and online marketplaces. There were a small number of cycles that realised large profits that may warrant different types of policy responses. However, for most suppliers in our sample, diversion was not as financially lucrative as end-user studies have suggested. Our research demonstrates the importance of examining both cost and sale price through supply-side research, as well as accounting for drug supply by selling, gifting and trading in calculations of revenue, profit and mark-up. There is merit is replicating this research in other contexts with different healthcare systems including North America and Europe – which are facing similar concerns in relation to pharmaceutical diversion and NMU.

6 Chapter Six: Discussion

The body of work presented in this thesis was prompted by increases in mortality involving pharmaceutical drugs in Australia and overseas (ABS, 2017, Roxburgh et al., 2017, UNODC, 2018) and knowledge that the risk of harm is exacerbated when pharmaceutical drugs are diverted from legal sources and used non-medically such as in greater quantities, frequencies or in combination with other substances (Daniulaityte et al., 2014). As outlined in **Chapter One**, international and Australian research has focused on understanding the demand, risk factors and harms associated with pharmaceuticals (see for example Casati et al. (2012), Wilens et al. (2008), Lucke et al. (2018), McCabe et al. (2014), Roxburgh (2018), Sagoe et al. (2014)), however prior to this thesis, there was limited research to understand diversion and supply for NMU. Comparatively there is a much larger international evidence-base on the supply of illicit drugs like cannabis, cocaine, heroin and meth/amphetamine. This has been important for unpacking the nuances of drug supply, challenging assumptions and informing the targeting of policies and interventions (see for example Babor et al. (2018), Bouchard (2007), Caulkins and Reuter (1998), Hughes et al. (2019b), Hughes et al. (2016b), MacCoun and Reuter (2001), Reuter and Kleiman (1986)).

This thesis aimed to fill this knowledge gap by examining diversion and supply of pharmaceutical drugs for NMU in Australia. Specifically, it focused on unpacking the illegal supply chain from the medical system to end users, including the mechanisms, methods, motivations, price and mark-ups associated with pharmaceutical diversion and supply. There were four empirical studies conducted, as follows:

1. **Chapter Two** consolidated international evidence to estimate the prevalence of end-user sourcing through medical and non-medical or intermediary access routes and examined how sourcing and diversion varied between different drug classes and population groups.

2. **Chapter Three** examined the circumstances surrounding diversion from the medical system and identified factors contributing to inappropriate supply and misappropriation of pharmaceutical drugs by health practitioners in Australia.
3. **Chapter Four** identified the source and motivations of pharmaceutical diversion and supply according to a sample of active suppliers in Australia, with a focus on understanding correlates of medical and non-medical or intermediary sourcing and financial and altruistic motives.
4. **Chapter Five** calculated the revenue and mark-up of pharmaceutical drugs supplied on the black market and examined factors influencing price and mark-up including drug class, drug scheduling and quantity and frequency of supply.

This research is timely given the increasing policy attention that has been paid to addressing pharmaceutical diversion and supply for NMU. This chapter will summarise and synthesise the findings of the four empirical studies in the context of existing knowledge and discuss the implications for policy, practice and future research.

6.1 Summary of key findings and contributions to the literature

6.1.1 Drug sourcing by end-users and diversion in an international context

Chapter Two identified 149 studies published between 1996 and 2017 in Australia, North America and Europe that examined the source or diversion of pharmaceutical drugs for NMU. This study used meta-analyses to estimate the prevalence of drug sourcing as reported by 34 cross-sectional studies that surveyed end-users about where they accessed their drugs. A key finding was that across all population groups (i.e. general population, PWUD and patients) and drug classes (i.e. pharmaceutical opioids, sedatives and stimulants), friends and family were the most prominent source. Specifically, it was estimated that two in three end-users accessed their drugs from friends or family without payment and one in five with payment.

It was also estimated that one in three end-users accessed their drugs directly from the medical system, whereby drugs were initially obtained for the treatment of legitimate symptoms of illness or injury and leftover supplies were subsequently used for non-medical purposes. This was a particularly common access point for PWUD. Illegitimate medical sourcing through practices such as doctor shopping and prescription forgery were infrequent access points reported by end-users (less than one in ten) and this was consistent across all population groups and drug classes.

Meta-analyses of the seven comparable studies that examined diversion by PWUD and students showed that gifting was more common than selling and trading. A common risk factor for diversion as identified in the extant literature was the NMU of pharmaceutical drugs, suggesting diversion may manifest out of reciprocity and a mutual understanding about the perceived benefits or reasons for use.

An important outcome of **Chapter Two** was the abundance of prior research that sought to understand end-user sourcing and the concomitant absence of research examining how these pharmaceutical drugs were diverted from the medical system, and the steps in their supply from the medical system to the end user. Even the studies that specifically looked at diversion, focused on prevalence of gifting, trading and selling, rather than in-depth analyses of the mechanisms, drivers or consequences of diversion and supply. **Chapter Three, Four and Five** sought to fill this gap by exploring the circumstances surrounding diversion from the medical system, as well as the methods, mechanisms, drivers, price and mark-up pharmaceutical black market supply.

6.1.2 Problematic supply and diversion from the medical system

Chapter Three presented the results of the first Australian study to systematically examine the circumstances surrounding diversion from the medical system and the role of health practitioners in this process. This study involved a comprehensive search of the Australasian Legal Information Institute (AustLII) for all cases involving serious health practitioner misconduct for problematic supply or diversion of pharmaceutical drugs between 2010 and

2016. Given that the cases retrieved represented only a fraction of the entire health workforce (i.e. less than 0.001%) this suggests that most Australian practitioners are compliant and/or potentially misconduct that does occur may go undetected or is not serious enough to warrant referral to a high-level tribunal for a hearing.

Problematic supply comprised the majority of cases (n=85) and was typically classified as large scale, such that the misconduct extended for periods of more than five years, affected more than 10 patients, or involved large quantities (e.g. 5,000 pills). Subgroup analyses revealed that within this category there were two key groups with distinctive behaviour patterns and drivers. The first comprised doctors (n=52) who were typically involved in overprescribing Schedule 8 pharmaceutical opioids and hypnotic-sedatives to people who they ought to have known were likely to use the drugs non-medically, such as people with a substance use disorder or in the image enhancement community. These cases were typically attributed to the practitioner lacking the temperament and skills for managing the demands of these complex patient groups. The second group of practitioners involved in problematic supply comprised pharmacists (n=30) involved in the deliberate diversion of pseudoephedrine to persons known to be involved in the manufacture of meth/amphetamine and their conduct was more likely to be financially motivated.

This study adds to prior research in the US that identified problematic prescribing by health practitioners was a driver of overdose deaths (Rose et al., 2018), however there has been a focus on the role of practitioners in pain clinics who were financially incentivised to overprescribe (Rigg et al., 2010, Walker and Webster, 2012). This is an important departure from the Australian context where problematic prescribing occurs due to poor temperament and lacking skills of health practitioners, rather than financial incentives.

In Australia, deliberate misappropriation of workplace supplies comprised the minority of cases (n=36) and was typically classified as low scale, such that the misconduct extended for less than one year and affected up to five patients. While doctors, pharmacists and nurses were represented within this group, compared with the supply cases, this group was more likely to

involve nurses, which is largely reflective of the limited supply/prescribing responsibilities of nurses in Australia. Such misconduct typically involved the misappropriation of drugs for personal use and was borne out of the complex individual circumstances of the practitioner such as substance use disorders and mental health problems. Prior Australian research has shown that practitioners may access drugs from their workplace for personal use (Pilgrim et al., 2016), and this study builds upon this to illuminate the challenges facing such practitioners. An important outcome of **Chapter Three** was that the circumstances, drivers and scale of diversion and supply involving health practitioners varied by practitioner type, warranting nuanced policy responses.

6.1.3 Drug sourcing and motivations of suppliers

Chapter Four presented the results of the first Australian study to access a sample of people actively involved in the diversion and supply of pharmaceutical drugs and examined drug sourcing and motivations. This study identified that there were six sources used by suppliers: legitimately obtained prescriptions from the medical system, illegitimately obtained prescriptions via doctor shopping, friends and family, illicit drug dealers, online or dark net marketplaces, and third-parties who were neither friends nor dealers. Unlike end-users who primarily sourced through friends and family as determined in meta-analysis in **Chapter Two**, a key finding of **Chapter Four** was that one in two suppliers distributed drugs that were legitimately obtained from the medical system. However, similar to end-users, fewer suppliers (around one in ten) reported accessing their drugs through illegitimate practices like doctor shopping. Further analyses revealed that the quantity and frequency of drugs supplied varied by source, whereby doctor shopping was associated with the highest volume supply (mean of 10,620 doses) compared with those using other sources (mean of 224 doses). This suggests that while relatively rare, doctor shopping may still be an important source of pharmaceutical drugs that are diverted and supplied in Australia.

Similar proportions (around two in three) of suppliers reported financial and altruistic reasons for their involvement in diversion and supply, with some reporting both. Suppliers who were

altruistically motivated distributed a significantly lower number of doses (mean of 435 doses) than those not motivated altruistically (mean of 3,013 doses). When the suppliers in our study were asked about their perceptions as to the use of the drugs they supplied, two in five indicated that the drugs were being used therapeutically – that is, non-prescribed, therapeutic use such as for the self-treatment of pain, anxiety or withdrawal.

This study adds to prior research with people involved in pharmaceutical diversion and supply in the US that also identified a variety of methods for accessing drug supplies (see for example Green et al. (2013), Inciardi et al. (2009a), Rigg et al. (2012), Walker and Webster (2012), Worley and Thomas (2014)). However, unlike in the US where pain clinics have played an important role in facilitating diversion, in the Australian context with a different healthcare system there is no evidence of this. The high proportion of suppliers in this study that distributed their own leftover drugs to friends and family for reasons other than financial gain adds to literature on the social supply of illicit drugs, particularly cannabis (Hakkarainen and Perala, 2011).

6.1.4 Price and mark-up of black market pharmaceuticals

Building upon the analysis of **Chapter Four,** but at the cycle rather than participant-level, **Chapter Five** quantified the revenue, profit and mark-up associated with pharmaceutical black market supply. Data collected from suppliers on source, cost of obtainment, sale price and quantity and frequency of supply were used to make the first estimates of gross revenue, gross profit and mark-up from pharmaceutical diversion and supply. **Chapter Five** found that for every dollar invested in acquiring the drugs, the suppliers in our sample earned a median of $3.19 or a mean of $19.90 per cycle. Whether the drugs were sourced directly from the medical system or through an intermediary was the single predictor of mark-up. Specifically, drugs sourced directly from the medical system had a median mark-up ratio of $13.49, compared with $1.23 for those drugs that were sourced through an intermediary. This reflected the much lower cost of drugs acquired from the medical system and subsidised through the Australian PBS (i.e.

median per unit cost price $0.43), compared with the higher cost of drugs sourced through intermediaries (i.e. median per unit cost price $2.00).

The frequency at which suppliers returned to the source for additional drug supplies over a six-month period was also examined. This showed that most suppliers accessed additional supplies less than monthly (median of three times every six months). Accounting for this, the median gross revenue per month was merely $30. This finding disputes assumptions that have been made about the potentially lucrative nature of pharmaceutical black market supply, at least in an Australian context (Grzybowski, 2004, Leukefeld et al., 2007, Sajan et al., 1998). These modest returns suggest that for the most part, the supply activity described was for the purpose of cost recovery or supporting personal substance use, rather than as an income generating activity in and of itself. That said, the distribution of profit was positively skewed, meaning that there were a small number of highly profitable cycles. The maximum gross revenue per month was $9,500 and involved the distribution of 200 units (tablets) of alprazolam on a weekly basis, sold in lots of three units at $11 per unit.

Around two in five cycles involved freebies or gifts. For these cycles, the non-realised revenue was calculated by imputing the 'expected' sale of price of the drugs given away. It was estimated that these suppliers were willing to gift drugs that could have otherwise been sold for a median of $28 (AUD) per cycle. This further accentuates the point that the diversion and supply of pharmaceuticals may be driven by reasons other than financial incentive.

6.2 Contributions of this thesis to knowledge on illicit markets

This thesis contributes to discourse around the operation of illicit markets. Table 6.1 provides a summary of the extant knowledge on illicit drug supply compared with what has been shown in this thesis in relation to pharmaceutical diversion and supply. Both markets for illicit drugs and those for diverted pharmaceutical drugs involve exchanges of a product that hold some monetary value. Like other economic markets, drug markets are underpinned by the principles of demand and supply, whereby the amount consumers wish to purchase and the amount suppliers wish to provide, is a function of price (Moore et al., 2005). While consumers make

decisions about which product to purchase based on a number of factors such as availability and value for money, suppliers adopt strategies for attracting customers and maximising profits. This may include offering discounts when large quantities are purchased, providing freebies to customers, offering a variety of products and keeping costs to a minimum. Indeed, illicit drug market research has shown that quantity discounts are applied for cannabis, cocaine, heroin and meth/amphetamine (Caulkins et al., 2009, Caulkins and Padman, 1993, Clements, 2006, Gong et al., 2012); suppliers may offer multiple drug types or even trade in other commodities like firearms (Europol, 2017, Hughes et al., 2016a); and the quality or purity of drugs may be manipulated to keep costs down and in response to changes in availability (Caulkins and Padman, 1993, Moore et al., 2005). This thesis has shown a number of similarities including that pharmaceutical drugs that are diverted and supplied are provided at a lower per unit price as transaction size increases; suppliers may offer multiple pharmaceutical drugs and illicit drugs; and drugs may be sourced from a variety of sources depending on availability.

While suppliers may be profit motivated, there is also a certain amount of drug trading that occurs without monetary involvement, underpinned by the principles of good will, trust and reciprocity. In illicit drug markets, research has shown that home-cultivated cannabis may be shared when too much has been produced for personal use (Hakkarainen and Perala, 2011) and drugs, particularly cannabis and ecstasy (more so than heroin), may be distributed for minimal or no profit in social and recreational settings (Bright and Sutherland, 2017, Taylor and Potter, 2013, Werse and Bernard, 2016). This thesis similarly identified that non-monetary exchanges and non-financial motives are central to black market pharmaceutical supply.

While there are evidently shared characteristics between markets for illicit drugs and diverted pharmaceutical drugs, this thesis showed that markets are also a reflection of the distinct legislative frameworks and regulatory environments in which they are operate. For instance, the illegal nature of drugs like cannabis, cocaine, heroin and meth/amphetamine makes trafficking in them particularly challenging because the risks of detection and costs of enforcement are so high (Babor et al., 2018, Caulkins et al., 2016, Caulkins et al., 2009, Desroches, 2007,

Giommoni et al., 2017, Hughes et al., 2016a, McFadden et al., 2014, Reuter, 2014, Ritter et al., 2012, Tzvetkova et al., 2016). As a consequence the supply chain is long and complex involving many players at various levels. Illicit drugs like cocaine and heroin are often trafficked across borders via sea and air cargo, with the aid of corrupt officials and the involvement of organised crime groups (Europol, 2017, Hughes et al., 2016a). As a result the price of illicit drugs is remarkably high and the return on investment can be enormous (Caulkins, 2014, Gong et al., 2012, McFadden et al., 2014, Reuter and Kleiman, 1986). By comparison, this thesis has shown that the legal nature and manufacturing of pharmaceutical drugs serves to shorten the supply chain and concentrate access for NMU around the medical system and between persons known to one another. The legal manufacturing of pharmaceutical drugs also means that their quality or potency is generally not manipulated (excluding counterfeit pharmaceutical production, which is an issue outside the scope of this thesis). While the price of pharmaceutical drugs supplied on the black market may be high relative to the low cost of drugs obtained medically, this thesis found that for most suppliers, diversion and supply is unlikely to be an income generating activity in and of itself.

Table 6.1. Comparing knowledge on illicit drug supply with the diversion and supply of pharmaceutical drugs as identified in this thesis

	Knowledge on illicit drug supply	**Knowledge on pharmaceutical diversion and supply**
Methods and mechanisms of supply	The supply chain is long involving many players at various levels, which partly reflects risks and inefficiencies in the trade of illicit goods (Babor et al., 2018, Caulkins et al., 2016, Caulkins et al., 2009, Desroches, 2007, Giommoni et al., 2017, Hughes et al., 2016a, McFadden et al., 2014, Reuter, 2014, Ritter et al., 2012, Tzvetkova et al., 2016). Importation (via sea and air cargo) is an important part of the supply chain, particularly for those drugs produced in a small number of geographic regions such as is the case for heroin and cocaine (UNODC, 2019b). A key facilitator of distribution is the corruption of officials (Europol, 2017, Hughes et al., 2016a).	• The legal manufacturing of pharmaceutical drugs by its very nature eliminates several layers of the supply chain, thus simplifying the distribution process. • The supply chain is shorter, whereby there are fewer levels connecting the medical system to the supplier / intermediary and end-user. • One in three end-users accessed drugs directly from the medical system (**Chapter Two).** • One in three suppliers accessed drugs directly from the medical system (**Chapter Four**). • The diversion and supply of pharmaceutical drugs is concentrated domestically, reducing the need for sea and air cargo and corruption.
	Very diverse methods of supply and distribution routes, and significant regional variation. Methods and mechanisms of supply are highly adaptable over time, in response to demand or supply issues (O'Reilly, 2018). There is increasing diversification of supply methods and mechanisms due to globalisation and the expansion of trade routes (Hughes et al., 2016a, Rubin et al., 2013). Technological advancements have also provided new access routes such as the dark net and encrypted telecommunications (Europol, 2017, May and Hough, 2004).	• Less diverse methods of supply and distribution routes, with much more concentrated access from medical system. • Online marketplaces including the dark net are used, but low frequency reported by end-users (**Chapter Two**) and suppliers (**Chapter Four).** • The type of drugs diverted from the medical system varies by practitioner type relating to access and opportunity (**Chapter Three**).
Price, mark-up and motives	Quality and purity of illicit drugs may be manipulated by suppliers/manufacturers to influence price in the face of supply changes	• Pharmaceutical drugs are legally manufactured and so their quality is controlled by strict regulations.

	Knowledge on illicit drug supply	Knowledge on pharmaceutical diversion and supply
	(Caulkins, 2007, Caulkins and Reuter, 1996, Caulkins and Reuter, 1998, Moore et al., 2005, O'Reilly, 2018).	• **Chapter Five** examined whether the purity of pharmaceutical opioids and sedatives, classified as high or low potency using Oral Morphine Equivalent (OME) and Oral Diazepam Equivalent (ODE) respectively, had any influence on price and no relationship was found.
	Illicit drug prices (for drugs other than cannabis) are in general, extremely high and mark-ups can also be very high (Caulkins, 2014, Gong et al., 2012, McFadden et al., 2014, Reuter and Kleiman, 1986). For example, in Australia, McFadden et al. (2014) estimated that retail-level illicit dealers received between $2 and $3 for every dollar invested in acquiring the drugs, while distributors received $5, and an importer or producer received between $16 and $17. The frequency at which suppliers return to their source for additional drug supplies can also be very high (weekly or even daily), which leads to large revenue (Caulkins et al., 2009). Notably, profits do vary widely in illicit markets depending on a number of factors including size of the organisation, drug type supplied and level within the supply chain (Hughes et al., 2016a, Matrix Knowledge Group, 2007).	• **Chapter Five** found that drugs supplied on pharmaceutical markets have high per unit price and at face value mark-ups are comparable to those for illicit drugs. For every dollar invested acquiring the drugs for distribution the supplier earned a median of $3 and a mean of $19.90. • Cycle frequency is much lower than for illicit drugs, which means that monthly revenues are modest **(Chapter Five).**
	Mark-up varies by drug type (McFadden et al., 2014).	• **Chapter Five** showed that there seems to be no relationship between mark-up and drug type, though mark-ups are influenced by source (i.e. medical or intermediary/non-medical).
	Suppliers of cannabis, cocaine, heroin and meth/amphetamine offer quantity discounts, whereby per unit price is lower when sold in bulk (Caulkins and Padman, 1993, Clement et al., 2015, Gong et al., 2012).	• **Chapter Five** showed that quantity discounts also exist for pharmaceutical drugs.

	Knowledge on illicit drug supply	**Knowledge on pharmaceutical diversion and supply**
	Suppliers offer freebies or gifts – this is particularly common in cannabis markets (Caulkins and Pacula, 2006, Caulkins and Padman, 1993, Clements, 2006, Pardal et al., 2014). Some research has shown this might be a strategy employed by suppliers to secure a stable customer base (Pardal et al., 2014).	• Gifting may be more common for pharmaceutical drugs. • **Chapter Five** showed that just less than one in two distribution 'cycles' involved gifting. The drivers of gifting might be a reflection of altruistic motives, social supply and goodwill (**Chapter Four**).
	Social supply occurs – most commonly in cannabis and ecstasy markets (Bright and Sutherland, 2017, Coomber et al., 2018, Lenton et al., 2015). The terms social supply and minimally commercial supply have been used to describe the supply of illicit drugs between friends and family for little or no profit. Social networks may be a preferred source because they provide a 'buffer' from the risks of illicit markets such as violence, disorder and law enforcement detection (Hakkarainen and Perala, 2011).	• Social supply exists and may even be more prominent in the pharmaceutical market than for most illicit markets, particularly in the context of drugs being used for self-treatment and therapeutic reasons such as for pain and withdrawal.
	Different supply mechanisms, methods and motivators are associated with different risk profiles in terms of profit and potential for harm. For example, poly-drug trafficking is associated with higher volume supply, higher profits and greater involvement in other forms of criminal activity than those involved in trafficking only one substance (Hughes et al., 2016b). This is important for identifying which are the higher priority groups to target.	Different diversion and supply mechanisms and motivators of supply are associated with different risk profiles. • Doctor shopping (illegitimate medical sourcing) is associated with significantly higher quantity and frequency supply than other mechanisms **(Chapter Four).** • Drugs sourced and supplied from the medical system have higher mark-up **(Chapter Five).** • There is evidence of the convergence of illicit and pharmaceutical markets – with suppliers often poly-trafficking **(Chapter Four).** • Altruistically motivated suppliers, distribute significantly lower quantities than those not altruistically motivated **(Chapter Four).**

6.3 Implications for policy and practice

The findings of the four empirical chapters of this thesis demonstrated that there are multiple sources, mechanisms and drivers of pharmaceutical diversion and supply for NMU, warranting multifaceted responses. There are three key implications for policy and practice that will be discussed in turn below: (1) addressing problematic supply from the medical system; (2) addressing the imbalance between oversupply and undersupply; and (3) formally recognising social supply.

6.3.1 Addressing problematic supply from the medical system

A key finding of this thesis was that a large proportion of pharmaceutical drugs that are used non-medically are accessed directly from the medical system. This is partially enabled by a small number of health practitioners involved in persistent overprescribing, often due to a lack of training and assertiveness to manage complex patient groups (**Chapter Three**). There is an opportunity here for targeted prevention through the provision of better training and support for health practitioners. This might include assertiveness training programs that have been shown to be effective in improving communication with patients (Omura et al., 2017), as well as expanding training and information on the use of physical and psychological therapies for managing complex medical issues like pain (Pacula and Powell, 2018). This is particularly pertinent when considering that of those cases where practitioners were able to continue practicing following disciplinary procedures, most were required to attend further education or training (**Chapter Three**). Thus efforts to identify practitioners at-risk of misconduct and intervene early are likely to be beneficial.

In **Chapter Four** it was identified that people involved in diversion and supply to the black market in Australia mostly accessed their drugs directly from the medical system. Further analyses revealed that those involved in doctor shopping were responsible for supplying the highest volume of drugs. In Australia and internationally, particularly North America, there has been a policy focus on restricting access from the medical system for problematic use, diversion and supply through scheduling changes and the implementation of prescription drug monitoring

programs (PDMPs). However, available evidence from the US has shown that such policies, while reducing supply, have had mixed effectiveness in reducing harms and in some cases, resulted in unintended consequences. For instance, scheduling restrictions on the availability of hydrocodone in the US was associated with displacement to dark net purchasing (Martin et al., 2018), while some PDMPs in the US have been associated with increases in heroin overdose (Fink et al., 2018). Adding to this, recent research has shown that discontinuing prescribing is unlikely to result in cessation of use, and other access routes such as family members may be used (Barnett et al., 2019). Given the relatively small proportion of health practitioners involved in problematic prescribing (**Chapter Three**), and similarly, the small proportion of end-users (**Chapter Two**) and suppliers involved in doctor shopping (**Chapter Four**) – the question is raised as to how much focus and investment should be given to these systems versus addressing other drivers of pharmaceutical drug diversion. This is an important question if achieving a reduction in supply from the medical system is serving no other purpose than to shift the problem elsewhere.

6.3.2 Correcting the imbalance between oversupply and undersupply

Paradoxically, this thesis identified that an oversupply of pharmaceutical drugs among some people serviced a perceived undersupply among others. This raises two important questions:

1. Why do people have leftover drugs that then become susceptible to diversion and supply?
2. Do people seeking drugs from the black market have unmet therapeutic needs? If so, what are the barriers to access?

The issue of oversupply may be partly a product of problematic prescribing by health practitioners as discussed above (**Chapter Three**). Another broader trend is the disproportionate increase in the prescribing of drugs like opioids relative to changes in population health (AIHW, 2018). One of the main drivers, for example, has been the higher use of opioids for the treatment of chronic non-cancer pain (Campbell et al., 2018). Undoubtedly

there are more pharmaceutical opioids in circulation (UNODC, 2019b), which increases their accessibility for diversion and supply. This means that now more than ever, it is important that appropriate quantities are prescribed and health practitioners exercise good stewardship techniques. Further consideration could be given to pack sizes. Additionally, health practitioners have a crucial role to play in properly educating patients on proper use and disposal of their pharmaceutical drugs (Anderson and Alger, 2019). Notably, the Return Unwanted Medicines (RUM) project in Australia was met with funding cuts this year (Doyle and Paolo, 2018), which seems to be contrary to the current risks posed from oversupply and the diversion of leftover drugs.

Turning now to the issue of perceived undersupply, a relevant concept is the 'medicalisation' or 'pharmaceuticalisation' of society. Medicalisation is "defining a problem in medical terms, usually as an illness or disorder, or using a medical intervention to treat it" (Conrad, 2005), while pharmaceuticalisation is the process whereby social, behavioural or bodily conditions are treated with drugs (Abraham, 2010). Medicalisation – particularly in the US context where there is direct-to-consumer promotions of medicines – has been attributed to increased patient requests and overprescribing, with research showing marginalised populations are particularly at-risk (Becker and Midoun, 2016, Gilbody and Wilson, 2005). While Australians are not exposed to direct-to-consumer promotions of medicines (Prosser, 2019), these concepts may nevertheless be useful for understanding growing demand. Another explanatory factor for pharmaceuticalisation is the notable differences in the out-of-pocket expenses for pharmaceutical drugs compared with non-drug treatments (like psychological and physical therapies), whereby the former is heavily subsidised via the Australian PBS and the latter is not (Islam et al., 2014b). Medicalisation is under researched in Australia and given the increased trends associated with prescribing, NMU and harms – it is timely for this to be further considered. Particular attention should be paid to understanding the impact that the increased utilisation of pharmaceutical drugs in Australia is having on consumer behaviours, including

perceptions around their need for drugs, requests to prescribers, as well as diversion and supply for NMU.

This is not to discount cases where genuine therapeutic need does exist and yet supply is not available, thus displacing people to access via black market sources. People taking high doses of pharmaceutical opioids may meet the criteria for opioid dependence. Evidence based treatments such as methadone and buprenorphine provision, may be an appropriate option for reducing demand on prescribed opioids and reducing mortality. For example, US research has shown that increasing capacity for buprenorphine treatment may reduce prescription opioid use (Wen et al., 2018). The qualitative findings of **Chapter Four** suggested that one barrier to accessing treatment might be stigmatisation. Stigma has been shown to be a health barrier among many populations including men, lesbian, gay, transgender, intersex and queer (LGBTIQ) communities, people with sexually transmitted infections like human immunodeficiency virus (HIV), people with a mental illness and people with a substance use disorder (Allen and Harocopos, 2016, Arnold et al., 2014, Clement et al., 2015, Corrigan, 2004, Eaton et al., 2015, Link et al., 1997, Luoma et al., 2007, Olsen and Sharfstein, 2014, Room, 2005). These stigmas are further exacerbated when comorbidities are present. Ritter et al. (2019) showed that in Australia there is almost 50% unmet demand for drug and alcohol treatment. Taken together, this thesis supports previous calls for the expansion of treatment (Pacula and Powell, 2018), as a strategy for addressing diversion and supply. This is particularly important to ensure that supply-reduction policies such as PDMPs do not reinforce treatment gaps and further marginalise already undertreated populations.

6.3.3 Formally recognising social supply

There was evidence throughout this thesis that social supply and informal exchanges between friends and family for minimal or no profit is a defining feature of the pharmaceutical black market. In Australia it is an imprisonable offence to supply pharmaceutical drugs to another person without a valid prescription. A key feature of the Australian criminal law, as with the US and parts of Europe, is that the severity of the offence is determined by reference to the quantity

of drugs involved (Hughes, 2003). In all jurisdictions of Australia, excepting Queensland, supply offences (including for pharmaceutical drugs) are distinguished from simple possession offences using quantity thresholds (Hughes et al., 2014b). This means, for example, that the same penalty applies for someone supplying to a family member for self-treatment of pain and to a stranger for profit.

In recognition of such vastly different scenarios and risk profiles, there has been an increasing focus at an international level on formally recognising social supply or minimally commercial supply within criminal justice systems (Coomber et al., 2018). In England and Wales, sentencing frameworks adopt "an explicit model designed to mitigate against disproportionate sentencing through the use of mitigating factors such as non-commercial or minimally commercial supply and perceived levels of harm and involvement in the supply chain" (Coomber et al., 2018). Comparatively, Coomber et al. (2018) identified that social supply is an under-developed concept in Australian criminal law. Australian scholars like Hughes et al. (2014a) have advocated for the recognition of supplier motive at sentencing, in addition to quantity thresholds, to avoid unjustified sanctioning. However, Australian (and international) research has largely been focused on the social supply of illicit drugs, like cannabis and MDMA (Coomber et al., 2018). In showing that social supply is a defining feature of the pharmaceutical black market, this thesis extends the evidence base to include pharmaceutical drugs, and in doing so, supports the argument for considering how varying supply practices can be formally distinguished within the legislative framework.

6.4 Future research

This thesis provides the basis for further research and analysis in three key areas. These include: (1) estimating the scale and nature of diversion from higher up the supply chain; (2) evaluating the intended and unintended outcomes of policies aimed at addressing diversion and supply for NMU; and (3) understanding diversion and supply in the global context.

6.4.1 Estimating the scale and nature of diversion from higher up the supply chain

Pharmaceutical drugs are manufactured in many countries around the world and imported and exported across borders for wholesale distribution and therapeutic use. For example, the US is the main manufacturer of oxycodone and hydrocodone (UNODC, 2019b) and in 2018, it was estimated that Australia imported $5.4 billion worth of pharmaceutical drugs (Workman, 2019). Australia – Tasmania specifically – is also a major exporter of poppy straw that is used for the production of pharmaceutical opioids like morphine and codeine. In 2013, Australian opium provided 25% of the world's morphine and codeine, 85% of the world's thebaine and 100% of the world's oripavine (Miltenburg, 2017). This means that pharmaceutical drugs (and their precursors) may be diverted during importation and exportation, and at the wholesale level prior to them reaching the medical system and there is some evidence that this has occurred. For instance, in 2017 five milligram packets of diazepam (i.e. Valium) were recalled in Australia following the discovery that they had been substituted with different drugs at the manufacturing site (Australian Broadcasting Corporation, 2017). In addition and as shown in this thesis, pharmaceutical drugs may be purchased online from surface websites and the dark net.

This thesis focused on understanding the mechanisms and methods of diversion and supply from the medical system to the end-user. That is, **Chapter Two** consolidated end-user studies, **Chapter Three** examined diversion by health practitioners and **Chapter Four** and **Five** involved interviews with suppliers who tended to operate at the lower end of the supply chain. Future research should seek to better understand diversion of pharmaceutical drugs prior to them reaching the medical system, including from imports/exports, the wholesale distribution chain and online and dark net sales. This will be important for not only understanding the relative importance of these mechanisms, but also for understanding how supply methods, drivers and profits may differ across market levels. For example, illicit drug market research has shown that mark-ups vary greatly as drugs are moved through the distribution chain (Caulkins et al., 2009) and this too, may be observed here. For instance, it is feasible that the added effort and risk associated with diverting large quantities of drugs at the import/export or wholesale

level may require involvement from organised crime groups and corruption, and may potentially result in higher prices and profits than diversion after the drugs have already reached the medical system. Furthermore, it remains unknown what is involved in the sale of drugs online, including where the drugs are sourced and the modus operandi and methods for shipment. Given the emerging nature of these access routes and the potential risks in terms of the volumes and methods of supply, it should be a priority for future research to better understand these phenomena.

6.4.2 Evaluating intended and unintended policy outcomes

At an international level there has been increasing policy attention paid to addressing the diversion and supply of pharmaceutical drugs for NMU. In Australia, the current approach comprises scheduling and regulatory controls, abuse-deterrent formulations, PDMPs and criminal sanctions. In the US, among others, there has been rescheduling, the introduction of abuse-deterrent formulations and PDMPs. In the UK, rescheduling has occurred and there has been a focus on education provision for health practitioners. Such policy changes demand thorough and timely evaluation to identify both the intended and unintended effects.

Table 6.2 provides a summary of current evidence from the US on policies targeted at addressing pharmaceutical diversion and supply for NMU. As shown, the effects are mixed and several unintended consequences have been identified. This has been attributed to people dependent on pharmaceutical opioids (following dramatic increases in prescribing from the early 1990s) shifting to the use of heroin that was widely available and at lower costs, whereas pharmaceutical opioids were under increasingly strict regulations. This contributed to a drug market where there was a strong demand for illicit opioids and the subsequent emergence of fentanyl in the heroin supply, particularly in the Northeast and Midwest of the country (Brown and Morgan, 2019, Ciccarone, 2019, Pacula and Powell, 2018). Because heroin is typically administered by injection, these displacement effects increased the risk and prevalence of blood-borne viruses like Hepatitis C (Powell et al., 2019).

Pacula and Powell (2018) argued that one of the key flaws of the US approach to the opioid crisis was that discrete supply-reduction interventions were introduced targeting only one source or supply route, rather than broader interventions that considered the full market and that complemented demand-side strategies, such as the expansion of treatment aimed at meeting the needs of those with opioid dependence so that they would not need to seek pharmaceuticals or heroin from the illicit market. At the same time, supply-side interventions that control the availability of pharmaceuticals are needed because there is variable uptake in substance abuse treatment and relapse is common (Pacula and Powell, 2018). In Australia, many of the policy responses are in their relative infancy, which presents a useful opportunity to understand the complexities through research and evaluation, assess the effectiveness of policies and intervene early taking into account unique specificities of the Australian context (Nielsen and Dietze, 2019).

Table 6.2. Effects of policies targeted at pharmaceutical diversion and supply for NMU in the US

Policy	Effects
PDMPs	• Systematic review by Fink et al. (2018) found mixed effects on overdose and identified at least three studies that have shown increases in heroin overdose. • Ringwalt et al. (2015) and Reisman et al. (2009) identified that effects can be non-selective, whereby overall prescribing is reduced rather than just problematic prescribing. This has been referred to in the literature as the 'chilling effect'. • Concerns have been raised about the potential negative impacts PDMPs may have for people seeking to access pharmaceutical drugs for legitimate therapeutic purposes (Islam and McRae, 2014, Rubin, 2019), as well as the potential risks of displacement to black markets or to the use of illicit opioids like heroin (Pardo, 2016).
Hydrocodone rescheduling	• Seago et al. (2016) found a reduction in hydrocodone prescribing as intended, however this was offset by dramatic increases in prescribing of Schedule III opioids like tramadol and consequently, there were only slight changes in overall morphine equivalents prescribed. • Martin et al. (2018) identified a concomitant rise in crypto market sales and most concerning; the largest increases were observed for more potent opioids, specifically oxycodone and fentanyl. The authors discussed the risks of displacement to online purchasing, not only because of the trend to access more potent drugs, but also because "it becomes more difficult to track individual use of prescription opioids, and to offer treatment and help to users"
Abuse-deterrent oxycodone	• Alpert et al. (2018) found that the substitution of pharmaceutical

Policy	Effects
formulation	opioids with heroin that occurred following restrictions to availability, in particular the introduction of an abuse-deterrent formulation of OxyContin in 2010, resulted in an increase in injection and a concomitant rise in the incidence of Hepatitis C.

6.4.3 Understanding diversion and supply in the global context

Harms related to pharmaceutical drugs are experienced internationally, however the drivers and patterns of harm vary across contexts. As outlined in **Chapter One**, North America is amidst an opioid 'epidemic', which began with increases in prescribing of pharmaceutical opioids, following by substitution effects to heroin when pharmaceutical opioids became less available, which is thought to have contributed to the rising presence of fentanyl in the heroin supply (Ciccarone, 2019). Another example is Scotland where recent data showed the highest rate of drug-related mortality in Europe, with benzodiazepines and pharmaceutical opioids attributed to the majority of deaths (National Records on Scotland, 2019). Here there was a shift to benzodiazepines obtained via street sources, which is thought to be partly a consequence of reduced and restricted benzodiazepine prescribing (Johnson et al., 2016).

There are also international differences and variations in the healthcare systems, fee structures and regulatory environments in which pharmaceutical drugs are produced and supplied. For instance, Australia operates a universal healthcare system subsidised via Medicare and the PBS, whereas the US healthcare system is a "publicly and privately funded patchwork of fragmented systems and programs" (Tunstall, 2015). As another example, the pharmaceutical stimulant modafinil is available by prescription-only in high-income countries like Australia and the US, however is available over-the-counter (OTC) in low-income countries like India. As mentioned earlier in this chapter, Australia is also a major exporter of poppy straw used for opioid production (Miltenburg, 2017), while the US produces most of the world's oxycodone and hydrocodone (UNODC, 2019b). As outlined in **Chapter One**, Australia is geographically isolated, whereas Europe and North America are in close proximity to other countries. These cross-country nuances are likely to have important implications for the mechanisms, methods,

drivers and profitability of pharmaceutical diversion and supply. Specifically, non-universal healthcare systems may result in increased costs and reduced accessibility to treatment, which may directly influence demand for and profits from black market supply. Countries with less stringent controls over the availability of medications may be at greater risk of cross-border diversions such as via online sales. Similarly, manufacturing sites may be targeted for high-level diversion. There may also be differences in the transportation methods for diverted drugs depending on if they are being supplied within countries or cross-borders.

As shown in **Chapter Two**, while there has been some limited research conducted internationally, mainly in the US context, to understand diversion and supply for NMU (see for example Inciardi and Cicero (2009), Inciardi et al. (2009b), Inciardi et al. (2006), Inciardi et al. (2007b), Rigg et al. (2012), Rigg et al. (2010)), overall the evidence-based is scarce. The findings of this thesis are based upon primary data collected in Australia and given that pharmaceutical diversion and supply is an issue affecting many countries around the world, it is timely that further research is conducted to better understand the circumstances surrounding diversion in other contexts. The replication of each of the studies of this thesis to examine to what extent the methods, mechanisms, drivers and profitability of pharmaceutical diversion and supply differ in other countries, will be useful for informing targeted policy efforts and addressing this issue on a broader scale.

6.5 Strengths and limitations of this thesis

This thesis made a number of original contributions to the evidence-base. The broad focus on supply extended what was already known about demand, harms and risk factors for NMU, which is important for informing holistic policy responses. **Chapter Two** consolidated what was a large, disparate evidence base on drug sourcing and diversion in an international context. This allowed for original estimates of sourcing and diversion and provided a systematic basis for the conduct of further research. **Chapter Three** moved beyond surface-level assumptions about health practitioner involvement in problematic prescribing and diversion, to ask *why* these practices were occurring and in what circumstances behaviours are more versus less

problematic. **Chapter Four** and **Five** were the first in Australia to access active suppliers – a typically hard-to-reach population – and in doing so, provided novel insights into diversion and supply practices including access routes, motives, pricing and profits. **Chapter Five** was the first study to estimate the revenues, profits and mark-ups associated with pharmaceutical black market supply and in doing so, challenged assumptions about the lucrative nature of diversion. **Chapter Four** and **Five** contributed to theory and discourse on illicit markets and provided the basis for comparisons between pharmaceutical diversion and supply and the supply of illicit drugs like cannabis, cocaine, heroin and meth/amphetamine. Finally, this thesis made headway in bridging the evidence-policy gap by identifying nuances in pharmaceutical diversion and supply in terms of the methods, mechanisms, drivers, profitability and consequences.

Each of the four empirical chapters presented in this thesis identified specific limitations relevant to each study. However, there are two additional caveats to consider with the findings of this thesis as a whole. First, the empirical studies, particularly those presented in **Chapter Three**, **Chapter Four** and **Chapter Five** were based upon research with relatively small samples. While such sample sizes are not uncommon for research of this nature, particular with suppliers (Caulkins, 2007), this limited the analytical techniques that could be employed and the generalisability of the findings. Second, the research was conducted during a time of considerable policy attention on pharmaceutical-related problems in Australia. For example, in 2018 codeine was up-scheduled nationwide and a real-time PDMP was rolled out in Victoria. These changes occurred after data was collected for this thesis, which means the likely impact of such changes on the findings of this thesis is unknown. This reinforces the need for ongoing research to understand how such policy changes might influence the mechanisms and consequences of diversion and supply for NMU in Australia.

6.6 Conclusion

This thesis has provided novel insight into the diversion and supply of pharmaceutical drugs for NMU – a topic that was previously under researched in Australia and internationally. A key finding was that the legal manufacturing of pharmaceutical drugs streamlines the distribution

process and most drugs for NMU are accessed directly from the medical system or through intermediaries with medical access. This is an important point of departure from illicit drug supply chains that tend to be long and complex, involving many players at multiple levels (Babor et al., 2018, Caulkins et al., 2016, Caulkins et al., 2009, Desroches, 2007, Giommoni et al., 2017, Hughes et al., 2016a, McFadden et al., 2014, Reuter, 2014, Ritter et al., 2012, Tzvetkova et al., 2016). An important driver of supply from the medical system for NMU is overprescribing by a relatively small number of health practitioners due to training and skills deficits for managing complex patients groups.

There are numerous motives for individual involvement in diversion and supply of pharmaceutical drugs. These include altruism, which tends to occur when people distribute leftover drug supplies to friends and family for the self-treatment of a perceived ailment or medical issue. Social supply between family and friends for little or no profit is a dominant practice for pharmaceutical drugs. Financial gain is a motivating factor for some suppliers and pharmaceutical drugs can be sold on the black market at high prices and mark-ups can be extremely high when considering the low cost of drugs obtained from the medical system. However, quantification of the revenue and profits from diversion and supply accounting for distribution by multiple modes including gifting and trading, indicate that for most suppliers this is unlikely to be an income generating activity in and of itself. These findings provide strong evidence of the need for a multi-faceted response to this issue, but also raise policy dilemmas.

While there has been increasing policy attention at an Australian and international level to addressing pharmaceutical diversion and supply for NMU – there is also growing evidence, particularly from the US, that some of these policies have been met with limited effectiveness and adverse consequences (Powell, 2019). This suggests that such policies have not been adequately informed nor effectively targeted, and a more holistic approach addressing both demand and supply factors and multiple supply levers are needed. This thesis has provided evidence in the Australian context to support a holistic approach that might involve: better supporting and training health practitioners from the undergraduate level for responding to the

complex patient groups; addressing unmet treatment demand through the widespread expansion of treatment and the delivery of treatment in a range of ways (and fee structures to support this) that address the needs of different patient groups; broader education of the general population to address misconceptions that it is 'safe' to share pharmaceutical drugs; and better monitoring of high-volume supply practices by health practitioners.

This thesis affirms the importance of ongoing and rigorous evaluation of the intended and unintended effects of such policies. Not unlike other parts of the world, Australia is currently facing unprecedented harms due to pharmaceutical drugs (ABS, 2017). However, the magnitude of the harms remains well below that of the US (Ciccarone, 2019, Scholl et al., 2019). The time is now for Australia to utilise the evidence that is available on both the demand and supply of pharmaceutical drugs for NMU and the lessons from overseas to address rising harms. It is hoped that this thesis will contribute to these efforts.

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Appendices

Chapter Two Appendices

Appendix 2A. Detailed search strategies

Table A2.1. Search strategies by database

July 2017 – EMBASE via Ovid		
	Searches	**Results**
1	pharmaceuticals.mp.	39775
2	medication.mp. or exp drug therapy/	2299582
3	therapeutic drug.mp.	12016
4	exp prescription/ or exp non prescription drug/ or exp prescription drug diversion/ or exp prescription drug/	145515
5	over-the-counter.mp.	9321
6	exp opiate/	60286
7	analgesic.mp.	147417
8	stimulant.mp.	33140
9	exp benzodiazepine/	23122
10	"drug use"/ or "licit drugs".mp.	89348
11	or/1-10	2641229
12	supply chain.mp.	2413
13	supplier.mp.	2934
14	"drug suppl*".mp.	1336
15	"sourcing route".mp.	1
16	(supply and distribution).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	17237
17	drug market.mp. or exp drug traffic/	2512
18	or/12-17	25668
19	Internet/ or Dark Web.mp.	85498
20	doctor shopping.mp.	216
21	or/19-20	85706
22	"non-medical use".mp.	408
23	exp drug abuse/ or exp drug misuse/ or exp substance abuse/ or misuse.mp.	120325
24	"recreational use".mp.	1013
25	"illicit use".mp.	475
26	11 and 18 and 21	76
27	limit 26 to embase	68
28	limit 27 to (human and english language and yr="1996 -Current")	44
29	limit 28 to (editorial or letter or note or short survey or trade journal)	7
30	28 not 29	37
31	exp prescription drug diversion/	150
32	12 or 13 or 14 or 15 or 16 or 17 or 31	25826
33	22 or 23 or 24 or 25	121540
34	11 and 21 and 32 and 33	48

35	limit 34 to (human and english language and yr="1996 -Current")	34
36	limit 35 to (editorial or letter or note or short survey or trade journal)	5
37	35 not 36	29

July 2017 – MEDLINE via Ovid		
	Searches	**Results**
1	pharmaceuticals.mp.	20533
2	Self Medication/	4669
3	pharmaceutical drug.mp.	607
4	Prescriptions/	2997
5	therapeutic drug.mp.	8530
6	Analgesics/ or Analgesics, Opioid/ or Analgesics, Short-Acting/ or Analgesics, Non-Narcotic/	92034
7	Central Nervous System Stimulants/	19525
8	Benzodiazepines/	21834
9	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8	168206
10	Drug Industry/	32580
11	supply chain.mp.	1594
12	Prescription Drug Diversion/	161
13	drug market.mp.	601
14	Internet/sd [Supply & Distribution]	70
15	doctor shopping.mp.	147
16	pharmacy shopping.mp.	7
17	Inappropriate Prescribing/	2191
18	Theft/	1647
19	Fraud/	7097
20	10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19	45386
21	Substance-Related Disorders/ or non-medical.mp.	96947
22	"illicit use".mp.	379
23	"recreational use".mp.	846
24	Prescription Drug Misuse/	1280
25	21 or 22 or 23 or 24	98722
26	9 and 20 and 25	162
27	limit 26 to (english language and humans and yr="1996 - 2017")	134

July 2017 – PsycINFO via Ovid		
	Searches	**Results**
1	exp Drugs/ or exp Prescription Drugs/	267678
2	medication.mp.	54290
3	exp PRESCRIPTION DRUGS/	3180
4	"licit drugs".mp.	71
5	exp Nonprescription Drugs/	361
6	exp Analgesic Drugs/ or over-the-counter.mp.	18358
7	exp Opiates/	20859
8	exp CNS Stimulating Drugs/	19181
9	exp BENZODIAZEPINES/	9653
10	exp ANALGESIC DRUGS/	17102
11	or/1-10	301866
12	exp Supply Chains/ or "supply chain".mp.	1760
13	suppl*.mp.	56332
14	"sourcing route".mp.	1
15	drug diversion.mp.	92
16	exp Illegal Drug Distribution/ or exp Crime/ or drug market.mp.	85834
17	drug trafficking.mp. or exp Illegal Drug Distribution/	794
18	exp Internet/ or dark web.mp.	25258
19	doctor shopping.mp.	64
20	exp THEFT/	1436
21	exp FRAUD/	642
22	or/12-21	166053
23	exp Drug Abuse/ or misuse.mp.	100960
24	"illicit use".mp.	205
25	"non-medical use".mp.	203
26	"recreational use".mp.	408
27	or/23-26	101400
28	11 and 22 and 27	1140
29	limit 28 to (human and english language and yr="1996 -Current")	894
30	limit 29 to ("column/opinion" or "comment/reply" or editorial or encyclopedia entry or letter or obituary or poetry or review-media or review-software & other)	91
31	29 not 30	803

July 2017 – CINCH via Informit	
Searches	**Results**
("MEDICATIONS" OR "PRESCRIPTION" OR "STIMULANT" OR "PRESCRIBED" OR "STIMULANTS" OR "MEDICATED" OR "MEDICATION" OR "PHARMACEUTICAL" OR "ANALGESICS" OR "PHARMACEUTICALS" OR "BENZODIAZEPINE" OR "OPIOIDS" OR "OPIOID" OR "ANALGESIC" OR "BENZODIAZEPINES") AND (OR "SUPPLY" OR "SUPPLIER" OR "SUPPLYING" OR "SUPPLIES" OR "TRAFFICKING" OR "INTERNET" OR "SOURCE" OR "DIVERSION" OR "SUPPLIERS" OR OR "SUPPLIED") AND ("NONMEDICAL" OR "MISUSE" OR "MISUSE/ABUSE" OR "non-medical use" OR "recreational use")	28

July 2017 – Criminal Justice Abstracts via EBSCO		
	Searches	**Results**
S1	pharmaceutical OR TX medication OR TX prescription drugs OR TX prescription medication OR TX drugs OR TX over the counter medications OR TX opioid OR TX analgesics OR TX benzodiazepines OR TX sedative drugs OR TX stimulant medication	48,793
S2	TX supply chain OR TX supply OR TX sources OR TX diversion OR TX drug diversion OR TX drug market OR TX black market OR TX (drug trade or drug trafficking) OR TX (dark web or dark net) OR TX internet OR TX doctor shopping OR TX (drug dealing and selling)	64,201
S3	TX non-medical prescription drug use OR TX misuse of prescription drugs OR TX (misuse or abuse) OR TX illicit use OR TX recreational OR TX abuse	69,571
S4	(S1 AND S2 AND S3)	2,546
	After filtering for English; 1996 to current	644

July 2017 – Drug Database – DRUG via Informit	
Searches	**Results**
(AB:"non-medical use" OR AB:misuse OR AB:"illicit use" OR AB:"recreational use" OR su:"POLYDRUG USE" OR su:LEISURE OR su:"DRUG USE") AND (AB:"Dark Web" OR AB:"Dark Net" OR AB:"doctor shopping" OR AB:"pharmacy shopping" OR AB:theft OR AB:crime OR AB:forgery OR AB:SUPPLYING OR AB:SUPPLY OR AB:SUPPLIERS OR AB:SUPPLIER OR AB:SUPPLIES OR su:INTERNET OR su:OVERPRESCRIBING OR su:TRAFFICKING OR su:DIVERSION) AND (su:"OTC DRUGS or PRESCRIPTION DRUGS" OR su:"PRESCRIPTION DRUGS or OTC DRUGS" OR su:"OTC DRUGS" OR su:"OTC DRUGS" OR su:"OTC DRUGS" OR su:ANALGESICS OR su:OPIOIDS OR su:STIMULANTS OR su:BENZODIAZEPINES)	111

July 2017 – National Criminal Justice Reference Service via ProQuest	
Searches	**Results**
(Pharmaceuticals OR medication OR prescription drug OR therapeutic drug OR non-prescription drugs OR over-the-counter OR opioid OR analgesic OR stimulant OR benzodiazepine) AND (Supply chain OR supply OR supplier OR diversion OR drug diversion OR sourcing routes OR drug market OR drug trade OR drug trafficking) AND (Non-medical use OR "prescription drug misuse" OR "drug misuse" OR "illicit use" OR "recreational use" OR abuse OR "polydrug")	224

Appendix 2B. Assessment criteria for quality appraisal of cross-sectional studies

The cross-sectional surveys included in the meta-analyses were assessed using the quality assessment tool for cross-sectional survey designs developed by DuRant (1994) and adapted similarly to Pont et al. (2009), as follows.

Table A2.2. Quality assessment criteria

Description of sample a. Are the criteria for inclusion of subjects described? b. Has the study sample been clearly described in terms of demographic characteristics such as age, race, gender, location, socioeconomic status etc.? c. Is the study sample appropriate to the research objectives? d. Is the study sample large enough to achieve the research objectives (i.e. greater than 100)?
Sampling methods e. Was the study sample randomly selected?
Study design f. Is the design of the study clearly described? g. Does the design of the study adequately achieve the research objectives?
Measurement of variables h. Have the measurement of outcome, independent, and control variables been clearly described? i. Are the variables measured with appropriate and accurate methods?
Validity of instruments j. Have the instruments and/or questionnaires used to measure the variables undergone validity and reliability testing?
Risk of bias k. Have the number of non-respondents/refusals been kept reasonable small (i.e. less than 20%)?
Statistical procedures l. Were the statistical tests used to analyse the data clearly described? m. Were the statistical tests chosen to analyse the data appropriate? n. Were multivariate analyses undertaken?

Since DuRant's (1994) tool does not have a pre-specified scoring system, a score of 1 was given for 'YES' responses and 0 for 'NO'. Thus, a higher score indicates better methodological quality. The weaker quality studies were scored one to five, the moderate quality studies were scored six to ten, and the high quality studies scored 11 to a maximum of 14.

Appendix 2C. Quality appraisal of cross-sectional studies included in meta-analyses

Table A2.3. Quality scoring

	Author (Date)	Description of sample (4)	Sampling methods (1)	Study design (2)	Measurement of variables (2)	Validity of instruments (1)	Risk of bias (1)	Statistical procedures (2)	GLOBAL SCORE (14)
1	Aldridge et al. (2011)	4	0	2	2	0	1	2	**11**
2	Ashrafioun et al. (2014)	4	0	2	2	1	1	2	**12**
3	Barrett et al. (2005)	3	0	2	2	0	0	2	**9**
4	Bazazi et al. (2011)	3	0	2	1	0	1	2	**9**
5	Belcher et al. (2014)	4	0	2	2	1	0	1	**10**
6	Boyd (2006)	4	0	2	2	1	1	3	**13**
7	Bruno (2007)	4	0	2	1	0	0	0	**7**
8	Cassidy et al. (2015b)	4	0	2	2	1	1	3	**13**
9	Cassidy et al. (2015a)	4	0	2	2	1	0	2	**11**
10	Chen et al. (2014)	4	1	2	2	1	0	3	**13**
11	Cicero et al. (2008)	4	0	2	2	0	0	0	**8**
12	Cicero et al. (2011)	4	0	2	2	1	1	3	**13**
13	Cottler et al. (2013)	4	0	2	2	1	0	2	**11**
14	Daniulaityte et al. (2014)	4	0	2	2	1	0	3	**12**
15	Darredeau et al. (2007)	3	0	2	2	1	0	3	**11**
16	Davis and Johnson (2008)	3	0	2	1	0	0	2	**8**
17	DeSantis et al. (2008)	4	0	2	1	1	0	1	**9**
18	DeSantis et al. (2009)	4	0	2	2	1	0	0	**9**
19	DeSantis et al. (2013)	4	0	2	2	1	0	1	**10**
20	Duffy and Baldwin (2012)	4	0	2	1	0	0	2	**9**
21	Dupont et al. (2008)	4	1	2	2	1	0	0	**10**
22	Festinger et al. (2016)	4	0	2	2	1	1	1	**11**

	Author (Date)	Description of sample (4)	Sampling methods (1)	Study design (2)	Measurement of variables (2)	Validity of instruments (1)	Risk of bias (1)	Statistical procedures (2)	GLOBAL SCORE (14)
23	Gallucci et al. (2015)	3	0	2	2	1	1	3	**12**
24	Goldsworthy et al. (2008)	3	0	2	2	1	0	2	**10**
25	Holloway and Bennett (2012)	4	0	2	2	0	0	0	**8**
26	Holloway et al. (2013)	4	0	2	2	0	0	0	**8**
27	Ibañez et al. (2013)	4	0	2	2	1	0	3	**12**
28	(Inciardi et al., 2010)	4	0	2	2	1	0	3	**12**
29	(Johnson and Richert, 2015a)	4	0	2	2	1	0	3	**12**
30	Katz et al. (2008)	4	0	2	2	1	0	2	**11**
31	Kaye et al. (2014)	4	0	2	2	0	0	3	**11**
32	Larance et al. (2011a)	4	0	2	2	1	0	2	**11**
33	Lasopa et al. (2015)	4	1	2	2	1	0	3	**13**
34	Launonen et al. (2015)	4	0	2	1	0	0	3	**10**
35	Levy (2007)	4	0	2	1	0	0	0	**7**
36	Martins et al. (2009)	4	1	2	2	1	0	3	**13**
37	McCabe et al. (2007)	4	1	2	2	1	0	3	**13**
38	McCabe et al. (2013)	4	1	2	2	1	0	3	**13**
39	Monte et al. (2009)	3	0	2	2	0	0	0	**7**
40	Ng and MacGregor (2012)	3	0	2	1	0	0	1	**7**
41	Nielsen et al. (2008)	4	0	2	2	0	0	1	**9**
42	Nielsen et al. (2013)	4	0	2	1	0	0	2	**9**
43	Novak et al. (2007)	4	0	2	2	1	1	3	**13**
44	O'Reilly et al. (2007)	4	0	2	1	0	0	0	**7**
45	Poulin (2001)	4	1	2	2	1	1	3	**14**
46	Poulin (2007)	4	1	2	2	1	1	3	**14**
47	Rabiner et al. (2009)	4	0	2	2	1	0	1	**10**

	Author (Date)	Description of sample (4)	Sampling methods (1)	Study design (2)	Measurement of variables (2)	Validity of instruments (1)	Risk of bias (1)	Statistical procedures (2)	GLOBAL SCORE (14)
48	Ross et al. (1996)	4	0	2	2	0	0	2	**10**
49	Schepis and Krishnan-Sarin (2009)	4	1	2	2	1	0	3	**13**
50	Schulte et al. (2016)	4	0	2	2	1	0	3	**12**
51	Smith et al. (2007)	4	0	2	1	0	0	0	**7**
52	Vivian et al. (2005)	4	0	2	2	1	0	1	**10**
53	Vuolo et al. (2014)	4	1	2	2	0	0	3	**12**
54	Wilens et al. (2006)	3	0	2	2	0	0	3	**10**

Notes: Quality assessment based on the tool developed by DuRant (1994).

Appendix 2D. Articles excluded from systematic review

Table A2.4. Exclusions with reasons

	Citation	Reason for exclusion
1	Arria, A. M. and R. L. DuPont (2010). Nonmedical prescription stimulant use among college students: why we need to do something and what we need to do.	Not empirical
2	Australian Institute of Health and Welfare (AIHW) (2013). National Drug Strategy Household Survey detailed report: 2013.	No focus on mechanisms or nature of supply
3	Australasian Centre for Policing Research, 2002. The diversion of pharmaceutical drugs onto the illicit market, Conference of Police Commissioners of Australasia and the South West Pacific Region. Australasian Centre for Policing Research, Adelaide, South Australia.	Not empirical
4	Bell, J. (2010). The global diversion of pharmaceutical drugs: opiate treatment and the diversion of pharmaceutical opiates: a clinician's perspective.	No focus on mechanisms or nature of supply
5	Binswanger, I. A. and Glanz J.M. (2015). Pharmaceutical opioids in the home and youth: implications for adult medical practice.	Not empirical
6	Brandt, S. A., Taverna, E. C. and Hallock R.M (2014). A survey of nonmedical use of tranquilizers, stimulants, and pain relievers among college students: patterns of use among users and factors related to abstinence in non-users.	No focus on mechanisms or nature of supply
7	Caulkins, J.P., Disley, E., Tzvetkova, M., Pardal, M., Shah, H. and Zhang, X. (2016). Modelling the structure and operation of drug supply chains: the case of cocaine and heroin in Italy and Slovenia.	No focus on pharmaceutical drugs
8	Compton, W. M. (2006). Major increases in opioid analgesic abuse in the United States: concerns and strategies.	Not empirical
9	Cooper, R. J. (2013). Over-the-counter medicine abuse: a review of the literature.	No focus on mechanisms or nature of supply
10	Corazza, O., Bersani, F.S., Brunoro, R., Valeriani, G., Martinotti, G., Schifano, F., 2014. The diffusion of performance and image-enhancing drugs (PIEDs) on the internet: the abuse of the cognitive enhancer piracetam. Substance Use & Misuse 49(14), 1849-1856.	Not empirical
11	Crime and Misconduct Commission, 2002. The illicit market for ADHD prescription drugs in Queensland. Crime Bulletin Series(4), 1-6.	Not empirical
12	Degenhardt, L., Black E., Breen C., Bruno R., Kinner S., Roxburgh A. et al. (2006). Trends in	No focus on mechanisms or nature of supply

	Citation	Reason for exclusion
	morphine prescriptions, illicit morphine use and associated harms among regular injecting drug users in Australia.	
13	Dobbin, M. (2014). Pharmaceutical drug misuse in Australia.	Not empirical
14	El-Aneed, A., Alaghehbandan, R., Gladney, N., Collins, K., Macdonald, D., Fischer, B., 2009. Prescription drug abuse and methods of diversion: the potential role of a pharmacy network. Journal of Substance Use 14(2), 75-83.	Not empirical
15	Feussner, G. (2002). Diversion, trafficking, and abuse of methylphenidate.	Data pre-1996 and minimal focus on supply
16	Fischer, B., Rehm J., Patra J. and Cruz M.F. (2006). Changes in illicit opioid use across Canada.	Not empirical
17	Fischer, B., Gittins, J., Rehm, J., 2008. Characterizing the "awakening elephant" of prescription opioid misuse in North America: Epidemiology, harms, interventions. Contemporary Drug Problems: An Interdisciplinary Quarterly 35(2-3), 397-426.	Not empirical
18	Fischer, B., Bibby, M., Bouchard, M., 2010. The global diversion of pharmaceutical drugs: non-medical use and diversion of psychotropic prescription drugs in North America: a review of sourcing routes and control measures. Addiction 105(12), 2062-2070.	Not empirical
19	Ford, J. A. and Schroeder R.D. (2009). Academic strain and non-medical use of prescription stimulants among college students.	No focus on mechanisms or nature of supply
20	Forman, R. F., Marlowe D.B. and McLellan A.T. (2006). The internet as a source of drugs of abuse.	Discussion of law enforcement activity in the United States with little focus on the actual mechanisms or nature of supply
21	Forsyth, A. J. M., Khan F. and McKinlay B. (2011). Diazepam, alcohol use and violence among male young offenders: 'The devil's mixture'.	No focus on mechanisms or nature of supply
22	Fry, C., Smith B., Bruno R., O'Keefe B. and Miller, P. (2007). Benzodiazepine and pharmaceutical opioid misuse and their relationship to crime: an examination of illicit prescription drug markets in Melbourne, Hobart and Darwin National overview report.	Summary of findings from three separate jurisdictional studies that were included separately in the review. This report did not produce any novel findings or data.
23	Gallucci, A. R., Usdan S.L., Martin R.J. and Bolland K.A. (2014). Pill popping problems: The non-medical use of stimulant medications in an undergraduate sample.	No focus on mechanisms or nature of supply
24	Ghandour, L.A., 2012. Prevalence and patterns of commonly abused psychoactive prescription drugs in a sample of university students from	Outside country of origin – Lebanon

	Citation	Reason for exclusion
	Lebanon: an opportunity for cross-cultural comparisons. Drug & Alcohol Dependence 121(1-2), 110-117.	
25	Gibson, A., Larance, B., Roxburgh, A., Degenhardt, L. and Black, E. (2007). The extent of diversion of fentanyl for non-medical purposes in Australia: what do we know?	No focus on mechanisms or nature of supply
26	Heimer, R., Lyubimova, A., Barbour, R., Levina, O.S., 2016. Emergence of methadone as a street drug in St. Petersburg, Russia. International Journal of Drug Policy 27, 97-104.	Outside country of origin – Russia
27	Inciardi, J.A., Cicero, T.J., 2009. Black beauties, gorilla pills, footballs, and hillbilly heroin: some reflections on prescription drug abuse and diversion research over the past 40 years. Journal of Drug Issues 39(1), 101-114.	Not empirical
28	Inciardi, J.A., Surratt, H.L., Cicero, T.J., Kurtz, S.P., Martin, S.S., Parrino, M.W., 2009. The "black box" of prescription drug diversion. Journal of Addictive Diseases 28(4), 332-347.	Not empirical
29	Jenkinson, R. A., Clark N.C., Fry C.L. and Dobbin M. (2005). Buprenorphine diversion and injection in Melbourne, Australia: an emerging issue?	No focus on mechanisms or nature of supply
30	Kadison, R. (2005). Getting an edge - use of stimulants and antidepressants in college.	Not empirical
31	Kaye, S., Darke, S., 2012. The diversion and misuse of pharmaceutical stimulants: what do we know and why should we care? Addiction 107(3), 467-477.	Not empirical
32	Kelly, B. C., Vuolo M., Pawson M., Wells B.E. and Parsons J.T. (2015). Chasing the bean: Prescription drug smoking among socially active youth.	No focus on mechanisms or nature of supply
33	Larance, B., Degenhardt L., Lintzeris N., Winstock A. and Mattick R. (2011). Definitions related to the use of pharmaceutical opioids: extramedical use, diversion, non-adherence and aberrant medication- related behaviours.	Conceptual paper looking at definitions with no focus on mechanisms of supply
34	Larance, B., Ambekar, A., Azim, T., Murthy, P., Panda, S., Degenhardt, L., Mathers, B., 2011. The availability, diversion and injection of pharmaceutical opioids in South Asia. Drug & Alcohol Review 30(3), 246-254.	Outside country of origin – Asia
35	Liang, B. A., MacKey, T.K, Archer-Hayers, A.N. and Shinn, L.M. (2013). Illicit online marketing of lorcaserin before DEA scheduling.	No focus on mechanisms or nature of supply
36	Lofwall, M.R., Walsh, S.L., 2014. A review of	Not empirical

	Citation	Reason for exclusion
	buprenorphine diversion and misuse: the current evidence base and experiences from around the world. Journal of Addiction Medicine 8(5), 315-326.	
37	Maher, D. P., Kissen, M., Danovitch, I., Yumul R. and Louy C. (2014). Perioperative substance use disorder, opioid diversion, and opioid misuse by a medical professional undergoing orthopedic surgery.	Case notes
38	Manchikanti, L., Fellows, B., Ailinani, H., Pampati, V., 2010. Therapeutic use, abuse, and nonmedical use of opioids: a ten-year perspective. Pain Physician 13(5), 401-435.	Not empirical
39	Manchikanti, L., Singh, A., 2008. Therapeutic opioids: a ten-year perspective on the complexities and complications of the escalating use, abuse, and nonmedical use of opioids. Pain Physician 11(2 Suppl), S63-88.	Not empirical
40	McAvoy, B.R., Dobbin, M.D.H and Tobin, C.T. (2011). Over-the-counter codeine analgesic misuse and harm: characteristics of cases in Australia and New Zealand.	Case files and no focus on mechanisms or nature of supply
41	McCabe, S. E., Cranford J.R., Teter C.J., Rabiner D.L., and Boyd C.J. (2012). Use, misuse, and diversion of scheduled prescription medications by college students.	Book chapter with primary focus on pharmaceutical misuse, with small component on diversion that has already been included in the review as part of a separate study
42	Mounteney, J. and Haugland S. (2009). Earlier warning: a multi-indicator approach to monitoring trends in the illicit use of medicines.	No focus on mechanisms or nature of supply
43	Nielsen, S., Barratt, M.J., 2009. Prescription drug misuse: is technology friend or foe? Drug and alcohol review 28(1), 81-86.	Not empirical
44	Office of National Drug Control Policy (2008). Prescription for danger: a report on the troubling trend of prescription and over-the-counter drug abuse among the nations teens.	Data on supply duplicative of other study included in review
45	Okumura, Y., Shimizu, S., Matsumoto, T., 2016. Prevalence, prescribed quantities, and trajectory of multiple prescriber episodes for benzodiazepines: a 2-year cohort study. Drug and Alcohol Dependence 158, 118-125.	Outside country of origin – Japan
46	Rough, K., Dietrich J., Essien T., Grelotti D., Bansberg D., Gray G. and Katz I. (2014). Whoonga and the abuse and diversion of antiretrovirals in Soweto, South Africa.	No focus on pharmaceutical drugs
47	Severtson, S. G. (2010). Reduced abuse, therapeutic errors and diversion following reformulation of extended-release oxycodone in 2010.	No focus on mechanisms or nature of supply
48	Shehnaz, S.I., Agarwal, A.K., Khan, N., 2014.	Outside country of origin – United Arab

	Citation	Reason for exclusion
	A systematic review of self-medication practices among adolescents. Journal of Adolescent Health 55(4), 467-483.	Emirates
49	Sheridan, J. and Butler R. (2011). Prescription drug misuse in New Zealand: challenges for primary health care professionals.	No focus on mechanisms or nature of supply
50	Sikes, A., Walley, C., McBride, R., Fusco, A., Cole, R.F., Lauka, J., 2011. Inhalant and prescription medication abuse among adolescents: An inexpensive, accessible, and misperceived trend. Journal of Child & Adolescent Substance Abuse 20(3), 237-252.	Not empirical
51	St George, B. N (2004). Overseas-based online pharmacies: a source of supply for illicit drug users?	Not empirical
52	Strang, J., Sheridan J., Hunt C., Kerr B., Gerada B. and Pringle M. (2005). The prescribing of methadone and other opioids to addicts: national survey of GPs in England and Wales.	No focus on mechanisms or nature of supply
53	Sung, H. E., Richter L., Vaughan R., Johnson P.B. and Thom B. (2005). Nonmedical use of prescription opioids among teenagers in the United States: trends and correlates.	No focus on mechanisms or nature of supply
54	Takeshita, J (2003). Internet pharmacy prescription and phentermine overdose.	Not empirical
55	Thomas, F and Depledge, M. (2015). Medicine 'misuse': Implications for health and environmental sustainability.	No focus on mechanisms or nature of supply
56	Tresidder, J (2005). Diversion of pharmaceutical drugs.	Not empirical
57	United States General Accounting Office (2003). Prescription drugs: OxyContin abuse & diversion & efforts to address the problem.	No focus on mechanisms or nature of supply
58	van Amsterdam, J. G. C., Nabben T., Keiman D., Haanschoten G. and Korf D. (2015). Exploring the attractiveness of New Psychoactive Substances (NPS) among experienced drug users.	No focus on pharmaceutical drugs
59	van Hout, M. C. (2014). Doctor shopping and pharmacy hopping: practice innovations relating to codeine.	No focus on mechanisms or nature of supply
60	van Hout, M. C. (2015). Nod and wave: An internet study of the codeine intoxication phenomenon.	No focus on mechanisms or nature of supply
61	Vardakou, I., Pistos C. and Spiliopoulou C. (2011). Drugs for youth via internet and the example of mephedrone.	No focus on pharmaceutical drugs
62	Varga, M.D., 2012. Adderall abuse on college campuses: c comprehensive literature review. Journal of Evidence-Based Social Work 9(3),	Not empirical

	Citation	Reason for exclusion
	293-313.	
63	Walsh, C. (2011). Drugs, the Internet and change.	Not empirical
64	Wisniewski, A. M., Purdy C.H. and Blondell R.D. (2008). The epidemiologic association between opioid prescribing, non-medical use, and emergency department visits.	No focus on mechanisms or nature of supply
65	Wolff, K. and Winstock, A.R. (2006). Ketamine: from medicine to misuse.	No focus on mechanisms or nature of supply
66	Yokell, M. A (2011). Buprenorphine and buprenorphine/naloxone diversion, misuse, and illicit use: an international review.	No focus on mechanisms or nature of supply

Appendix 2E. Additional study characteristics

Table A2.5. Country of origin and publication date of included literature

	n	%
Country of origin		
United States	87	58.4
Australia	31	20.8
Europe	14	9.4
France	7	4.7
Sweden	5	3.4
Finland	2	1.3
Germany	2	1.3
Spain	2	1.3
Belgium	1	0.7
Netherlands	1	0.7
Italy	1	0.7
Norway	1	0.7
Denmark	1	0.7
Italy	1	0.7
United Kingdom	10	6.7
England	6	4.0
Wales	2	1.3
Ireland	1	0.7
Scotland	1	0.7
Canada	7	4.7
Date of publication		
1996 - 1998	4	2.7
1999 - 2001	5	3.4
2002 - 2004	3	2.0
2005 - 2007	27	18.1
2008 - 2010	29	19.5
2011 - 2013	35	23.5
2014 - 2017	46	30.9
Total	149	100

Notes: Studies may examine multiple countries, so total does not add to 100. N=149.

Appendix 2F. Sensitivity testing of meta-analyses

Table A2.6. Sensitivity testing for source meta-analyses using random effect models

Excluded study	Prevalence %	LCI 95%	HCI 95%	Cochran's Q	I^2	I^2 LCI 95%	I^2 HCI 95%
Friends or family (free)							
Barrett et al. (2005)	57%	53%	61%	2936.73	98.54	98.34	98.70
Bazazi et al. (2011)	58%	53%	62%	2938.76	98.54	98.35	98.71
Boyd et al. (2006)	58%	53%	62%	2931.40	98.53	98.34	98.70
Bruno (2007)	57%	53%	61%	2941.41	98.54	98.35	98.71
Cassidy et al. (2015b)	56%	52%	61%	2750.32	98.44	98.23	98.62
Cassidy et al. (2015a)	57%	53%	62%	2939.06	98.54	98.35	98.71
Chen et al. (2014)	57%	53%	62%	2942.69	98.54	98.35	98.71
Cicero et al. (2008)	57%	53%	62%	2918.05	98.53	98.33	98.70
Cicero et al. (2011) - 1	58%	55%	62%	2030.86	97.88	97.57	98.16
Cicero et al. (2011) - 2	57%	53%	62%	2943.70	98.54	98.35	98.71
Daniulaitye et al. (2014)	56%	52%	61%	2674.27	98.39	98.17	98.58
DeSantis et al. (2008)	56%	52%	61%	2556.57	98.32	98.09	98.52
DeSantis et al. (2009)	56%	52%	60%	2575.57	98.33	98.10	98.53
DuPont et al. (2008)	56%	52%	61%	2858.95	98.50	98.30	98.67
Ibanez et al. (2013)	57%	53%	62%	2947.36	98.54	98.35	98.71
Inciardi et al. (2010) - 1	57%	53%	62%	2946.03	98.54	98.35	98.71
Inciardi et al. (2010) - 2	58%	53%	62%	2719.89	98.42	98.21	98.61
Inciardi et al. (2010) - 3	57%	53%	62%	2947.75	98.54	98.35	98.71
Katz et al. (2008)	57%	53%	62%	2917.68	98.53	98.33	98.70
Kaye et al. (2014)	57%	53%	61%	2933.92	98.53	98.34	98.70
Levy (2007)	57%	53%	61%	2916.66	98.53	98.33	98.70

Excluded study	Prevalence %	LCI 95%	HCI 95%	Cochran's Q	I^2	I^2 LCI 95%	I^2 HCI 95%
Martins et al. (2009) - 1	57%	53%	61%	2927.34	98.53	98.34	98.70
Martins et al. (2009) - 2	57%	53%	62%	2825.44	98.48	98.28	98.66
McCabe et al. (2007)	58%	53%	62%	2921.19	98.53	98.34	98.70
McCabe et al. (2013)	57%	53%	62%	2943.63	98.54	98.35	98.71
Monte et al. (2009)	57%	53%	62%	2945.93	98.54	98.35	98.71
Ng & Macgregor (2012) - 1	57%	53%	61%	2945.02	98.54	98.35	98.71
Ng & Macgregor (2012) - 2	57%	53%	62%	2945.33	98.54	98.35	98.71
Ng & Macgregor (2012) - 3	57%	53%	62%	2947.72	98.54	98.35	98.71
Ng & Macgregor (2012) - 4	58%	53%	62%	2947.03	98.54	98.35	98.71
Ng & Macgregor (2012) - 5	58%	53%	62%	2942.94	98.54	98.35	98.71
Nielsen et al. (2013) - 1	58%	54%	62%	2928.01	98.53	98.34	98.70
Nielsen et al. (2013) - 2	58%	53%	62%	2945.06	98.54	98.35	98.71
Novak et al. (2007)	57%	53%	61%	2940.17	98.54	98.35	98.71
Novak et al. (2016) - 1	58%	53%	62%	2928.84	98.53	98.34	98.70
Novak et al. (2016) - 2	58%	53%	62%	2943.99	98.54	98.35	98.71
Novak et al. (2016) - 3	57%	53%	62%	2897.96	98.52	98.32	98.69
O'Reilly et al. (2007) - 1	58%	53%	62%	2939.41	98.54	98.35	98.71
O'Reilly et al. (2007) - 2	58%	54%	62%	2920.88	98.53	98.34	98.70
Schepis et al. (2009) - 1	58%	53%	62%	2930.27	98.53	98.34	98.70
Schepis et al. (2009) - 2	57%	53%	62%	2947.37	98.54	98.35	98.71
Schepis et al. (2009) - 3	58%	54%	62%	2929.00	98.53	98.34	98.70
Schulte et al. (2016)	57%	53%	62%	2947.64	98.54	98.35	98.71
Smith et al. (2007) - 1	57%	53%	61%	2942.15	98.54	98.35	98.71
Smith et al. (2007) – 2	57%	52%	61%	2881.63	98.51	98.31	98.68

Excluded study	Prevalence %	LCI 95%	HCI 95%	Cochran's Q	I^2	I^2 LCI 95%	I^2 HCI 95%
Dealer or street market							
Barrett et al. (2005)	32%	23%	42%	19330.12	99.81	99.80	99.82
Bazazi et al. (2011)	32%	23%	42%	19330.55	99.81	99.80	99.82
Bruno (2007)	32%	23%	42%	19328.58	99.81	99.80	99.82
Cassidy et al. (2015b)	32%	23%	42%	19311.88	99.81	99.80	99.82
Cassidy et al. (2015a) - 1	32%	21%	43%	18328.16	99.80	99.78	99.81
Cassidy et al. (2015a) - 2	32%	23%	42%	19224.13	99.81	99.79	99.82
Chen et al. (2014)	33%	24%	42%	16472.74	99.78	99.76	99.79
Cicero et al. (2008)	31%	22%	40%	18899.70	99.80	99.79	99.82
Cicero et al. (2011) - 1	31%	22%	41%	18872.75	99.80	99.79	99.82
Cicero et al. (2011) - 2	31%	22%	40%	18997.87	99.81	99.79	99.82
Davis & Johnson (2008) - 1	31%	22%	41%	19309.98	99.81	99.80	99.82
Davis & Johnson (2008) - 2	31%	22%	40%	19298.57	99.81	99.80	99.82
DeSantis et al. (2008)	32%	23%	42%	19062.91	99.81	99.79	99.82
DeSantis et al. (2009)	32%	23%	42%	19266.10	99.81	99.79	99.82
Ibanez et al. (2013)	31%	22%	40%	18863.46	99.80	99.79	99.82
Inciardi et al. (2010) - 1	31%	22%	41%	18009.06	99.79	99.78	99.81
Inciardi et al. (2010) - 2	30%	23%	38%	10700.19	99.65	99.63	99.68
Inciardi et al. (2010) - 3	32%	23%	42%	19323.58	99.81	99.80	99.82
Katz et al. (2008)	30%	22%	40%	18501.84	99.80	99.79	99.81
Kaye et al. (2014)	32%	23%	42%	19320.81	99.81	99.80	99.82
Martins et al. (2009) - 1	32%	23%	41%	19335.59	99.81	99.80	99.82
Martins et al. (2009) - 2	32%	23%	42%	17959.15	99.79	99.78	99.81
McCabe et al. (2007)	33%	24%	42%	18840.06	99.80	99.79	99.82
McCabe et al. (2013)	32%	23%	42%	19259.08	99.81	99.79	99.82

Excluded study	Prevalence %	LCI 95%	HCI 95%	Cochran's Q	I^2	I^2 LCI 95%	I^2 HCI 95%
Monte et al. (2009)	31%	23%	41%	19335.21	99.81	99.80	99.82
Ng & Macgregor (2012) - 1	32%	23%	42%	19328.99	99.81	99.80	99.82
Ng & Macgregor (2012) - 2	32%	23%	42%	19329.15	99.81	99.80	99.82
Ng & Macgregor (2012) - 3	31%	23%	41%	19335.25	99.81	99.80	99.82
Ng & Macgregor (2012) - 4	32%	23%	41%	19335.23	99.81	99.80	99.82
Ng & Macgregor (2012) - 5	31%	22%	41%	19327.43	99.81	99.80	99.82
Nielsen et al. (2013) - 1	31%	22%	41%	19329.64	99.81	99.80	99.82
Nielsen et al. (2013) - 2	32%	23%	42%	19312.55	99.81	99.80	99.82
O'Reilly et al. (2007) - 1	32%	23%	42%	19330.28	99.81	99.80	99.82
O'Reilly et al. (2007) - 2	32%	23%	42%	19302.94	99.81	99.80	99.82
Schepis et al. (2009) - 1	33%	24%	42%	17511.96	99.79	99.77	99.80
Schepis et al. (2009) - 2	32%	23%	42%	19257.55	99.81	99.79	99.82
Schepis et al. (2009) - 3	32%	23%	42%	18953.90	99.80	99.79	99.82
Schulte et al. (2016)	30%	22%	40%	19169.28	99.81	99.79	99.82
Vivian et al. (2005)	31%	22%	41%	19323.94	99.81	99.80	99.82
Legitimate medical source							
Barrett et al. (2005)	30%	23%	36%	7819.61	99.62	99.58	99.65
Bruno (2007)	28%	22%	35%	7802.84	99.62	99.58	99.65
Cassidy et al. (2015b)	30%	23%	36%	7754.89	99.61	99.58	99.65
Cassidy et al. (2015a) - 1	28%	24%	33%	2843.91	98.95	98.80	99.08
Cassidy et al. (2015a) - 2	29%	23%	36%	7700.58	99.61	99.57	99.65
Chen et al. (2014)	30%	24%	36%	5827.14	99.49	99.43	99.54
Cicero et al. (2008)	28%	22%	35%	7562.20	99.60	99.56	99.64
Cicero et al. (2011) - 1	29%	23%	36%	7733.69	99.61	99.57	99.65
Cicero et al. (2011) - 2	30%	23%	36%	7630.57	99.61	99.57	99.64

Excluded study	Prevalence %	LCI 95%	HCI 95%	Cochran's Q	I^2	I^2 LCI 95%	I^2 HCI 95%
Daniulaitye et al. (2014)	29%	22%	35%	7807.57	99.62	99.58	99.65
Davis & Johnson (2008) - 1	29%	23%	35%	7830.41	99.62	99.58	99.65
Davis & Johnson (2008) - 2	30%	23%	36%	7818.45	99.62	99.58	99.65
Ibanez et al. (2013)	30%	23%	36%	7405.09	99.59	99.55	99.63
Inciardi et al. (2010) - 1	29%	22%	36%	7764.60	99.61	99.58	99.65
Inciardi et al. (2010) - 2	29%	23%	36%	7096.04	99.58	99.53	99.62
Inciardi et al. (2010) - 3	29%	22%	35%	7829.98	99.62	99.58	99.65
Katz et al. (2008)	29%	23%	36%	7727.44	99.61	99.57	99.65
Kaye et al. (2014)	30%	24%	37%	7788.62	99.61	99.58	99.65
Levy (2007)	30%	23%	36%	7780.90	99.61	99.58	99.65
Martins et al. (2009) - 1	29%	23%	36%	7800.90	99.62	99.58	99.65
Martins et al. (2009) - 2	29%	23%	36%	7597.84	99.61	99.57	99.64
McCabe et al. (2013)	29%	22%	36%	7829.74	99.62	99.58	99.65
Nielsen et al. (2013) - 1	29%	23%	36%	7830.12	99.62	99.58	99.65
Nielsen et al. (2013) - 2	28%	22%	34%	7747.69	99.61	99.57	99.65
O'Reilly et al. (2007) - 1	29%	23%	36%	7826.04	99.62	99.58	99.65
O'Reilly et al. (2007) - 2	30%	23%	37%	7788.89	99.61	99.58	99.65
Ross et al. (1996)	29%	22%	35%	7818.08	99.62	99.58	99.65
Schepis et al. (2009) - 1	29%	23%	36%	7499.73	99.60	99.56	99.64
Schepis et al. (2009) - 2	29%	23%	36%	7814.80	99.62	99.58	99.65
Schepis et al. (2009) - 3	30%	23%	36%	7566.56	99.60	99.56	99.64
Smith et al. (2007) - 1	28%	22%	35%	7801.50	99.62	99.58	99.65
Smith et al. (2007) - 2	28%	21%	34%	7739.78	99.61	99.57	99.65
Friend or family (purchase)							
Bruno (2007)	23%	17%	29%	1538.56	98.57	98.30	98.79

Excluded study	Prevalence %	LCI 95%	HCI 95%	Cochran's Q	I^2	I^2 LCI 95%	I^2 HCI 95%
Chen et al. (2014)	23%	17%	31%	1552.54	98.58	98.32	98.80
Daniulaitye et al. (2014)	21%	17%	25%	810.60	97.29	96.65	97.80
Levy (2007)	24%	18%	31%	1519.45	98.55	98.28	98.78
Martins et al. (2009) - 1	22%	17%	28%	1330.77	98.35	98.02	98.62
Martins et al. (2009) - 2	24%	17%	31%	1550.17	98.58	98.32	98.80
McCabe et al. (2013)	23%	17%	29%	1396.31	98.42	98.12	98.68
Ng & Macgregor (2012) - 1	23%	17%	29%	1553.21	98.58	98.32	98.80
Ng & Macgregor (2012) - 2	23%	17%	29%	1554.61	98.58	98.32	98.81
Ng & Macgregor (2012) - 3	23%	18%	30%	1556.69	98.59	98.33	98.81
Ng & Macgregor (2012) - 4	23%	17%	29%	1555.12	98.59	98.32	98.81
Ng & Macgregor (2012) - 5	23%	17%	29%	1545.60	98.58	98.31	98.80
Nielsen et al. (2013) - 1	23%	17%	29%	1528.17	98.56	98.29	98.79
Nielsen et al. (2013) - 2	23%	18%	30%	1556.14	98.59	98.33	98.81
Novak et al. (2007)	24%	18%	30%	1556.15	98.59	98.33	98.81
Novak et al. (2016) - 1	24%	18%	30%	1547.94	98.58	98.32	98.80
Novak et al. (2016) - 2	24%	18%	30%	1443.94	98.48	98.19	98.72
Novak et al. (2016) - 3	24%	18%	30%	1553.19	98.58	98.32	98.80
O'Reilly et al. (2007) - 1	23%	17%	29%	1530.86	98.56	98.30	98.79
O'Reilly et al. (2007) - 2	23%	17%	29%	1554.71	98.58	98.32	98.81
Schepis et al. (2009) - 1	24%	18%	31%	1370.17	98.39	98.08	98.65
Schepis et al. (2009) - 2	24%	18%	30%	1540.35	98.57	98.31	98.80
Schepis et al. (2009) - 3	24%	18%	30%	1542.53	98.57	98.31	98.80
Smith et al. (2007)	23%	17%	29%	1549.91	98.58	98.32	98.80
Theft [a]							
Barrett et al. (2005)	10%	8%	13%	1402.37	97.72	97.31	98.06

Excluded study	Prevalence %	LCI 95%	HCI 95%	Cochran's Q	I^2	I^2 LCI 95%	I^2 HCI 95%
Bruno (2007)	11%	8%	13%	1382.40	97.69	97.27	98.04
Cassidy et al. (2015b)	10%	8%	13%	1403.03	97.72	97.31	98.07
Chen et al. (2014)	10%	8%	13%	1247.58	97.44	96.96	97.84
Cicero et al. (2008)	10%	8%	12%	1272.73	97.49	97.02	97.88
Cicero et al. (2011) - 1	10%	8%	13%	1346.74	97.62	97.19	97.99
Cicero et al. (2011) - 2	10%	8%	13%	1399.92	97.71	97.31	98.06
Daniulaitye et al. (2014)	10%	8%	12%	1361.58	97.65	97.23	98.01
Ibanez et al. (2013)	10%	8%	13%	1389.98	97.70	97.28	98.05
Inciardi et al. (2010) - 1	10%	8%	12%	1257.81	97.46	96.98	97.85
Inciardi et al. (2010) - 2	10%	8%	13%	1075.83	97.03	96.44	97.51
Inciardi et al. (2010) - 3	10%	8%	13%	1401.97	97.72	97.31	98.06
Katz et al. (2008)	10%	8%	12%	1373.37	97.67	97.25	98.03
Martins et al. (2009) - 1	10%	8%	12%	1348.73	97.63	97.20	97.99
Martins et al. (2009) - 2	10%	8%	13%	1402.26	97.72	97.31	98.06
McCabe et al. (2013)	10%	8%	12%	1314.88	97.57	97.12	97.94
Ng & Macgregor (2012) - 1	10%	8%	13%	1402.79	97.72	97.31	98.06
Ng & Macgregor (2012) - 2	10%	8%	13%	1400.36	97.71	97.31	98.06
Ng & Macgregor (2012) - 3	10%	8%	13%	1402.60	97.72	97.31	98.06
Ng & Macgregor (2012) - 4	10%	8%	13%	1403.10	97.72	97.31	98.07
Ng & Macgregor (2012) - 5	10%	8%	13%	1401.86	97.72	97.31	98.06
Nielsen et al. (2013) - 1	10%	8%	13%	1399.22	97.71	97.30	98.06
Nielsen et al. (2013) - 2	10%	8%	13%	1401.56	97.72	97.31	98.06
Novak et al. (2007)	10%	8%	12%	1367.41	97.66	97.24	98.02
Novak et al. (2016) - 1	10%	8%	12%	1284.64	97.51	97.05	97.90
Novak et al. (2016) - 2	10%	8%	12%	1185.33	97.30	96.79	97.73

Excluded study	Prevalence %	LCI 95%	HCI 95%	Cochran's Q	I^2	I^2 LCI 95%	I^2 HCI 95%
Novak et al. (2016) - 3	10%	8%	12%	1350.41	97.63	97.20	97.99
O'Reilly et al. (2007) - 1	10%	8%	13%	1393.99	97.70	97.29	98.05
O'Reilly et al. (2007) - 2	10%	8%	13%	1388.91	97.70	97.28	98.05
Schepis et al. (2009) - 1	10%	8%	13%	1400.40	97.71	97.31	98.06
Schepis et al. (2009) - 2	10%	8%	13%	1399.29	97.71	97.30	98.06
Schepis et al. (2009) - 3	10%	8%	13%	1403.27	97.72	97.31	98.07
Smith et al. (2007) - 1	10%	8%	13%	1397.49	97.71	97.30	98.06
Smith et al. (2007) - 2	10%	8%	13%	1403.20	97.72	97.31	98.07
Illegitimate medical source [b]							
Bruno (2007)	8%	6%	10%	1057.74	97.45	96.93	97.88
Cassidy et al. (2015b)	8%	6%	10%	1057.68	97.45	96.93	97.88
Chen et al. (2014)	8%	6%	10%	1017.19	97.35	96.80	97.80
Cicero et al. (2011)	7%	5%	9%	986.73	97.26	96.69	97.74
Daniulaitye et al. (2014)	7%	5%	10%	1037.88	97.40	96.86	97.84
Ibanez et al. (2013)	8%	6%	10%	1054.38	97.44	96.92	97.87
Inciardi et al. (2010) - 1	8%	5%	10%	1036.01	97.39	96.86	97.84
Inciardi et al. (2010) - 2	8%	6%	10%	804.39	96.64	95.89	97.26
Katz et al. (2008)	8%	6%	10%	1057.26	97.45	96.93	97.88
Martins et al. (2009) - 1	7%	5%	9%	1035.48	97.39	96.86	97.84
Martins et al. (2009) - 2	8%	6%	10%	1057.08	97.45	96.92	97.88
Ng & Macgregor (2012) - 1	7%	5%	9%	1046.99	97.42	96.89	97.86
Ng & Macgregor (2012) - 2	8%	6%	10%	1056.60	97.44	96.92	97.88
Ng & Macgregor (2012) - 3	8%	6%	10%	1057.65	97.45	96.93	97.88
Ng & Macgregor (2012) - 4	7%	5%	9%	1054.63	97.44	96.92	97.87
Ng & Macgregor (2012) - 5	8%	6%	10%	1055.73	97.44	96.92	97.88

Excluded study	Prevalence %	LCI 95%	HCI 95%	Cochran's Q	I^2	I^2 LCI 95%	I^2 HCI 95%
Nielsen et al. (2013) - 1	7%	5%	9%	1048.67	97.43	96.90	97.86
Nielsen et al. (2013) - 2	7%	5%	9%	1013.26	97.34	96.78	97.79
Novak et al. (2007)	7%	5%	9%	1035.85	97.39	96.86	97.84
Novak et al. (2016) - 1	7%	5%	9%	913.57	97.04	96.41	97.57
Novak et al. (2016) - 2	7%	5%	9%	802.09	96.63	95.88	97.25
Novak et al. (2016) - 3	7%	5%	9%	895.76	96.99	96.33	97.52
O'Reilly et al. (2007) - 1	8%	6%	10%	1054.42	97.44	96.92	97.87
O'Reilly et al. (2007) - 2	7%	6%	10%	1055.26	97.44	96.92	97.88
Schepis et al. (2009) - 1	8%	6%	10%	1032.50	97.38	96.85	97.83
Schepis et al. (2009) - 2	8%	6%	10%	1056.39	97.44	96.92	97.88
Schepis et al. (2009) - 3	8%	6%	10%	1034.61	97.39	96.85	97.84
Smith et al. (2007) - 1	7%	6%	10%	1057.19	97.45	96.92	97.88
Smith et al. (2007) - 2	7%	5%	9%	1047.28	97.42	96.89	97.86
Internet							
Boyd et al. (2006)	2%	1%	3%	319.34	93.74	91.67	95.29
Chen et al. (2014)	2%	1%	3%	323.05	93.81	91.77	95.34
Cicero et al. (2008)	2%	1%	3%	275.45	92.74	90.21	94.61
Daniulaitye et al. (2014)	2%	1%	3%	321.57	93.78	91.73	95.32
Festinger et al. (2016) - 1	2%	1%	3%	324.54	93.84	91.81	95.36
Festinger et al. (2016) - 2	2%	1%	3%	323.64	93.82	91.79	95.35
Festinger et al. (2016) - 3	2%	1%	3%	323.40	93.82	91.78	95.35
Inciardi et al. (2010) - 1	2%	1%	3%	308.92	93.53	91.36	95.15
Inciardi et al. (2010) - 2	2%	1%	3%	324.90	93.84	91.82	95.37
Inciardi et al. (2010) - 3	2%	1%	3%	325.19	93.85	91.83	95.37
Katz et al. (2008)	2%	1%	3%	300.34	93.34	91.09	95.02

Excluded study	Prevalence %	LCI 95%	HCI 95%	Cochran's Q	I^2	I^2 LCI 95%	I^2 HCI 95%
Martins et al. (2009) - 1	2%	1%	3%	322.74	93.80	91.76	95.34
Martins et al. (2009) - 2	2%	1%	3%	315.70	93.66	91.56	95.24
McCabe et al. (2007)	2%	2%	3%	302.92	93.40	91.18	95.06
McCabe et al. (2013)	2%	1%	3%	323.82	93.82	91.79	95.35
Novak et al. (2007)	2%	1%	3%	321.96	93.79	91.74	95.33
Novak et al. (2016) - 1	2%	1%	3%	287.56	93.04	90.66	94.82
Novak et al. (2016) - 2	2%	1%	3%	310.85	93.57	91.42	95.17
Novak et al. (2016) - 3	2%	1%	3%	323.02	93.81	91.77	95.34
Schepis et al. (2009) - 1	2%	1%	3%	324.50	93.84	91.81	95.36
Schepis et al. (2009) - 2	2%	2%	3%	189.11	89.42	85.24	92.42
Schepis et al. (2009) - 3	2%	1%	3%	318.80	93.73	91.65	95.28

Notes: The highlighted rows indicate the studies that influenced the overall prevalence estimates by more than 1%. No study influenced the results by more than 3%.
LCI = lower confidence interval, HCI = higher confidence interval, Cochran's Q = the weighted sum of squared differences between individual study effects and the pooled effect across studies, I^2 = the percentage of variation across studies that is due to heterogeneity rather than chance, Tau^2 = absolute value of true variance.
[a)] Includes theft from family, friends and others
[b)] Includes faking symptoms, doctor shopping and prescription forgery practice

Appendix 2G. Sub-group meta-analyses

Table A2.7. Sub-group meta-analyses by target population, drug class, date of publication and study quality

RANDOM EFFECTS	Prevalence %	95% LCI	95% HCI	Cochran's Q	I^2	Tau^2	No. of studies	No of. Estimates
People who use drugs								
Friends or family (free) [a]	54%	48%	60%	1479.54	98.65	0.08	16	23
Dealer or street market	47%	35%	60%	10331.65	99.81	0.32	15	21
Legitimate medical source	34%	27%	41%	4474.99	99.53	0.13	15	22
Friends or family (buy)	31%	10%	57%	516.25	98.64	0.50	6	8
Theft ~	7%	5%	11%	673.83	97.92	0.04	11	15
Illegitimate medical ^	7%	5%	10%	346.88	96.54	0.50	9	13
Internet	2%	2%	3%	83.09	91.58	0.50	5	8
General population								
Friends or family (free) [a]	56%	51%	62%	403.14	97.52	0.03	6	11
Dealer or street market	11%	7%	15%	225.06	97.33	0.03	4	7
Legitimate medical source	16%	11%	21%	271.23	97.79	0.03	4	7
Friends or family (buy)	15%	11%	20%	463.02	98.06	0.04	5	10
Theft ~	15%	11%	21%	595.12	98.32	0.05	6	11
Illegitimate medical ^	8%	5%	13%	653.80	98.47	0.06	6	11
Internet	2%	1%	4%	196.81	95.43	0.02	5	10
Students								
Friends or family (free) [a]	72%	51%	89%	688.92	98.98	0.35	8	8
Dealer or street market	11%	6%	19%	105.91	95.28	0.06	6	6
Legitimate medical source	30%	19%	43%	12.81	84.39	0.04	3	3
Friends or family (buy)	.	.	.	.	.		0	0

RANDOM EFFECTS	Prevalence %	95% LCI	95% HCI	Cochran's Q	I^2	Tau^2	No. of studies	No of. Estimates
Theft ~	9%	1%	24%	29.11	93.13	0.11	3	3
Illegitimate medical ^	.	.	.	.	.		0	0
Internet	1%	0%	2%	8.91	66.34	0.01	4	4
Opioids								
Friends or family (free) [a]	50%	45%	56%	1588.94	98.49	0.07	19	26
Dealer or street market	43%	30%	55%	14788.24	99.84	0.39	17	24
Legitimate medical source	31%	24%	38%	4372.35	99.59	0.12	14	17
Friends or family (buy)	29%	17%	42%	1369.90	99.20	0.21	9	12
Theft [b]	11%	8%	14%	999.26	98.20	0.05	13	19
Illegitimate medical [c]	6%	4%	9%	489.55	97.14	0.03	11	15
Internet	2%	1%	3%	271.53	95.21	0.01	11	14
Opioids (excluding OST medications)								
Friends or family (free) [a]	52%	46%	59%	1548.80	98.97	0.07	12	18
Dealer or street market	41%	26%	57%	14597.05	99.90	0.40	10	16
Legitimate medical source	30%	23%	39%	4321.95	99.68	0.12	10	13
Friends or family (buy)	28%	14%	44%	1320.29	99.47	0.22	6	8
Theft [b]	13%	10%	18%	975.87	98.67	0.05	9	14
Illegitimate medical [c]	6%	4%	9%	471.37	98.09	0.03	7	10
Internet	2%	1%	3%	271.53	95.21	0.01	11	14
Sedatives								
Friends or family (free) [a]	54%	44%	63%	151.27	95.37	0.07	8	8
Dealer or street market	20%	1%	50%	488.29	98.98	0.50	6	6
Legitimate medical source	41%	17%	67%	555.38	98.92	0.45	7	7
Friends or family (buy)	18%	10%	29%	110.25	94.56	0.10	7	7

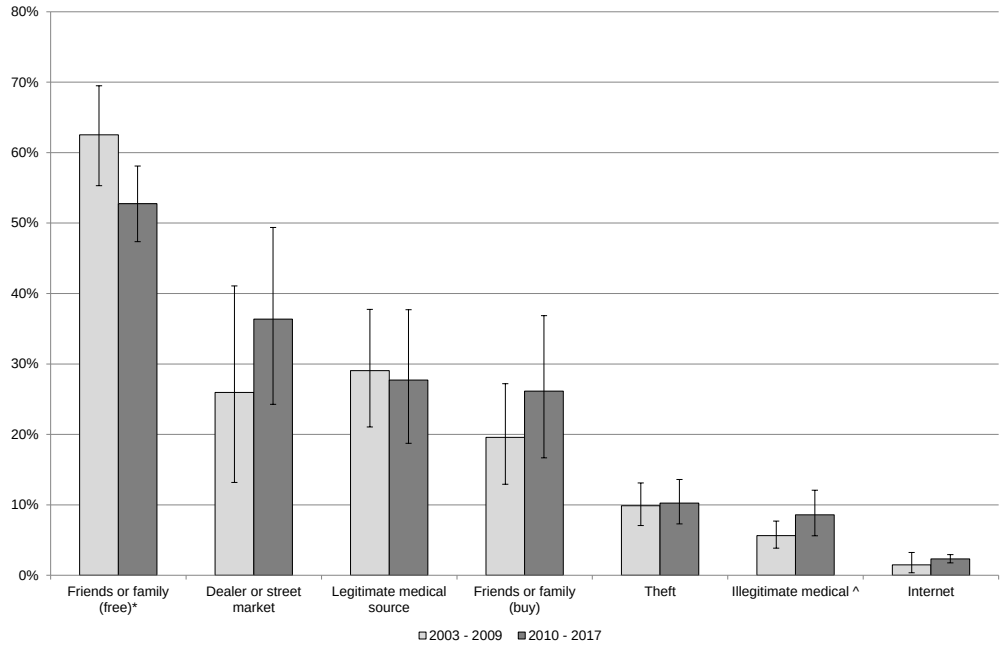
RANDOM EFFECTS	Prevalence %	95% LCI	95% HCI	Cochran's Q	I^2	Tau^2	No. of studies	No of. Estimates
Theft [b]	6%	3%	10%	103.92	93.26	0.05	8	8
Illegitimate medical [c]	15%	5%	30%	484.76	98.56	0.09	8	8
Internet	1%	0%	3%	10.09	80.19	0.01	3	3
Stimulants								
Friends or family (free) [a]	74%	64%	83%	904.12	98.78	0.14	12	12
Dealer or street market	11%	6%	17%	455.57	98.02	0.07	9	9
Legitimate medical source	10%	5%	16%	302.28	98.02	0.04	6	6
Friends or family (buy)	15%	11%	19%	23.02	82.63	0.01	5	5
Theft [b]	12%	5%	22%	257.17	97.67	0.09	7	7
Illegitimate medical [c]	6%	1%	14%	233.37	97.86	0.09	6	6
Internet	2%	1%	4%	69.11	92.77	0.01	4	5
Published 2003 – 2009								
Friends or family (free) [a]	63%	55%	69%	1067.23	98.13	0.11	16	21
Dealer or street market	26%	13%	41%	4041.02	99.58	0.45	13	18
Legitimate medical source	29%	21%	38%	1026.99	98.54	0.13	10	16
Friends or family (buy)	20%	13%	27%	452.36	97.79	0.08	7	11
Theft [b]	10%	7%	13%	240.45	94.59	0.03	9	14
Illegitimate medical [c]	6%	4%	8%	108.30	89.84	0.02	7	12
Internet	1%	0%	3%	240.83	96.26	0.03	7	10
Published 2010 – 2017								
Friends or family (free) [a]	53%	47%	58%	1583.09	98.55	0.07	14	24
Dealer or street market	36%	24%	49%	13278.41	99.85	0.36	12	21
Legitimate medical source	28%	19%	38%	6260.71	99.78	0.17	10	15
Friends or family (buy)	26%	17%	37%	1007.99	98.81	0.16	6	13

RANDOM EFFECTS	Prevalence %	95% LCI	95% HCI	Cochran's Q	I^2	Tau^2	No. of studies	No of. Estimates
Theft [b]	10%	7%	14%	1076.60	98.24	0.05	10	20
Illegitimate medical [c]	9%	6%	12%	945.83	98.31	0.05	9	17
Internet	2%	2%	3%	75.88	85.50	0.00	6	12
High quality (Score 11 - 14)								
Friends or family (free) [a]	54%	49%	59%	1842.12	98.70	0.06	17	25
Dealer or street market	29%	17%	43%	17547.30	99.90	0.39	13	20
Legitimate medical source	23%	15%	31%	7194.81	99.75	0.16	12	19
Friends or family (buy)	21%	14%	29%	1416.92	99.22	0.11	7	12
Theft [b]	13%	10%	17%	1213.50	98.43	0.04	12	20
Illegitimate medical [c]	7%	5%	10%	967.42	98.35	0.04	11	17
Internet	2%	1%	3%	275.45	92.74	0.01	12	21
Moderate quality (Score 6 - 10)								
Friends or family (free) [a]	61%	50%	72%	740.93	97.44	0.25	13	19
Dealer or street market	32%	19%	45%	946.28	98.10	0.37	12	19
Legitimate medical source	39%	27%	53%	448.09	97.32	0.23	9	13
Friends or family (buy)	25%	17%	34%	110.75	90.07	0.10	17	12
Theft [b]	5%	2%	10%	177.91	92.69	0.11	7	14
Illegitimate medical [c]	7%	4%	12%	58.49	81.19	0.05	5	12
Internet	-	-	-	-	-	-	1	1

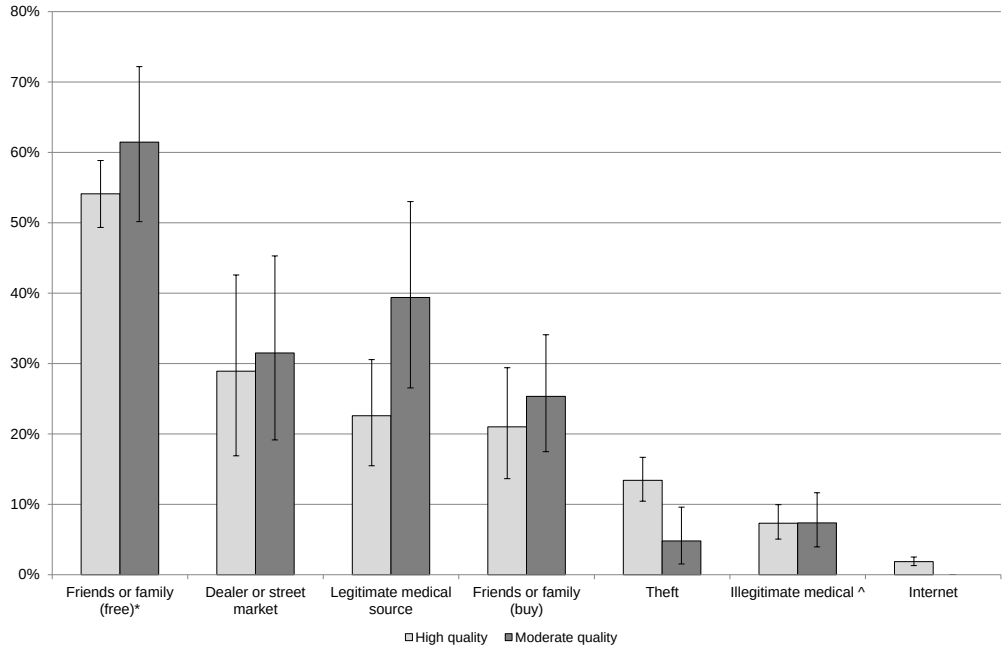
Note: There was one 1996 study that examined medical sourcing, which has not been included in this sub-group analysis because pooling was not possible. LCI = lower confidence interval, HCI = higher confidence interval, Cochran's Q = the weighted sum of squared differences between individual study effects and the pooled effect across studies, I^2 = the percentage of variation across studies that is due to heterogeneity rather than chance, Tau^2 = absolute value of true variance. [a)] Includes studies that indicated drugs were sourced from friends or family, but did not specify whether money was exchanged. [b)] Includes theft from family, friends and others. [c)] Includes faking symptoms, doctor shopping and prescription forgery practices

Figure A2.1. Sub-group meta-analyses by publication date and study quality

A. Publication date



B. Study quality



Notes:

^ Includes studies that indicated drugs were sourced from friends or family, but did not specify whether money was exchanged

~ Includes theft from family, friends and others

* Includes faking symptoms, doctor shopping and prescription forgery practices

Chapter Three Appendices

Appendix 3A: Search strategy used for text-mining tool

Table A3.1. Search strategy for text-mining tool

Jurisdiction	Tribunal name	AustLII web link (correct as of Jan 2017 when searches were conducted)	Primary key words (Health professions)	Supplementary key words (Relevant misconduct)
Victoria	Victorian Civil and Administrative Tribunal	http://www.austlii.edu.au/au/cases/vic/VCAT/	• 'Medical', OR • 'Psychology', OR • 'Nursing and Midwifery', OR • 'Chinese Medicine', OR • 'Osteopathy', OR • 'Podiatry', OR • 'Optometry', OR • 'Pharmacy', OR • 'Physiotherapy', OR • 'Medical Radiation', OR • 'Dental', OR • 'Pharmacist', OR • 'Nursing', OR • 'Health Care Complaints Commission', OR • 'HCCC'	• 'prescription/prescribed', OR • 'drug', OR • 'misuse', OR • 'controlled substance', OR • 'controlled drug'
New South Wales	New South Wales Civil and Administrative Tribunal - Occupational Division	http://www.austlii.edu.au/au/cases/nsw/NSWCATOD/		
	New South Wales Medical Professional Standards Committee	http://www.austlii.edu.au/au/cases/nsw/NSWMPSC/		
	Chiropractors Tribunal of New South Wales	http://www.austlii.edu.au/au/cases/nsw/NSWCHT/		
	Nursing and Midwifery Tribunal of New South Wales	http://www.austlii.edu.au/au/cases/nsw/NSWNMT/		
	Optometry Tribunal of New South Wales	http://www.austlii.edu.au/au/cases/nsw/NSWOPT/		

Jurisdiction	Tribunal name	AustLII web link (correct as of Jan 2017 when searches were conducted)	Primary key words (Health professions)	Supplementary key words (Relevant misconduct)
	Physiotherapists Tribunal of New South Wales	http://www.austlii.edu.au/au/cases/nsw/NSWPYT/		
	Psychologists Tribunal of New South Wales	http://www.austlii.edu.au/au/cases/nsw/NSWPST/		
	Dental Tribunal of New South Wales	http://www.austlii.edu.au/au/cases/nsw/NSWDT/		
	Nursing and Midwifery Professional Standards Committee of New South Wales	http://www.austlii.edu.au/au/cases/nsw/NSWNMPSC/		
	Osteopathy Tribunal of New South Wales	http://www.austlii.edu.au/au/cases/nsw/NSWOST/		
	Pharmacy Tribunal of New South Wales	http://www.austlii.edu.au/au/cases/nsw/NSWPHT/		
Queensland	Queensland Civil and Administrative Tribunal	http://www.austlii.edu.au/au/cases/qld/QCAT/		
South Australia	Health Practitioners Tribunal of South Australia	http://www.austlii.edu.au/au/cases/sa/SAHPT/		

Jurisdiction	Tribunal name	AustLII web link (correct as of Jan 2017 when searches were conducted)	Primary key words (Health professions)	Supplementary key words (Relevant misconduct)
Northern Territory	Northern Territory Health Professional Review Tribunal	http://www.austlii.edu.au/au/cases/nt/NTHPRT/		
Western Australia	State Administrative Tribunal of Western Australia	http://www.austlii.edu.au/au/cases/wa/WASAT/2010/		
Tasmania	Tasmania Health Practitioners Tribunal	http://www.austlii.edu.au/au/cases/tas/TASHPT/		
Australian Capital Territory (ACT)	ACT Civil and Administrative Tribunal	http://www.austlii.edu.au/au/cases/act/ACAT/		

Note: Searches conducted in January 2017.

Appendix 3B. Exclusions with reasons (de-identified case numbers)

Table A3.2. Excluded cases

No.	Tribunal	Year	Reason for exclusion
1	ACT Civil and Administrative Tribunal	2010	Pre 1 July 2010
2	ACT Civil and Administrative Tribunal	2010	Pre 1 July 2010
3	ACT Civil and Administrative Tribunal	2010	Sexual misconduct
4	ACT Civil and Administrative Tribunal	2011	File relates to stay order, provides no detail of allegations
5	ACT Civil and Administrative Tribunal	2011	File relates to stay order, provides no detail of allegations
6	ACT Civil and Administrative Tribunal	2011	Appeal and allegation unrelated to diversion
7	ACT Civil and Administrative Tribunal	2015	Appeal and allegation unrelated to diversion
8	ACT Civil and Administrative Tribunal	2016	Appeal and allegation unrelated to diversion
9	ACT Civil and Administrative Tribunal	2016	Sexual misconduct
10	Dental Tribunal of New South Wales	2011	Sexual misconduct
11	Health Practitioners Tribunal of South Australia	2010	Medical error, not diversion
12	Health Practitioners Tribunal of South Australia	2011	Medical error, not diversion
13	Health Practitioners Tribunal of South Australia	2011	Not relevant
14	Health Practitioners Tribunal of South Australia	2011	Medical error, not diversion
15	Health Practitioners Tribunal of South Australia	2011	Medical error, not diversion
16	Health Practitioners Tribunal of South Australia	2013	Issues over practitioner qualifications
17	Health Practitioners Tribunal of South Australia	2013	Appeal
18	Health Practitioners Tribunal of South Australia	2014	Medical error, not diversion
19	Health Practitioners Tribunal of South Australia	2014	Health issues of practitioner
20	Health Practitioners Tribunal of South Australia	2014	Medical negligence

No.	Tribunal	Year	Reason for exclusion
21	Health Practitioners Tribunal of South Australia	2015	Appeal
22	Health Practitioners Tribunal of South Australia	2015	Sexual misconduct
23	Health Practitioners Tribunal of South Australia	2016	Illicit drugs
24	Health Practitioners Tribunal of South Australia	2016	Falsely representing urine screening
25	Health Practitioners Tribunal of South Australia	2012	Illicit drugs
26	Health Practitioners Tribunal of South Australia	2015	Medical use so not diversion
27	Health Practitioners Tribunal of South Australia	2016	Medical use so not diversion
28	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Sexual misconduct
29	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Administering unapproved treatment for cancer to relative
30	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Involve use of illicit drugs, not pharmaceuticals
31	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Involves professional incompetency, unrelated to diversion
32	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Relates to non-compliance with a condition previously placed on registration
33	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Hearing dismissed by tribunal
34	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Unreleated to diversion
35	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Appeal
36	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Appeal

No.	Tribunal	Year	Reason for exclusion
37	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Non-compliance with previous conditions
38	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Illicit drugs, not pharmaceutical
39	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Allegations relate to incometency and narcissistic personality disorder
40	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Sexual misconduct
41	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Alcohol
42	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Most allegations not proved, unrelated to prescription drug use or diversion
43	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Second hearing relating to allegations unrelated to diversion (nature of allegations not clear from record)
44	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Diversion not proven
45	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Not related to diversion
46	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Illicit drugs
47	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Sexual misconduct
48	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Failure to disclose criminal history
49	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Application from practitioner to return to practice

No.	Tribunal	Year	Reason for exclusion
50	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Application for lifting of sanctions
51	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Appeal
52	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Practitioner seeking reinstatement
53	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Practitioner seeking reinstatement
54	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Practitioner seeking reinstatement
55	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Practitioner seeking reinstatement
56	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Practitioner seeking reinstatement
57	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Appeal
58	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Practitioner seeking reinstatement
59	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Inappropriate administration of alternative treatment - rapid detoxification
60	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Order dismissed
61	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Appeal
62	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Not related to diversion

No.	Tribunal	Year	Reason for exclusion
63	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Appeal
64	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Application for re-registration by practitioner
65	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Sexual misconduct
66	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Impairment not proven
67	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Not related to diversion
68	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Not proven
69	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Illicit drugs
70	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Application for re-instatement
71	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Appeal
72	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Appeal
73	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Application for re-instatement
74	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Appeal
75	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Appeal

No.	Tribunal	Year	Reason for exclusion
76	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Illicit drugs
77	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Appeal
78	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Appeal
79	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Impairment issues, in current complaint no diversion occurred
80	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Complementary medicine issues
81	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Sexual misconduct, alcoholism
82	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	Second hearing to 81 - complementary medicine issues
83	New South Wales Civil and Administrative Tribunal - Occupational Division	2015	No evidence of misappropriation, impairment issue
84	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Primary complaint does not relate to diversion
85	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Reinstatement application
86	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Administering incorrect drugs to patients
87	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Boundary violations
88	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	As above

No.	Tribunal	Year	Reason for exclusion
89	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Unauthorised prescription, no oversupply or diversion involved
90	New South Wales Civil and Administrative Tribunal - Occupational Division	2016	Complaints relating to diversion were dismissed by tribunal (not proven)
91	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Inappropriate use of rapid detoxification treatment
92	New South Wales Civil and Administrative Tribunal - Occupational Division	2017	Not related to diversion
93	New South Wales Civil and Administrative Tribunal - Occupational Division	2014	Not related to diversion
94	Nursing and Midwifery Professional Standards Committee of New South Wales	2011	Not related to diversion
95	Nursing and Midwifery Professional Standards Committee of New South Wales	2011	Not related to diversion
96	Nursing and Midwifery Tribunal of New South Wales	2010	Sexual misconduct
97	Nursing and Midwifery Tribunal of New South Wales	2010	Not related to diversion
98	Nursing and Midwifery Tribunal of New South Wales	2010	Qualifications of practitioner
99	Nursing and Midwifery Tribunal of New South Wales	2010	Appeal
100	Nursing and Midwifery Tribunal of New South Wales	2010	Not related to diversion
101	Nursing and Midwifery Tribunal of New South Wales	2010	Impairment no diversion
102	Nursing and Midwifery Tribunal of New South Wales	2010	Sexual misconduct
103	Nursing and Midwifery Tribunal of New South Wales	2010	Not proven
104	Nursing and Midwifery Tribunal of New South Wales	2010	Not proven
105	Nursing and Midwifery Tribunal of New South Wales	2011	Appeal
106	Nursing and Midwifery Tribunal of New South Wales	2011	Appeal

No.	Tribunal	Year	Reason for exclusion
107	Nursing and Midwifery Tribunal of New South Wales	2011	Boundary violations
108	Nursing and Midwifery Tribunal of New South Wales	2011	Competency issues, unrelated to diversion
109	Nursing and Midwifery Tribunal of New South Wales	2011	Competency issues and impairment, unrelated to diversion
110	Nursing and Midwifery Tribunal of New South Wales	2011	Sexual allegations and impairment (not proven)
111	Nursing and Midwifery Tribunal of New South Wales	2011	Sexual misconduct
112	Nursing and Midwifery Tribunal of New South Wales	2011	Reinstatement application
113	Nursing and Midwifery Tribunal of New South Wales	2012	Competency issues, unrelated to diversion
114	Nursing and Midwifery Tribunal of New South Wales	2012	Alcohol related issues
115	Nursing and Midwifery Tribunal of New South Wales	2012	Sexual misconduct
116	Nursing and Midwifery Tribunal of New South Wales	2013	Competency issues, unrelated to diversion
117	Nursing and Midwifery Tribunal of New South Wales	2013	Illicit drugs
118	Nursing and Midwifery Tribunal of New South Wales	2013	Sexual misconduct
119	Nursing and Midwifery Tribunal of New South Wales	2013	Appeal
120	Nursing and Midwifery Tribunal of New South Wales	2013	Illicit drugs
121	Nursing and Midwifery Tribunal of New South Wales	2013	Reinstatement application
122	Nursing and Midwifery Tribunal of New South Wales	2013	Appeal
123	Nursing and Midwifery Tribunal of New South Wales	2013	Appeal
124	Nursing and Midwifery Tribunal of New South Wales	2013	Appeal
125	Nursing and Midwifery Tribunal of New South Wales	2013	Appeal
126	Nursing and Midwifery Tribunal of New South Wales	2013	Appeal
127	Nursing and Midwifery Tribunal of New South Wales	2013	Failure to notify impairment
128	Nursing and Midwifery Tribunal of New South Wales	2010	Pre 1 July 2010
129	Nursing and Midwifery Tribunal of New South Wales	2010	Pre 1 July 2010
130	Nursing and Midwifery Tribunal of New South Wales	2010	Pre 1 July 2010

No.	Tribunal	Year	Reason for exclusion
131	Nursing and Midwifery Tribunal of New South Wales	2010	Pre 1 July 2010
132	Nursing and Midwifery Tribunal of New South Wales	2010	Pre 1 July 2010
133	Nursing and Midwifery Tribunal of New South Wales	2011	Pre 1 July 2010
134	Nursing and Midwifery Tribunal of New South Wales	2011	False entries in drug register, no diversion
135	Nursing and Midwifery Tribunal of New South Wales	2011	Removal of saline from workplace to treat herself, other complaints not proven
136	Nursing and Midwifery Tribunal of New South Wales	2012	Unauthorised handling of drugs and access cards / access to drug safes (no diversion)
137	Nursing and Midwifery Tribunal of New South Wales	2011	No evidence of diversion / misappropriation
138	Optometry Tribunal of New South Wales	2012	Sexual misconduct
139	Pharmacy Tribunal of New South Wales	2013	Alcoholism and criminal record
140	Pharmacy Tribunal of New South Wales	2010	Defrauding the Commonwealth by lodging false prescriptions to PBS
141	Pharmacy Tribunal of New South Wales	2012	Second hearing following round 1 hearing, which occurred pre-2010 so under previous law
142	Pharmacy Tribunal of New South Wales	2013	Related to the above case, hearing regarding costs
143	Pharmacy Tribunal of New South Wales	2012	Medical errors / negligence
144	Pharmacy Tribunal of New South Wales	2013	Lack of operating procedures for exportation of drugs to USA
145	Pharmacy Tribunal of New South Wales	2013	As above (related case)
146	Physiotherapists Tribunal of New South Wales	2010	Fraud
147	Psychologists Tribunal of New South Wales	2010	Failure to report
148	Psychologists Tribunal of New South Wales	2010	Impairment no diversion
149	Psychologists Tribunal of New South Wales	2010	Illicit drugs
150	Psychologists Tribunal of New South Wales	2010	Appeal
151	Psychologists Tribunal of New South Wales	2010	Appeal
152	Psychologists Tribunal of New South Wales	2012	Sexual misconduct
153	Psychologists Tribunal of New South Wales	2012	Medical negligence

No.	Tribunal	Year	Reason for exclusion
154	Queensland Civil and Administrative Tribunal	2010	Not relevant, medical misconduct
155	Queensland Civil and Administrative Tribunal	2010	Illicit drugs
156	Queensland Civil and Administrative Tribunal	2011	Not diversion
157	Queensland Civil and Administrative Tribunal	2011	Sexual misconduct
158	Queensland Civil and Administrative Tribunal	2011	Reinstatement application
159	Queensland Civil and Administrative Tribunal	2011	Illicit drugs
160	Queensland Civil and Administrative Tribunal	2011	Not details on complaint, orders imposed
161	Queensland Civil and Administrative Tribunal	2011	Illicit drugs
162	Queensland Civil and Administrative Tribunal	2012	Alcohol intoxication
163	Queensland Civil and Administrative Tribunal	2012	Not related to diversion
164	Queensland Civil and Administrative Tribunal	2012	Appeal
165	Queensland Civil and Administrative Tribunal	2012	Record keeping
166	Queensland Civil and Administrative Tribunal	2012	Record keeping
167	Queensland Civil and Administrative Tribunal	2013	Illicit drugs
168	Queensland Civil and Administrative Tribunal	2013	Appeal
169	Queensland Civil and Administrative Tribunal	2013	Inadequate record keeping
170	Queensland Civil and Administrative Tribunal	2013	Failing to report
171	Queensland Civil and Administrative Tribunal	2014	Prior allegations related to pharmaceuticals, current complaint related to sexual conduct
172	Queensland Civil and Administrative Tribunal	2014	Sexual misconduct
173	Queensland Civil and Administrative Tribunal	2014	Appeal, review of conditions
174	Queensland Civil and Administrative Tribunal	2014	Appeal
175	Queensland Civil and Administrative Tribunal	2014	Unauthorised supply only
176	Queensland Civil and Administrative Tribunal	2015	Appeal

No.	Tribunal	Year	Reason for exclusion
177	Queensland Civil and Administrative Tribunal	2015	Medical treatment
178	Queensland Civil and Administrative Tribunal	2015	Sexual misconduct
179	Queensland Civil and Administrative Tribunal	2015	Appeal
180	Queensland Civil and Administrative Tribunal	2015	Medical conduct
181	Queensland Civil and Administrative Tribunal	2016	Not relevant
182	Queensland Civil and Administrative Tribunal	2010	Failure to keep drugs in appropriate storage, inappropriate labelling and record keeping
183	Queensland Civil and Administrative Tribunal	2011	Issues around unconventional treatment, not diversion
184	Queensland Civil and Administrative Tribunal	2012	Not relevant to diversion
185	Queensland Civil and Administrative Tribunal	2012	Record keeping
186	Queensland Civil and Administrative Tribunal	2012	Heard under previous legislation pre-July 2010 (i.e. not the National Law)
187	Queensland Civil and Administrative Tribunal	2012	Not relevant
188	Queensland Civil and Administrative Tribunal	2012	Diversion related complaints not pursued
189	Queensland Civil and Administrative Tribunal	2013	Heard under previous legislation pre-July 2010 (i.e. not the National Law)
190	Queensland Civil and Administrative Tribunal	2013	Appeal
191	Queensland Civil and Administrative Tribunal	2014	Not relevant
192	Queensland Civil and Administrative Tribunal	2015	Appeal
193	Queensland Civil and Administrative Tribunal	2016	Lack of information
194	State Administrative Tribunal of Western Australia	2012	Inappropriate relationship
195	State Administrative Tribunal of Western Australia	2012	Gross carelessness (failure to administer antibiotics in time, etc.)
196	State Administrative Tribunal of Western Australia	2012	Making false allegations in medical report
197	State Administrative Tribunal of Western Australia	2013	Incompetency (failure to administer adrenalin in time, etc.)
198	State Administrative Tribunal of Western Australia	2013	Engaging in unapproved treatment for cancer
199	State Administrative Tribunal of Western Australia	2013	Involves practitioner not stopping to render assistance in case of accident

No.	Tribunal	Year	Reason for exclusion
200	State Administrative Tribunal of Western Australia	2016	Application dismissed, no conditions placed on practitioner
201	State Administrative Tribunal of Western Australia	2015	Application dismissed, no conditions placed on practitioner
202	State Administrative Tribunal of Western Australia	2016	Not disclosing criminal history and inadequate record keeping
203	State Administrative Tribunal of Western Australia	2016	Qualifications of practitioner
204	State Administrative Tribunal of Western Australia	2016	Sexual misconduct
205	State Administrative Tribunal of Western Australia	2013	Appeal
206	State Administrative Tribunal of Western Australia	2013	Application dismissed, no conditions placed on practitioner
207	State Administrative Tribunal of Western Australia	2017	Sexual misconduct
208	State Administrative Tribunal of Western Australia	2014	Not relevant
209	Tasmania Health Practitioners Tribunal	2014	Failure to notify impairment
210	Tasmania Health Practitioners Tribunal	2015	Illicit drugs
211	Victorian Civil and Administrative Tribunal	2010	Appeal
212	Victorian Civil and Administrative Tribunal	2010	Medical negligence
213	Victorian Civil and Administrative Tribunal	2011	Medical negligence
214	Victorian Civil and Administrative Tribunal	2011	Medical negligence
215	Victorian Civil and Administrative Tribunal	2011	Appeal
216	Victorian Civil and Administrative Tribunal	2012	Appeal
217	Victorian Civil and Administrative Tribunal	2012	Inappropriate practice of Chinese medicine
218	Victorian Civil and Administrative Tribunal	2012	Issues around billing / fees
219	Victorian Civil and Administrative Tribunal	2012	Appeal
220	Victorian Civil and Administrative Tribunal	2012	Appeal
221	Victorian Civil and Administrative Tribunal	2012	Appeal
222	Victorian Civil and Administrative Tribunal	2013	Inappropriate examination of patient
223	Victorian Civil and Administrative Tribunal	2013	Appeal

No.	Tribunal	Year	Reason for exclusion
224	Victorian Civil and Administrative Tribunal	2013	Appeal
225	Victorian Civil and Administrative Tribunal	2013	Sexual misconduct
226	Victorian Civil and Administrative Tribunal	2013	Appeal
227	Victorian Civil and Administrative Tribunal	2014	Sexual misconduct
228	Victorian Civil and Administrative Tribunal	2014	Sexual misconduct
229	Victorian Civil and Administrative Tribunal	2014	Sexual misconduct
230	Victorian Civil and Administrative Tribunal	2014	Medical negligence
231	Victorian Civil and Administrative Tribunal	2015	Impairment only
232	Victorian Civil and Administrative Tribunal	2015	Medical negligence
233	Victorian Civil and Administrative Tribunal	2016	Appeal
234	Victorian Civil and Administrative Tribunal	2016	Not relevant
235	Victorian Civil and Administrative Tribunal	2016	Fail to take urine test
236	Victorian Civil and Administrative Tribunal	2016	Appeal
237	Victorian Civil and Administrative Tribunal	2010	Pre July 2010
238	Victorian Civil and Administrative Tribunal	2010	Pre July 2010
239	Victorian Civil and Administrative Tribunal	2010	Not involving any drugs dispensed
240	Victorian Civil and Administrative Tribunal	2011	Appeal
241	Victorian Civil and Administrative Tribunal	2011	Sexual misconduct
242	Victorian Civil and Administrative Tribunal	2013	Not relevant
243	Victorian Civil and Administrative Tribunal	2013	Criminal convictions not related to diversion
244	Victorian Civil and Administrative Tribunal	2014	Mediations not used non-medically

Appendix 3C. Codebook

Table A3.3. Codebook for tribunal decisions

Primary category	Sub-category	Description
Case identifiers	ID	Case citation
	Complainant	Applicant that has brought case forward
	Tribunal	Tribunal where the case is heard
	Jurisdiction	Jurisdiction where the case is heard
	Year of hearing	Year of first hearing date
Demographics of practitioner	Profession	Profession of practitioner
	Specialist area	Doctor specialty, if applicable
	Gender	Gender of practitioner
	Country trained	Country where practitioner gained formal qualifications
	Age (at time of hearing)	Age of practitioner at time of first hearing date
	Year of registration	Year the practitioner registered as a practitioner, extracted from the Australian Health Practitioner Regulation Authority (AHPRA) register of practitioners
	Length of career (at time of hearing)	Number of years between date of hearing and year of registration commencement (e.g. registration in 2006 and hearing in 2016 equals a ten year career)
	Age (proxy) (see further detail below) ^	A proxy categorical age variable was created by extrapolating the following patterns to the entire sample: • those aged 25 to 30 tended to have a career of one to five years • those aged 31 to 40 had careers of six to ten years • those aged 41 to 50 had careers of 11 to 20 years • those aged 51 to 60 had careers of 21 to 30 years • those aged over 60 had careers of over 30 years.

^ Creation of proxy age variable

Half of the records (50%, n=59) contained no information on the age of the health practitioner. As such, information was extracted from the AHPRA register of practitioners for the 'date of registration commencement' (AHPRA, 2018b). This was then used to calculate an estimated length of career from commencement date up until the hearing. Where both age and length of career were known (n= 46), there was an evident relationship (e.g. those aged 25 to 30 tended to have a career of one to five years). A proxy age variable was created by extrapolating these patterns to those without age data. There were 13 cases for which age and length of career was unknown. To maximise use of the data, these cases were assigned to the median age category for the relevant profession. To test the validity of this approach, we conducted separate analyses excluding these cases, with no

Primary category	Sub-category	Description
substantive difference to the multivariate results (see Appendix 3E).		
Background of practitioner	Prior allegations	Is there mention of the practitioner being previously investigated for professional misconduct or unsatisfactory conduct? (These matters must be separate to the current complaint and may include investigation by AHPRA, Police or other authoritative bodies) Yes / No / No mention
	Trained overseas	Did the practitioner gain formal (initial) qualifications in a country outside Australia? Yes / No / No mention
	Substance use disorder	Is there mention of the practitioner suffering from a substance use disorder? Yes / No
	Other health or personal issues	Is there mention of other health or personal problems experienced by the practitioner? (e.g. mental health, family breakdown, financial difficulties etc.) Yes / No
	Isolated practice	Is there mention of the practitioner working in an isolated manner (e.g. in a rural area, with limited supervision or support)? Yes / No
	Details of background factors	If yes to the above, provide details of these issues including nature of prior allegations, country where practiced and duration, nature of substance abuse / dependence, details of other personal health problems or information on isolation.
Proven complaints	Type of misconduct (primary)	Inappropriate supply and/or misappropriation
	Type of misconduct (secondary)	• Overprescribing / supply (excessive quantities, duration, frequency) • Inappropriate prescribing (to family/friends, for monetary benefit, to drug addicted persons, for abuse) • Inappropriate supply / dispensing (to family/friends, for monetary benefit, to drug addicted persons, for abuse) • Fraudulently prescribing (unlawfully modifying

Primary category	Sub-category	Description
		prescriptions) • Diversion from workplace for personal use • Diversion from workplace for unlawful distribution • Unauthorised prescribing / supply (in breach of registration conditions)
	Summary of complaint	Short summary of the particulars of the complaint
	Single or multiple patients	Whether one or more patients were affected by the practitioner's behaviour as described in the complaint. Note: In some cases no patients may have been directly affected – e.g. where drugs were misappropriated from workplace supplies for personal use.
	Single or multiple incidents	Whether the behaviour described was repeated on more than one occasion
	Details of complaint	Detailed summary of particulars of the case, as they relate to diversion
	Other complaints (unrelated to diversion)	List of complaints unrelated to diversion
Drugs involved	Schedule (category, not mutually exclusive)	Level of scheduling of drugs diverted: • Schedule 2, Schedule 3, Schedule 4, Schedule 4D, Schedule 8
	Drug class (category, not mutually exclusive)	Primary class of drugs involved: • Opioids, sedatives (benzodiazepines, Z-drugs, barbiturates), stimulants, pseudoephedrine, PIEDs, antidepressants, antipsychotics, antiretroviral drugs, other
	Drug name	Specific name of drugs involved (not brand name)
	Scale of diversion	• Number of patients affected • Duration of misconduct • Quantity flag
Reasons for decision / contributing factors / motivations	Contributing factor(s) (category, not mutually exclusive)	The factor(s) that are determined by the tribunal to be the contributor(s) to the practitioner's misconduct. Primary • Individual • System Secondary • Personal and health issues

Primary category	Sub-category	Description
		• Substance use disorder • Financial gain • Lacking temperament • Lacking training • Isolation and lack of support • Yes / No mention
	Details of contributing factor(s)	Explanation of diversionary behaviour, as determined by tribunal on the balance of all evidence.
Outcome of hearing	Finding of tribunal	• Professional misconduct • Unsatisfactory professional conduct • Impairment
Sanction imposed	Sanction impose by tribunal	• Pay costs • Reprimand • Health or practice conditions • Registration cancellation or disqualification • Registration suspension • Pay fine • Nil

Appendix 3D. Summary of missing values

Table A3.4. Missing values

Variable	Missing values n (%)
Jurisdiction of hearing	0
Year of hearing	0
Demographics	
Gender	0
Profession	0
Age (raw)	55 (47)
Date of registration commencement	25 (21.4)
Age (proxy) [a]	13 (11.1)
Continent where qualified	57 (48.7)
Nature of misconduct	
Inappropriate prescribing/supply	0
Misappropriation	0
Number of patients affected	12 (10.3)
Duration of misconduct	7 (6.0)
Scale (proxy) [b]	0
Outcome of hearing	0
Sanction imposed	0

Notes:
[a)] Based on information available on age (raw), date of registration commencement for ascertainment of 'length of career' (see Appendix 3C for further information).
[b)] Based on information available on either or all: number of patients affected, duration of misconduct, quantity of drugs (see method in Chapter Three).

Additionally, the following variables were coded as ‘yes’ or ‘no mention’:

- Prior misconduct or disciplinary action
- Drug class (opioids, sedatives, stimulants, PIEDs, pseudoephedrine, antipsychotics)
- High quantity flag
- Contributing factors
    - Individual: health issues, substance use disorder, financial gain, lacking temperament, inappropriate patient-practitioner relationship, other personal matters;
    - System: lacking experience or training, isolation or lack of support, excess workload, under duress from patient

Those with ‘no mention’ may reflect the level of detail provided in the tribunal decisions, rather than an absence of that factor. This should be borne in mind when interpreting the results.

Appendix 3E. Alternative method excluding missing age data

Table A3.5. Multivariate logistic regression predicting involvement in inappropriate supply – alternative method [a]

Independent variables		AOR	95% CI	*p*
Demographics				
Gender (ref = female)	Male	1.438	0.227, 9.100	0.700
Age (ref = under 40 years)	41 to 50 years	1.533	0.300, 7.837	0.608
	Over 50 years	45.121	4.140, 491.721	0.002**
Profession (ref = nurse)	Doctor	154.644	5.775, 4141.038	0.003**
	Pharmacist	247.937	6.455, 9522.913	0.003**
Contributors (ref = no)	Individual	0.068	0.006, 0.780	0.031*
	System	1.981	0.176, 22.254	0.580

Notes:

[a)] Excludes one case involving a dentist and 13 cases with missing age data.

AOR = adjusted odds ratio, ref = reference category, CI = confidence interval, *p* = p-value, * $p < 0.05$ ** $p < 0.01$. Multivariate model $\chi^2(7) = 69.81$, $p < 0.001$. Pseudo R Squared = 0.5792. Hosmer–Lemeshow goodness of fit test, p = 0.7197, area under the curve (AUC) = 0.9379, Bias-corrected 95% CI 0.75, 0.970, n = 103.

Table A3.6. Multivariate logistic regression predicting involvement in misappropriation – alternative method [a]

Independent variables		AOR	95% CI	*p*
Demographics				
Gender (ref = male)	Female	2.160	0.469, 9.940	0.32
Age (ref = over 50 years)	Under 40 years	8.471	1.801, 39.841	0.01*
	41 to 50 years	5.811	1.192, 28.340	0.03*
Profession (ref = doctor)	Pharmacist	0.813	0.196, 3.364	0.78
	Nurse	25.476	2.788, 232.774	0.00**
Contributors (ref = no)	Individual	5.704	0.991, 32.819	0.05
	System	0.281	0.038, 2.081	0.21

Notes:

[a)] Excludes one case involving a dentist and 13 cases with missing age data.

CI = confidence interval, AOR = adjusted odds ratio, ref = reference category, *p* = p-value, * $p < 0.05$ ** $p < 0.01$. Multivariate model $\chi^2(7) = 55.88$, $p < 0.001$. Pseudo R Squared = 0.4435. Hosmer-Lemeshow goodness of fit test, *p* = 0.2416, area under the curve (AUC) = 0.8996, Bias-corrected 95% CI 0.811, 0.968, N = 103.

Appendix 3F. Sample of cases applying the criteria for classifying scale of misconduct

Table A3.7. Scale of misconduct classifications

No. of patients affected		Duration of misconduct		Quantity		Scale
Raw	**Category**	**Raw**	**Category**	**Data**	**Flag**	**Classification**
0	0 - 5 patients	6 months	< 1 year	1,466 vials	Y	Large
20	> 10 patients	3 years	1 - 5 years		N	Large
0	0 - 5 patients	2 months	< 1 year		N	Small
2	0 - 5 patients	1	< 1 year		N	Small
5	0 - 5 patients	3 weeks	< 1 year	$10,499 retail value	Y	Large
11	> 10 patients	2.5 years	1 - 5 years	400kg product	Y	Large
60	> 10 patients	-	Not clearly		N	Large
-	Not clearly	12 years	> 5 years		N	Large
140	> 10 patients	2 years	1 - 5 years		N	Large
3	0 - 5 patients	1 year	1 - 5 years	More than 800	Y	Large
24	> 10 patients	-	Not clearly		N	Large
4	0 - 5 patients	4 years	1 - 5 years		N	Moderate
5	0 - 5 patients	2 years	1 - 5 years		N	Moderate
0	0 - 5 patients	2 years	1 - 5 years		N	Moderate
15	> 10 patients	2 years	1 - 5 years		N	Large
36	> 10 patients	-	Not clearly		N	Large
72	> 10 patients	1.5 years	1 - 5 years		N	Moderate
1	1 - 5 patients	1.5 years	1 - 5 years	355 pills, 999 vials	Y	Large
-	Not clearly	1.5 years	1 - 5 years		N	Moderate

Notes:
Small = zero to five patients, less than one year (all, otherwise cascade up)
Moderate = six to ten patients, one to five years (all or one in each small and moderate category, otherwise cascade up)
High = more than ten patients, more than five years, high quantity flag (any in this category).

Appendix 3G. Subgroup analyses by practitioner type

Table A3.8. Bivariate subgroup analyses for health practitioners involved in supply offences, by profession type

Independent variables		Doctor	Pharmacist	χ^2	*p*
		n (%)			
Drug class	Opioids	37 (71.2)	6 (20.0)	19.9601	0.00**
	Sedatives	30 (57.5)	5 (16.7)	13.0883	0.00**
	Stimulants [a]	3 (5.8)	3 (10.0)	0.5021	0.48
	Pseudoephedrine	4 (7.7)	14 (46.7)	16.8672	0.00**
	PIEDs	12 (23.1)	12 (40.0)	2.6318	0.11
Drug schedule	Schedule 3	4 (7.7)	14 (46.7)	16.8672	0.00**
	Schedule 4/4D	36 (69.2)	16 (53.3)	2.0724	0.15
	Schedule 8	37 (71.2)	6 (20.0)	19.9601	0.00**
Scale of misconduct	Low	8 (15.4)	7 (23.3)	0.2862	0.59
	Moderate	15 (28.8)	11 (36.7)	0.4757	0.49
	Large	29 (55.8)	12 (40.0)	0.0261	0.87
Contributors	Individual	29 (55.8)	15 (50.0)	0.2546	0.61
	Personal and health issues	16 (30.8)	9 (30.0)	0.0053	0.94
	Substance use disorder	3 (5.8)	0	1.7965	0.18
	Financial gain	2 (3.8)	14 (46.7)	22.2115	0.00**
	Lacking temperament	16 (30.8)	2 (6.7)	6.4508	0.01*
	System	19 (36.5)	7 (23.3)	1.5320	0.22
	Lacking training	21 (40.4)	6 (20.0)	3.5795	0.06
	Isolation and lack of support	15 (28.8)	9 (30.0)	0.0122	0.91

Notes:

[a)] Excluding pseudoephedrine

PIED = performance and image enhancing drugs, *p* = p-value, * $p < 0.05$ ** $p < 0.01$.

There were two nurses who were involved in supply-related offences, they have been omitted from the analyses. Pearson's chi-square (n=82).

Chapter Four Appendices

Appendix 4A. Interview protocol

PRE-SCREENING

I am going to ask you some questions to confirm whether you are eligible to participate in the research.

1. How did you hear about the research?
2. Are you over 18 years old? *(If under 18 years, STOP)*
3. Do you currently live in Australia? In what State or Territory do you live? *(If not in Aus, STOP)*
4. When was the last time that you supplied a prescription drug to someone else, either by selling them, giving the drug away for free or exchanging the drugs for something else? *(If more than 6 months ago, STOP)*
5. What type of prescription medications have you supplied to another person in the past 6 months? Can you tell me the brand name(s)?
6. How often have you supplied prescription medications to another person in the past 6 months?

Once eligibility has been confirmed, further detailed information about the study will be provided as follows:

- This research explores how pharmaceuticals are diverted from medical sources to the illegal marketplace for non-medical use in Australia.
- Participation in this research study is voluntary. If you do not want to take part, you do not have to.
- If you decide to participate, we will ask you to participate in a 30-45 minute telephone interview during which you will be asked questions about yourself, your involvement in providing prescription medications to others, and your use of drugs and alcohol. We may conduct this interview right away or at a later time.
- Your answers are completely confidential. We will take every step to protect your confidentiality and anonymity through de-identification of all data and using aggregate data in any publications or conference presentations. Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission, except as required by law.
- You may refuse to answer questions that you do not feel comfortable answering. You can also suspend or withdraw your participation in the project at any time, for any reason.
- I would like to remind you that during the course of the interview not to disclose specific and personal identifying information. If you do disclose such information or indicate that you or someone that you know is in immediate danger, I will be required by law to report this.
- You will be reimbursed for your time with $40 and you have the right to refuse this recompense.
- Are they any questions or concerns that you have about this research?

Verbal consent statement – Participant providing own consent

By providing verbal consent (audio-recorded), you are declaring:

- I have read the Participant Information Sheet;
- I understand the purpose and risks of the research described in the project;
- I have had an opportunity to ask questions and I am satisfied with the answers I have received;

☐ I freely agree to participate in this research study as described and understand that I am free to withdraw at any time during interview and that withdrawal will not affect my relationship with any of the named organisations and/or research team members.

Participants will be asked to state their name and the date and that they agree to the above

Part 1: Demographics

To begin the interview, I am going to ask you some questions about yourself.

1. What gender do you identify as?
    a. Male
    b. Female
    c. Other: _____
2. What is your current age (in years)?
    a. _____
3. What is your marital status:
    a. Never married
    b. Widowed
    c. Divorced
    d. Separated but not divorced
    e. Married (including de facto, living with life-partner)
4. What is your main current employment status? *(Select all that apply)*
    a. Self-employed
    b. Employed for salary, wages, or payment in-kind
    c. Unemployed
    d. Looking for work
    e. Solely engaged in home duties
    f. Full-time student
    g. Part-time student
    h. Retired or on a pension
    i. Volunteer/charity work
    j. Unable to work
    k. Other: _____
5. What is the highest year of primary or secondary school that you have completed?
    a. Did not go to school
    b. Year 6 or below
    c. Year 7 or equivalent
    d. Year 8 or equivalent
    e. Year 9 or equivalent
    f. Year 10 or equivalent
    g. Year 11 or equivalent
    h. Year 12 or equivalent

6. Have you completed a trade certificate or other educational qualification?
    a. Yes
    b. No (Skip to 8)

7. What is the highest qualification you have obtained?
    a. Trade certificate
    b. Non-trade certificate
    c. Associate diploma
    d. Undergraduate diploma
    e. Bachelor degree
    f. Master's degree, postgraduate
    g. Doctorate

8. Which of the following would represent your personal annual income, before tax, from all sources?
    a. $104,000 or more ($2000 or more/week)
    b. $83,200-$103,399 ($1,600-$1,999/week)
    c. $67,600-$83,199 ($1,300-$1,599/week)
    d. $52,000-$67,599 ($1,000-$1,299/week)
    e. $41,600-$51,999 ($800-$999/week)
    f. $31,200-$41,599 ($600-$799/week)
    g. $20,800-$31,199 ($400-$599/week)
    h. $13,000-$20,799 ($250-$399/week)
    i. $7,800-$12,999 ($150-$249/week)
    j. $1-$7,999 ($1-$149/week)
    k. Nil income
    l. Negative income
    m. Prefer not to say
    n. Don't know

9. In which State or Territory do you currently live?
    a. ACT
    b. NSW
    c. NT
    d. QLD
    e. SA
    f. TAS
    g. VIC
    h. WA

10. Do you live in a capital city or regional/rural area of Australia?
    a. Capital city
    b. Regional/rural area

11. Have you ever received help for drug and/or alcohol problems?
    a. Yes (Go to 12)
    b. No (Skip to 13)

12. Are you currently engaged in drug and/or alcohol treatment?
    a. Yes (Go to 12a)
    b. No (Skip to 13)

12a. Please specify type and frequency of treatment:
_____

13. In the past 6 months have you been in receipt of a valid prescription obtained from a registered healthcare professional for the following drug types:
    a. Opioids/analgesics
    b. Sedatives
    c. Stimulants
    d. Performance & Image Enhancing Drugs (PIEDs) (e.g. steroids, peptides, hormones)
    e. Antidepressants or antipsychotics
    f. Other: _____

    Specify subclass / brand name: _____

14. Have you ever been arrested or charged for a criminal offence?
    a. Yes
    b. No (Skip to 16)

15. Have you ever been arrested or charged for a drug-related offence?
    a. Yes (Specify: _____)
    b. No

Part 2: Drug and alcohol use

The next set of questions will ask you about your use of alcohol and other drugs.

16. How often do you have a drink containing alcohol?
    a. Never
    b. Monthly or less
    c. 2-4 times a month
    d. 2-3 times a week
    e. 4 or more times a week

17. How many standard drinks containing alcohol do you have on a typical day when drinking?
    a. 1 or 2
    b. 3 or 4
    c. 5 or 6
    d. 7 to 9
    e. 10 or more

18. In the last 6 months, have you used prescription medications that were not prescribed to you?
    a. Yes
    b. No

19. In the last 6 months, have you used prescription medications for recreational purposes?
    a. Yes
    b. No (Skip to 21)

20. Which prescription drugs have you used in this way?
    a. Opioids
    b. Sedatives

c. Stimulants
d. PIEDs
e. Antidepressants or antipsychotics
f. Other (e.g. antiretroviral, antibiotics): _____

21. How often have you used <EACH PRESCRIPTION DRUG> in the last 6 months?
    a. More than once a day
    b. Once a day
    c. Two to three times a week
    d. Once a week
    e. A couple of times a month
    f. Once a month
    g. Every few months
    h. Less frequently: _____

22. Why do you use prescription medications that are not prescribed to you? *(Select all that apply).*
    a. Medical reasons / self-medication
    b. To alleviate the effects of withdrawal
    c. To enhance the effects of other drugs and/or alcohol
    d. Because my drug of choice is unavailable
    e. Other: _____

23. In the past 6 months, have you used illicit drugs? (By illicit drugs we mean substances such as cannabis, ecstasy, cocaine, meth/amphetamine, GHB, synthetic cannabis or NPS).
    a. Yes
    b. No (Skip to Q26)

24. Which illicit drugs have you used in the last 6 months? *(Select all that apply)*
    a. Cannabis (e.g. marijuana, hash, pot, weed, grass)
    b. Ecstasy (e.g. E, Eccy, MDMA, MDDA)
    c. Meth/amphetamines (e.g. speed, base, Ice, crystal, meth, amphet)
    d. Heroin
    e. Cocaine (e.g. coke, crack, flake, snow)
    f. Hallucinogens (e.g. LSD, magic mushrooms)

25. How often have you used (any) illicit drugs in the last 6 months?
    a. More than once a day
    b. Once a day
    c. Two to three times a week
    d. Once a week
    e. A couple of times a month
    f. Once a month
    g. Every few months
    h. Less frequently: _____

26. In the last 6 months, have you supplied illicit drugs to someone else?
    a. Yes (Go to 26a-26c)
    b. No (Skip to 27)

26a. Which drugs supplied?
26b. What was the method of supply? *(Sold, gifted, exchanged)*
26c. Did the person receiving the illicit drugs also receive prescription medications from you?

Part 3: Pharmaceutical diversion

For the next set of questions, I am going to ask you about the prescription medications that you have supplied to someone else – either by selling them, giving the drugs away for free or exchanging the drugs for something else.

27. Can you tell me about your involvement in supplying pharmaceuticals to others?

28. How long have you been supplying pharmaceuticals to others? When did you first start?
    a. Can you tell me a bit about how / why you first started?

29. What types of drugs have you supplied? *(Drug class, brand name)*

30. How did you access the drugs?

31. Who have you supplied pharmaceuticals to? What was your relationship to the person you supplied to? *(Prompts: Friends, family, acquaintances, strangers)*

32. Why do these people need / want the drugs?

33. [If using for medical purposes] Why don't these people obtain the drugs through medical system?

34. What were your motivations for supplying pharmaceuticals to others?

35. Do you intend on supplying in the future? Why / why not?

Now I would like you to think specifically about the *last 6 months*.

36. In the last 6 months, how many times have your supplied pharmaceuticals to others? How often/frequency per week or month?

37. In the last 6 months, what type of pharmaceuticals have you supplied to others? *(Drug class and brand name)*
    a. If multiple, which drugs have you most often supplied?

38. How have you supplied <DRUG A>? (I.e. Sold, gifted, traded)
    a. If sold: Price, dosage and price variations by customer type

39. How did you access <DRUG A> to supply? [If multiple access points] How do you most commonly access <DRUG A> to supply?
    a. If from someone else, what was involved in getting them from someone else? *(Prompts: Did you purchase them? Did you steal them? Were they given to you? Was the arrangement formalized?)*
    b. If from someone else, where do you think they got them?

40. How would you describe the demand for <DRUG A>?

41. On a scale of 1 to 10 (where 1 = very easy and 10 = very difficult), how easy was <DRUG TYPE A> to obtain?

Part 4: Attitudes and further discussion

I have some final general questions for you.

42. What do you think are some of the risks of supplying pharmaceuticals to others, if any?

43. How does using prescription medications non-medically compares to using illicit drugs in terms of:
    a. Safety?
    b. Legality? Risk of being caught?

44. Why do you think people use prescription medications that are not prescribed to them?

45. Are there any prescription medications that you wouldn't supply to others (even if they were available to you)? What are the reasons for this?

46. Is there anything further you would like to tell me or discuss about your involvement in the supply of prescriptions to other people?

47. Do you have any questions or concerns about anything that we have spoken about today?

Invite the participant to refer other potentially eligible people to the research.

END INTERVIEW

Appendix 4B. Additional bivariate analyses

Table A4.1. Source and motive, by drug class (row percentages)

Drug class		Opioid	Sedative	Stimulant	Other	Fischer's exact
Number		12	25	12	2	
SOURCE						
Medical	Y	20.0	60.0	13.3	6.7	0.069
	N	28.6	33.3	38.1	0.0	
Legitimate	Y	16.7	62.5	12.5	8.3	0.059
	N	29.6	37.0	33.3	0.0	
Illegitimate [a]	Y	33.3	50.0	16.7	0.0	1.000
	N	22.2	48.9	24.4	4.4	
Non-medical	Y	26.0	39.0	35.0	0.0	0.196
	N	21.4	57.1	14.3	7.1	
Friend	Y	33.3	44.4	22.2	0.0	0.924
	N	21.4	50.0	23.8	4.7	
Illicit drug dealer	Y	28.6	42.9	28.6	0.0	1.000
	N	22.7	50.0	22.7	4.6	
Online	Y	20.0	20.0	60.0	0.0	0.315
	N	23.9	52.2	19.6	4.4	
Third-party [b]	Y	20.0	40.0	40.0	0.0	0.859
	N	23.9	50.0	21.7	4.4	
MOTIVE						
Altruistic	Y	23.0	48.0	26.0	3.2	1.000
	N	25.0	50.0	20.0	5.0	
Financial	Y	18.2	48.5	30.3	3.0	0.342
	N	33.3	50.0	11.1	5.6	

Notes:
Y = yes, N = no.
[a)] Includes doctor shopping, prescription forgery and faking symptoms
[b)] Third-parties were unique from other sources because they were not known to the supplier (i.e. not friends/family), nor were they involved in supplying illicit drugs.

Appendix 4C. Defined daily doses

Table A4.2. Allocated defined daily doses for drugs supplied by participants

	DDD
Opioid	
Buprenorphine	75mg
Codeine	100mg
Morphine	100mg
Oxycodone	75mg
Panadeine Forte	100mg
Tapentadol	400mg
Sedative	
Alprazolam	1mg
Clonazepam	8mg
Diazepam	10mg
Lorazepam	2.5mg
Medazepam	20mg
Stimulant	
Dexamphetamine	15mg
Methylphenidate	30mg
Modafanil	300mg
Other	
Olanzapine	10mg
Pregabalin	300mg

Source: WHO Collaborating Centre for Drug Statistics Methdology (2018).
Notes: DDD = defined daily doses.

Appendix 4D. Drug types supplied

Table A4.3. Frequency of drug types supplied by participants (primary drug) (n=51)

	n (%)
Opioid	
Buprenorphine	1 (2.0)
Codeine	2 (3.9)
Morphine	3 (5.9)
Oxycodone	4 (7.8)
Panadeine Forte	1 (2.0)
Tapentadol	1 (2.0)
Total	**12 (23.5)**
Sedative	
Alprazolam	3 (5.9)
Clonazepam	1 (2.0)
Diazepam	19 (37.3)
Lorazepam	1 (2.0)
Medazepam	1 (2.0)
Total	**25 (49.0)**
Stimulant	
Dexamphetamine	5 (9.8)
Methylphenidate	5 (9.8)
Modafinil	2 (3.9)
Total	**12 (23.5)**
Other	
Olanzapine	1 (2.0)
Pregabalin	1 (2.0)
Total	**2 (3.9)**
GRAND TOTAL	**51**

Chapter Five Appendices

Appendix 5A. Sensitivity testing for mode of distribution

Table A5.1. Sensitivity results for gross revenue and mark-up ratio

	Gross revenue		Mark-up ratio [a]	
	Mean	**Median**	**Mean**	**Median**
Calculated based on 65% quantity allocated to primary mode of distribution				
N	**88**		**82**	
Opioids	$356.07	$100.00	$27.48	$2.50
Sedatives	$322.74	$100.00	$19.04	$3.46
Stimulants	$131.37	$60.00	$7.48	$1.51
Other	$465.61	$75.00	$21.84	$10.44
Schedule 4	$324.01	$80.00	$11.98	$3.03
Schedule 8	$312.53	$95.00	$27.57	$3.28
Medical source	$401.14	$96.00	$35.72	$13.19
Non-medical source	$230.45	$78.00	$2.88	$1.23
Total	**$313.85**	**$92.50**	**$19.70**	**$3.27**
Calculated based on 85% quantity allocated to primary mode of distribution				
N	**88**		**82**	
Opioids	$325.16	$96.00	$27.40	$2.50
Sedatives	$323.92	$100.00	$19.16	$3.46
Stimulants	$129.12	$60.00	$6.56	$1.57
Other	$465.61	$75.00	$21.84	$10.44
Schedule 4	$323.88	$80.00	$12.01	$3.03
Schedule 8	$292.34	$80.00	$27.20	$2.88
Medical source	$397.73	$96.00	$316.13	$12.10
Non-medical source	$215.18	$60.00	$44.80	$1.17
Total	**$304.38**	**$85.00**	**$19.54**	**$3.20**

Notes:

All calculations exclude 23 cycles where drugs were gifted only.

Mark-up excludes six cycles where costs or revenue = $0.

[a)] The ratio of the sales revenue to the amount the supplier paid to acquire the drugs (McFadden et al., 2014).

Table A5.2. Bivariate gamma GLMM regression predicting mark-up

Covariates	N	β	*p*	SE
65/35 quantities (n=82) [a]				
ln(Transaction size)	75	-0.02		0.15
Drug class (ref = opioids)	25			
Sedatives	31	0.16		0.34
Stimulants	16	0.10		0.46
Other [c]	10	0.12		0.47
Drug schedule (ref = Schedule 4) [d]	42			
Schedule 8	38	0.41		0.28
Drug potency (ref = low)	12			
High	44	-0.30		0.45
Source (ref = medical)	42			
Non-medical	40	-1.94	**	0.33
Cycle frequency (6mos)	61	0.01		0.01
85/15 quantities (n=81) [b]				
ln(Transaction size)	74	0.00		0.15
Drug class (ref = opioids)	24			
Sedatives	31	0.07		0.35
Stimulants	16	-0.08		0.47
Other [c]	10	0.11		0.48
Drug schedule (ref = Schedule 4) [d]	42			
Schedule 8	37	0.43		0.29
Drug potency (ref = low)	12			
High	43	-0.28		0.45
Source (ref = medical)	42			
Non-medical	39	-1.79	**	0.37
Cycle frequency (6mos)	60	0.01		0.01

Notes:

[a)] Excludes 23 cycles that involved only gifting, six cycles where revenue or costs were nil, thus mark-up cannot be calculated.

[b)] Excludes an additional cycle where mark-up was equal to zero.

[c)] Includes gabapentin, antipsychotics and PIEDs.

[d)] Excludes cycles involving the supply of Schedule 3 drugs.

All models estimated using GLMM with link(log) and family(Gamma). Participant identifier used as a random intercept. N = available sample (number of cycles), SE = standard error, p = p-value, ** $p < 0.01$.

Appendix 5B. Pharmaceutical Benefits Scheme listings

Table A5.3. Drug supplied by participants with Pharmaceutical Benefits Scheme information

Drug type	Dose and form	Maximum quantity	General patient charge	N
Opioid				
Buprenorphine	8mg tablets	7	$28.60	1
Codeine (tablets)	30mg tablets	20	$25.55	3
Methadone	5mg / mL			2
Morphine*	20mg capsules	28	$33.89	2
Morphine*	30mg tablets	28	$39.50	1
Morphine*	60mg tablets	28	$39.50	2
Morphine*	100mg tablets	28	$39.50	3
Morphine	30mg tablets	20	$24.34	1
Morphine	30mg/mL injection	5 x 1 mL ampoules	$29.90	1
Oxycodone (Endone)	5mg tablets	20	$22.03	5
Oxycodone*	20mg tablets	28	$39.50	1
Oxycodone*	40mg tablets	28	$39.50	1
Oxycodone + Naloxone (Targin)	10/5mg	28	$38.81	1
Paracetamol + codeine (Panadeine Forte)	30mg tablets	20	$20.46	6
Tapentadol*	50mg tablets	28	$31.50	1
Tapentadol*	100mg tablets	28	$39.37	1
Tramadol	200mg tablets	20	$20.95	1
Tramadol*	100mg	20	$20.16	1
Tramadol	50mg	20	$19.42	1
			SUB TOTAL	36
Sedative				
Alprazolam	1mg tablets	10	$23.78	9
Clonazepam (Paxam)	2mg tablets	100	$38.43	2
Diazepam (Valium)	5mg tablets	50	$21.70	24
Lorazepam	1mg tablets	50	Not on PBS	1
Oxazepam (Serepax)	30mg tablets	25	$20.42	2
Temazepam	10mg tablets	25	$19.17	2
			SUB TOTAL	40
Stimulant				
Dexamphetamine	5mg tablet	100	$26.48	6
Methylphenidate* (Ritalin)	10mg tablet	100	$30.83	7

Drug type	Dose and form	Maximum quantity	General patient charge	N
Methylphenidate	54mg tablet	30	$39.50	3
Modafanil	100mg tablet	60	$39.50	3
			SUB TOTAL	20
Other				
Escitalopram (Lexapro)	10mg tablet	28	$29.21	1
Esomeprazole	40mg tablet	30	$27.81	1
Fluoxetine (Prozac)	20mg tablet	28	$21.90	1
Mirtazapine	15mg tablet	30	$19.41	2
Olanzapine	20mg wafer	28	$39.16	1
Pregabalin	150mg capsule	56	$39.50	4
Quetiapine (Seroquel)	100mg tablet	90	$33.53	2
Sertraline	100mg tablet	30	$18.78	1
Viagra (Sildenfil)	20mg tablet	90	$39.50	2
			SUB TOTAL	15
			GRAND TOTAL	**111**

Notes:
Drug type is the active ingredient rather than the brand name. Where dose not indicated by participant, the lowest / more conservative dose was used. * denotes modified release.

Appendix 5C. Potency classifications

Table A5.4. Oral Morphine Equivalent and Oral Diazepam Equivalent of drugs supplied by participants

Potency	Opioids	Dose	OME	Schedule
High	Buprenorphine	8mg	37.5	8
	Methadone	10mg/mL	4.7	8
	Methadone	5mg/mL	4.7	8
	Morphine (liquid)	30mg	3	8
	Oxycodone	40mg	1.5	8
	Oxycodone*	20mg	1.5	8
	Oxycodone*	5mg	1.5	8
	Oxycodone + Naloxone	10/5mg	1.5	8
	Morphine*	100mg	1	8
	Morphine*	60mg	1	8
	Morphine	30mg	1	8
	Morphine	20mg	1	8
Low	Tapentadol	100mg	0.4	8
	Tapentadol	50mg	0.4	8
	Codeine syrup	NS	0.25	4
	Tramadol	200mg	0.2	4
	Tramadol	100mg	0.2	4
	Tramadol	50mg	0.2	4
	Codeine[a]	30mg	0.13	3
	Sedatives	**Dose**	**ODE**	**Schedule**
High	Alprazolam	2mg	20	8
	Alprazolam	1mg	20	8
	Clonazepam	2mg	20	4D
	Lorazepam	1mg	5	4D
	Diazepam	5mg	1	4D
Low	Temazepam	30mg	0.4	4D
	Temazepam	5mg	0.4	4D
	Oxazepam	30mg	0.33	4D

Notes:
OME = oral morphine equivalent, ODE = oral diazepam equivalent.
The OME classifications are based on Nielsen et al. (2016). The ODE classifications are based on Nielsen (n.d.). * denotes modified release.
[a)] When the data was collected in 2017, codeine was available over-the-counter at a pharmacy and was classified as Schedule 3 drug.

Appendix 5D. Bivariate analyses of gifting

Table A5.5. Mixed effects logistic regression analysis for gifting versus no gifting

Covariate	N	β	SE
ln(Transaction size)	98	-0.23	0.38
Drug class (ref = opioids)	36		
Sedatives	40	1.63	1.03
Stimulants	20	0.57	1.23
Other	15	-0.97	1.62
Drug schedule (ref = Schedule 4)[a]	62		
Schedule 8	49	-1.27	0.80
Drug potency (ref = low)	18		
High	58	1.42	1.03
Source (ref = medical)	60		
Non-medical	51	-1.59	0.94
Cycle frequency (six months)	85	-0.01	0.02

Notes:
[a)] Excludes four cycles involving the supply of Schedule 3 drugs.
All models estimated using generalised linear mixed model (GLMM) with link (logit) and family (binomial). Participant identifier was used as a random intercept.
N = available sample (number of cycles), SE = standard error, ref = reference group.
Gifting (N = 48), no gifting (N = 63).