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Accidental and suicidal drug-induced deaths in Australia 1997-2001.

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ACCIDENTAL AND SUICIDAL DRUG-INDUCED DEATHS IN AUSTRALIA 1997-2001

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS **4**

EXECUTIVE SUMMARY **6**

1. INTRODUCTION **9**

1.1 Accidental drug-related deaths **9**

1.2 Suicidal drug-related deaths **10**

1.1.1 Aims 11

2. METHODS **12**

2.1 Data used in the study **12**

2.2 Coding of Australian cause of death data **12**

2.3 Underlying and contributing causes of death **13**

2.4 Classifying drug-induced deaths **14**

2.4.1 Accidental drug-induced deaths 16

2.4.2 Suicidal drug-induced deaths 17

3. RESULTS **18**

3.1 Time trends **18**

3.2 Demographic characteristics **19**

3.3 Underlying causes of death **22**

3.4 Drugs noted in toxic quantities at time of death **24**

3.5 Contributing causes of death **28**

4. Discussion **30**

4.1.1 Limitations 32

4.1.2 Conclusions 33

5. References **35**

Appendix A **38**

Appendix B **40**

Appendix C **42**

Appendix D **43**

EXECUTIVE SUMMARY

Aims:

This report compares trends in the characteristics of accidental and suicidal drug-induced deaths among Australians over the period 1997 to 2001, including demographics, underlying and contributing cause of death and drugs noted in toxic quantities at the time of death.

Method:

Cause of death (COD) data, coded according the International Statistical Classification of Diseases and Related Problems – 10th revision (ICD-10), was obtained from the Australian Bureau of Statistics (ABS) for the years 1997 to 2001. The following variables were assessed: sex, age groups, state of residence and underlying and contributing causes of death, as well as drugs noted at the time of death. The ABS definition of drug-induced death (including accidental and suicidal) was utilised.

Results:

(a) Trends in accidental and suicidal drug-induced deaths

From 1997 to 2001 there were 7307 drug-induced deaths. Accidental drug-induced deaths (N=5539) were the leading cause of drug-induced deaths in 2001, accounting for 68% of the total number of drug-induced deaths registered followed by suicide (N=1455) with nearly a third (27%). While the number of accidental drug-induced deaths has varied over time (high of 1403 in 1999 to five year low of 710 in 2001) suicidal deaths have remained relatively stable. In 2001 the rate of accidental drug-induced deaths was 46 deaths per million persons aged 15 years and over whereas the suicidal drug-induced death rate which was 18 deaths per million persons aged 15 and over.

(b) Demographic characteristics

The vast majority of accidental deaths were likely to be male (74%) whereas the sex ratio for suicide was roughly equivalent. The largest proportion of accidental deaths occurred within the 25-34 age group, whereas it was the 35-44 year age group for suicidal deaths. In addition there was a greater proportion of suicidal deaths occurring among older persons, with 25% occurring among those aged 55 and over. The majority of accidental

and suicidal drug-induced deaths occurred in the most populous Australian jurisdictions (NSW, VIC and QLD).

(c) Underlying causes of death

The most frequently assigned ICD-10 codes for underlying cause of death for accidental deaths were: accidental poisoning due to multiple drugs (X44 - 29%), accidental poisoning due to narcotics (X42 - 23%), opioid drug use disorder (F11 - 23%) and multiple drug use disorder (F19 - 17%). The most frequently applied underlying COD codes for suicidal drug-related deaths were: suicidal poisoning by multiple drugs (X64 - 53%), suicidal poisoning by sedative-hypnotics (X61 - 29.4%) and suicidal poisoning by narcotics (X62 - 14%).

(d) Drugs noted in toxic quantities at death

Opioids were more commonly noted among accidental deaths, and antidepressants and sedatives were more common among suicidal deaths: opioids (72% vs. 35%), sedative-hypnotics (24% vs. 35%) and antidepressants (11% vs. 32%). Notably, opioids accounted for the majority of accidental deaths whereas suicidal deaths had opioids, sedative-hypnotics and antidepressants present in similar proportions. Accidental drug-induced deaths had higher proportions of alcohol, amphetamines, hallucinogens and cocaine than suicidal drug-induced deaths, whereas suicidal drug-induced deaths had higher proportions of other medications than accidental drug-induced deaths. Accidental opioid deaths were more likely to have opioids alone whereas suicidal opioid deaths were more likely to have sedative-hypnotics, anti-depressants, and non-opioids in combination. When considering all opioid deaths, accidental deaths were more likely to have opioids alone whereas suicidal deaths were more likely to greater proportions of sedative-hypnotics, anti-depressants, and non-opioids in combination with opioids. When considering all sedative-hypnotic deaths, suicidal deaths were more likely to sedative-hypnotics alone and antidepressants and non-opioid in combination whereas accidental deaths where much more likely to have opioids in combination. When considering all antidepressant deaths, suicidal deaths were more likely to have antidepressants alone, whereas accidental deaths were more likely to have opioids and sedative-hypnotics in combination. While accidental opioid-related deaths showed marked decreases since 1999, suicidal drug related deaths showed gradual increases since that time.

(e) Contributing causes of death

Mood disorders were noted in 5% of accidental and 19% of suicidal deaths and acute hepatitis C was noted in 6% of accidental and 1.5% of suicidal deaths. Other contributing diseases were not commonly mentioned.

Discussion:

The majority of drug-induced deaths in Australia are noted as accidental. Accidental drug-induced deaths have significantly decreased in Australia from 1999 to 2001, whereas suicidal deaths have remained stable. Opioids, particularly heroin, continue to contribute to the majority of accidental drug-induced deaths, whereas suicidal deaths involve other opioid drugs, benzodiazepines and antidepressants in similar proportions. Males aged 25-35 continued to predominate accidental drug-induced deaths in states that are known to have higher rates of heroin use. Suicidal drug related deaths, in contrast, were equally common among males and females, were more concentrated in older age groups and more evenly dispersed across Australia.

Multiple drug deaths were common for both types of deaths. Mono-intoxication was likely for opioids in accidental deaths whereas benzodiazepines and antidepressants were common for suicidal deaths. Licit drugs such as benzodiazepines featured in a notable proportion of both accidental and suicidal drug-induced deaths. A relatively high prevalence of acute hepatitis C was demonstrated for accidental deaths whereas a high prevalence of mood disorders was recorded for suicidal deaths

Accidental and suicidal drug-related mortality are significant public health issues, but clear differences were found in the characteristics of each type of drug-related death, suggesting strongly that they are separate issues and thus require different strategies to address them. Consistent, accurate and timely monitoring of the changes in the patterns of these deaths over time provides an opportunity to inform key stakeholders so as to contribute to appropriate responses to this issue.

1. INTRODUCTION

Deaths caused by accidental overdoses (i.e. acute poisoning) are the most frequent cause of drug-induced death in the world, followed by suicidal drug-related deaths (Gossop, Stewart, Treacy, & Marsden, 2002; Oliver & Keen, 2003; Preti, Miotto, & de Coppi, 2002; Seymour, Black, & Oliver, 2001; Steentoft et al., 2001).

The human and economic costs of drug-induced deaths are significant despite these deaths contributing to a fraction of the total number of deaths per year in Australia - drug-induced deaths accounted for 0.8% of all the 128,544 deaths registered in 2001 (Australian Bureau of Statistics, 2002a).

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The number and nature of drug-related deaths in a country are the result of numerous social forces, including the prevalence of illicit drug use, drug availability and preference, socio-economic considerations as well as the response of the government and society to the issue of drug use (Australian Bureau of Statistics, 2002a).

In Australia, "drug-induced deaths" include those deaths due to either acute instances of poisoning, or those where drug use (including dependence) was thought to have been the underlying causal factor. They are classified due to their intent – accidental, suicidal, undetermined intent or assault. Furthermore they include deaths from illicit (e.g. heroin, amphetamines and cocaine) and licit (e.g. benzodiazepines and anti-depressants) drugs. Alcohol and tobacco-related deaths are excluded from this definition (Australian Bureau of Statistics, 2002b).

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1.1 Accidental drug-related deaths

The high rate of mortality amongst drug users is well documented (Coffin et al., 2003; Gossop et al., 2002; Mino, Bousquet, & Broers, 1999). Opioid overdoses, particularly those related to heroin, have received much of the attention devoted to accidental overdoses in Australia, particularly given increases in these deaths observed in the 1990s (Darke, Ross, Zador, & Sunjic, 2000; Degenhardt, 2001; Hall, Degenhardt, & Lynskey, 1999). Risk factors for accidental opioid overdose deaths include being male, being

unemployed, having a history of heroin dependence, not being in treatment for heroin dependence, injecting heroin, and the concomitant use of alcohol and benzodiazepines (Warner-Smith, Darke, Lynskey, & Hall, 2001). The presence of one or more drugs (such as benzodiazepines, cocaine, alcohol, anti-depressants) with opioids is a consistent feature of accidental opioid deaths worldwide (Coffin et al., 2003; Gueye et al., 2002; Oliver & Keen, 2003; Poulin, Stein, & Butt, 2000; Preti, Miotto, & De Coppi, 2002; Seymour et al., 2001; Steentoft et al., 2001). However, the predominance of fatal opioid overdoses has not been the norm in all countries: the United States, for example, has had a considerable problem with cocaine related morbidity *and* deaths (Office of Applied Studies Substance Abuse and Mental Health Services Administration, 2002).

1.2 Suicidal drug-related deaths

Deaths due to suicide composed 1.9% of all deaths registered in Australia in 2001 (Australian Bureau of Statistics, 2002c). Of these deaths poisoning by drugs contributed to approximately 12% in contrast to hanging (43%), poisoning by non-medical toxins (~21%), other means (14% includes drowning, jumping and using piercing instruments) and firearms (~11%). In 2001 there were distinct gender differences for suicide by drugs; nearly a third of women committed suicide by poisoning (it was the second most common method after hanging) in contrast to 8% of men (the least common method of suicide). The proportion of people using this method of suicide has decreased since 1991 for both males and females (Australian Bureau of Statistics, 2003). This may be due to increased use of other methods such as hanging and carbon monoxide poisoning, increased safety of prescription medications, restricted availability of more lethal medications, and improved resuscitation techniques (Australian Bureau of Statistics, 2002c).

The causes of suicide are complex and multifactorial. A review by Darke and Ross (2002) highlighted a number of factors have been associated with increased risk for suicide in the general population, including: gender, psychopathology, history of family dysfunction, history of family disadvantage, social isolation, social dysfunction, suicidal history and drug dependence (including alcohol, benzodiazepine, mixed drugs and opioids).

For heroin users, each of the suicide risk factors highlighted for the general population are salient for them also, with the distinction that psychopathology, history of family dysfunction/disadvantage, social isolation/dysfunction and drug dependence are already *highly prevalent* within this group. In addition heroin users also have specific risk factors for suicide that relate to their *drug use*, such as diagnosis of heroin dependence, higher levels of polydrug use, heavier use of alcohol, benzodiazepine use and HIV infection (Darke & Ross, 2002).

The review by Darke and Ross (2002) also showed that drug overdose was the main means of attempted and completed suicide among heroin users, but that *non-opioid* drugs were the preferred means (Darke & Ross, 2002). The latter finding supported previous Australian research that found that only 20% of heroin users used heroin as a means of suicide attempt in contrast to 44% using a non-opioid drug (Darke & Ross, 2001).

It is important to note that while accidental drug-induced deaths will almost always exclusively involve deaths of people who use drugs recreationally or are dependent this is not true for the deaths of people who are captured in the suicidal drug-induced death definition. Rather suicidal drug-induced deaths are likely to include non-drug users who commit suicide by drugs, recreational drug users and dependent drug users; although in what proportions is not known.

1.1.1 Aims

To date, there has been no detailed examination of Australian population data on drug-induced deaths with suicidal intent, compared to those that were thought to be accidental drug induced deaths. Recent changes in the processing and dassification of deaths in Australia has led to more consistent and detailed information being available for deaths where drugs were an underlying or contributing factor (Australian Bureau of Statistics, 2002b). Given these changes, and the lack of published epidemiological data on accidental and suicidal drug induced deaths in Australia, we aimed to do the following:

a) Examine the number and rate of accidental and intentional drug-induced deaths in Australia over recent years;
b) Compare the demographic characteristics of persons dying from these causes;
c) Examine the types drugs noted in these deaths;
d) Consider the contributing causes of death noted in these cases.

2. METHODS

2.1 Data used in the study

Data on illicit drug-related deaths for the 1997 to 2001 period were analysed using the Causes of Death (COD) collection, which is managed by the Australian Bureau of Statistics (ABS). The ABS is responsible for collecting data every year on persons who have died in Australia. This data is collected from the Medical Certificate of Cause of Death, which are submitted to: each Australian State or Territory's Registrar of Births, Deaths and Marriages (BD&M) by the medical practitioner certifying the death and to the National Coroners Information System (NCIS)[1] by the coroner certifying the death. In Australia, all deaths that are sudden and unexpected, or violent and unnatural (including drug related deaths), must be reported to a coroner (Harrison & Steenkamp, 2002).

2.2 Coding of Australian cause of death data

The ABS codes the COD according to the rules specified in the International Statistical Classification of Diseases and Related Problems (ICD), produced by the World Health Organization (WHO) (World Health Organization, 1993). This classification was designed to standardise the classification of the coding of diseases and clinical procedures hospital morbidity and mortality settings internationally; a clinically modified version of ICD is used in Australian hospitals.

More detailed COD information has been available since the introduction of the 10th revision of ICD (ICD-10) and the Automated Coding System (ACS) in 1997. ICD-10 provides more detail on drugs than previous versions of ICD, and the ACS has enabled the recording of the underlying factor (the factor *primarily* responsible for the person's death) and contributing causes of death (factors that *contributed* to the death but which were not the main cause of death). Prior to 1997, only the underlying cause of death was recorded (Australian Bureau of Statistics, 2002b).

[1] With the exception of QLD, whose data is not yet available via NCIS; as a result, QLD data is obtained directly from the QLD Coroners Office.

The typical stages of coding multiple COD data in Australia include: electronically extracting relevant information from the Medical Certificate Cause of Death from B,D&M and NCIS (if it is a coronial death) which is then coded into ICD-10 underlying and contributing causes of death using the ACS.

The process differs somewhat for drug-related deaths. The main reason being that the ACS is unable to code drug-related deaths effectively due to difficulties processing external cause codes. Instead the majority of drug-related deaths are manually coded. To ensure the information for each drug-related death is as accurate as possible a query flag is generated for each drug-related death so that a list can be generated at the end of each year. For smaller states (such as NT and TAS) the ABS review NCIS data online for completeness and manually update any additional or revised codes. For larger states and territories, a liaison officer[2] extracts the relevant information[3] from either electronic or hardcopy records at each of the jurisdictional coroner's court(s). The ABS then manually enters any additional information found by the liaison officer. Thus, despite the advent of the ACS, the vast majority of drug-related deaths are coded manually, which is the practice internationally (Wellington, 2003).

2.3 Underlying and contributing causes of death

Until 1997, the ABS produced causes of death statistics in which each death was assigned only an *underlying* cause. The underlying cause of death is defined as the "disease or injury that initiated the train of morbid events leading directly to death, or the circumstances of the accident or violence which produced the fatal injury". The underlying cause is defined in such a way so preventative strategies can be instituted to address that particular cause (Australian Bureau of Statistics, 2002b).

From 1997 onwards, multiple causes[4] of death data have been reported, made possible by ACS. Multiple causes of death refer to all morbid conditions, diseases and injuries

[2] This is because it is too time-consuming for the ABS staff to manually extract the relevant NCIS data for the larger states/territories.
[3] For example: "is this person identified as drug-dependent by a doctor, pathologist or other medical professional?" and "what specific drugs were identified at time of death in toxic amounts?"
[4] For the purposes of this report only seven contributing causes of data were analysed there are up to 20 contributing causes recorded, however, it is unlikely for a death certificate to have more than seven contributing causes recorded.

entered on the death certificate. This includes the underlying cause, immediate cause, or any intervening causes and those conditions that *contributed* to death, but were not related to the disease or condition *causing* death. Multiple causes of death is particularly useful for the analysis of deaths involving drugs, as a broader range of drugs which may have contributed to death without being considered the direct cause can now be identified (Australian Bureau of Statistics, 2002b).

2.4 Classifying drug-induced deaths

The ABS uses the term "drug" to refer to substances classified as drugs, medicaments or biological substances that are used for psychoactive or therapeutic purposes as per ICD guidelines (Australian Bureau of Statistics, 2002b).

The ABS definition of drug-induced death was based on extensive consultation between the ABS and key stakeholders (e.g. researchers, coroners, and health departments) within Australia and from a review of international definitions. There is no WHO definition of drug-induced death (Wellington, 2003).

The ABS definition of drug-induced death includes any death where the underlying cause of death was due to:

a) An acute condition caused by drug use where the deceased person was identified as having a **drug use disorder** (F11-F16, F19, F55); which is usually coded as **a history of drug dependence** (F11.2-F16.2, F19.2) – see Appendix A; and
b) An **acute poisoning or toxicity caused by drugs**. Included are deaths from accidental overdoses (X40-X44), intentional self-harm (X60-X64), assault (X85) and deaths of undetermined intent (Y10-Y14) – see Appendix B.

Table 1: ICD-10 codes used for ascertaining drug-induced deaths in Australia.

ICD-10 Codes	Descriptors
F11-F16, F19	Mental and behavioural disorders due to psychoactive substance use (excluding alcohol, tobacco and volatile substances)
F55	Abuse of non-dependence producing substances
X40-X44	Accidental poisoning by drugs, medicaments and biological substances
X60-X64	Intentional self-harm by drugs, medicaments and biological substances
X85	Assault by drugs, medicaments and biological substances
Y10-Y14	Deaths of undetermined intent by drugs, medicaments and biological substances

Although ICD-10 does not have a unique poison code for all drugs, many drugs of interest can be identified by cross-tabulating the appropriate external (X or Y) cause code by the one of the available poison codes for drugs, medicaments and biological substances (T36-T50) – see Appendix C (Australian Bureau of Statistics, 2002b).

Where evidence of drug use disorder or toxicity of more than one drug is found, a code indicating multiple drug use (F19, X44, X64, Y14) would ideally be used for the underlying cause (Australian Bureau of Statistics, 2002b). However, with the exception of a statement of 'multiple drug accidental poisoning', the recording of accidental poisoning due to multiple drug use (X44) only occurs if the drugs noted are from different categories within ICD-10 external cause chapter[5] and not if they occur within the same grouping[6]. Therefore, the presence of X44 may not be indicative of all cases where multiple drugs were recorded. Similarly, with the exception of a statement of 'multiple drug dependence', the recording of multiple drug dependence (F19.2) only occurs if there is more than one drug dependency noted (e.g. cocaine and heroin dependence). Thus, for mental and behavioural disorders due to psychoactive substance use the 4th character has to be the same for more than one drug before F19 can be utilised (Wellington, 2003).

[5] E.g. accidental poisoning due to heroin (from category X42) and benzodiazepines (from category X41) would be coded to accidental poisoning due to multiple drug use (X44).
[6] E.g. accidental poisoning due to heroin (from category X42) and cocaine (from category X42) would be coded to accidental poisoning due to narcotics and psychodysleptics (X42).

Since the definition of drug-induced death refers to those cases where the underlying cause of death is directly attributable to drug use, the following categories of death are excluded:

- any death considered to be indirectly related to drug use (such as motor vehicle accidents or drownings where drugs were reported as having a contributing role);
- any death where the underlying COD is a medical condition caused by long-term therapeutic drug use (cardiomyopathy due to therapeutic drugs);
- deaths of newborn babies associated with the mother's drug use;
- any death where the underlying COD is related to the use of alcohol, tobacco or volatile solvents (Australian Bureau of Statistics, 2002b).

2.4.1 Accidental drug-induced deaths

Based on the ABS definition of drug-induced death an "accidental drug-induced death" is any death where the underlying COD was due to:

a) an acute condition caused by drug use where the deceased person was identified as having a drug use disorder (F11-F16, F19, F55); which is usually coded as a history of drug dependence (F11.2-F16.2, F19.2); and
b) an accidental acute poisoning or toxicity caused by drugs (X40-X44).

It is important to note that for accidental drug-induced deaths where both drug dependence[7] and poisoning are noted on the death certificate *drug dependence* (F11.2 -F16.2, F19.2) always takes hierarchy over acute *poisoning* as the *underlying* COD. This is because, based on the definition of underlying COD, the person's drug dependence is the factor that lead to the use of the drug(s) which resulted in the accidental overdose. This rationale also applies to deaths where drug dependence and an acute condition (such as organ failure) are noted (Wellington, 2003).

It is also important to note that accidental drug-induced deaths due to *acute poisoning* are classified according to *circumstances* of the accident (the external cause), rather than to the nature of the injury. Due to this focus on the *circumstances* of death, the codes assigned to the underlying COD may not be unique to any specific drug. For example, X42 -

[7] Drug dependence is only coded if the doctor has recorded "drug dependence" on the death certificate or it was noted that the deceased person was in methadone treatment at the time of death.

Accidental poisoning by and exposure to narcotics and psychodysleptics - includes nine categorises of drugs including heroin; X41 - *Accidental poisoning by anti-epileptic, sedative-hypnotic, anti-parkinsonism and psychotropic drugs* - includes nine categories of drugs, including psychostimulants. However, the external cause codes (X codes) are always co-assigned with a corresponding poison code from T36-50 (e.g. T40.1 – *Poisoning by heroin*; T43.6 – *Poisoning by psychostimulants with potential for use disorder*) so that the deaths associated with specific drugs can be identified (Australian Bureau of Statistics, 2002b).

2.4.2 Suicidal drug-induced deaths

Based on the ABS definition of drug-induced death a "suicidal drug-induced death" is any death where the underlying COD was due to intentional acute poisoning by drugs (X60-X64).

3. RESULTS

3.1 Time trends

Figure 1 highlights trends in the number of drug-induced deaths for 1997 to 2001 in Australia. From 1997 to 2001 there were 7307 drug-induced deaths. Accidental drug-induced deaths (N=5539) were the leading cause of drug-induced deaths in 2001, accounting for 68% of all drug-induced deaths registered, followed by suicidal (N=1455) with nearly a third (27%). Small numbers of undetermined (around 4%) and homicidal (around 0.4%) drug-induced deaths were noted (see Appendix D). While the number of accidental drug-induced deaths has varied over time (high of 1403 in 1999 to five year low of 710 in 2001), suicidal deaths have remained relatively stable.

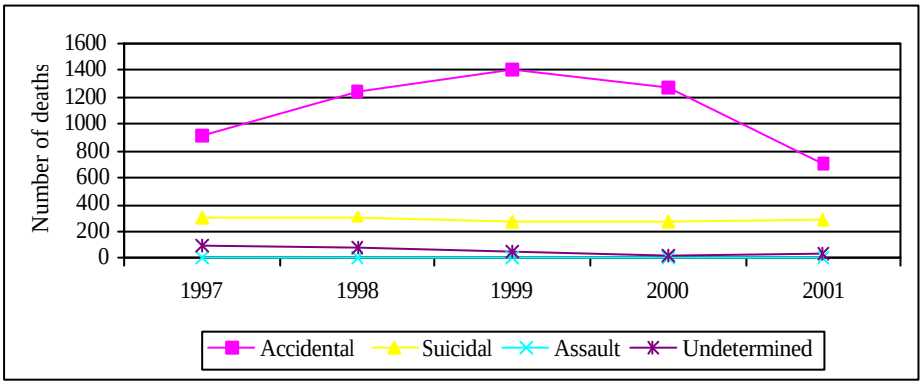

Figure 1: Trends in the numbers of drug-induced deaths by year of registration, Australia 1997-2001.

Table 2 presents the corresponding population rates of drug-induced death from 1997 to 2001 in Australia. In 2001 the rate of accidental drug-induced deaths was 46 deaths per million persons aged 15 years and over in contrast to the suicidal drug-induced death rate which was 18 deaths per million persons aged 15 and over.

Table 2. Rate of drug-induced death per million persons in Australia 1997-2001

Underlying COD	1997	1998	1999	2000	2001
Accidental	62.5	83.7	93.3	83.5	45.9
Suicidal	21.2	20.9	18.5	17.9	18.4
Undetermined	6.4	5.8	3.7	1.4	2.5
Assault	0.3	0.4	0.1	0.1	0.3
Total	**90.3**	**110.8**	**115.6**	**102.9**	**67.0**

3.2 Demographic characteristics

Table 3 suggests that the sex and age group breakdowns for accidental and suicidal drug-induced deaths differ. The vast majority of accidental deaths were likely to be male (74%) whereas the sex ratio for suicide was roughly equivalent (53%). Age breakdowns for accidental and suicidal deaths showed different patterns. Accidental deaths were most likely to occur between 15-44 age group whereas there were a greater proportion of suicidal deaths occurring among older persons, with 25% occurring among those aged 55 and over. For the 5-year period breakdowns for jurisdiction of usual residence were similar for accidental and suicidal drug-induced deaths, with NSW having the largest proportion of deaths followed by VIC and QLD. The proportions varied slightly for suicidal deaths, which were more evenly spread among NSW (32.9%), VIC (23.8%) and QLD (20.8).

Table 3. Characteristics of accidental and suicidal deaths in Australia, 1997-2001

	Accidental (%)	Suicidal (%)
Male	73.5	52.9
Age group		
0-14	0.4	0.1
15-24	19.5	8.9
25-34	36.9	21.9
35-44	27.6	26.7
45-54	9.1	18.0
55+	6.6	24.5
Jurisdiction of usual residence		
NSW	40.2	32.9
VIC	28.8	23.8
QLD	10.9	20.3
SA	6.7	9.1
WA	9.9	9.8
TAS	1.3	1.4
NT	0.8	1.2
ACT	1.3	1.4

Figure 2 suggests that sex trends in suicidal deaths have remained relatively stable with a slight decrease over the 5-year period, 10% (160 to 151 deaths) and 6% (149 to 134 deaths) for men and women respectively. The changes over time are much more marked for accidental deaths. Accidental deaths among males increased from 669 in 1997 to 1044 deaths in 1999 (a 56% increase) and declined to 480 in 2001. There was a similar trend for females, with 244 deaths in 1997, with the number peaking at 359 deaths in 1999 (a 47% increase) and decreasing to 239 deaths in 2001. It is notable that in 2001, the difference between male and female accidental deaths was the lowest over the 5-year period.

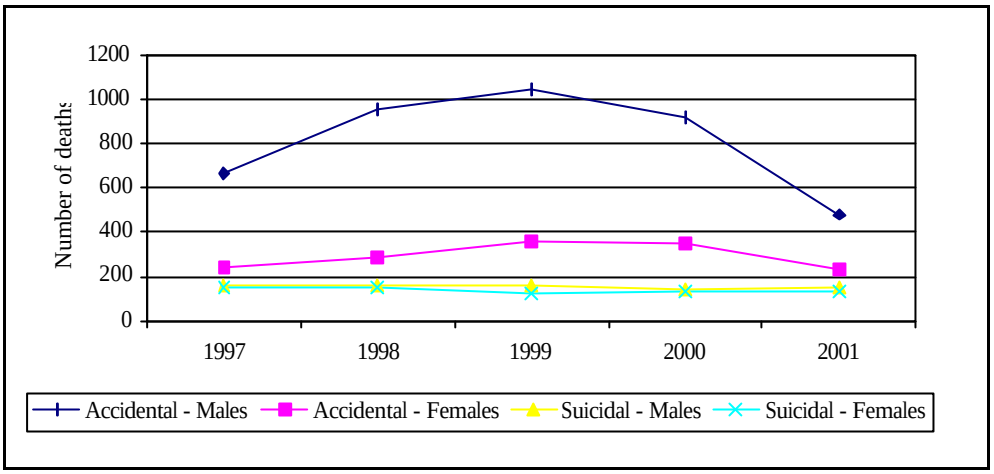

Figure 2: Trends in the numbers of accidental and suicidal drug-induced deaths by sex, Australia 1997-2001.

Figure 3 highlights that the largest proportion of accidental deaths occurred within the 25-34 age group, that deaths among 15-54 increased from 1997 to 1999 with a decline from 1999 to 2001, with the most marked decrease occurring among the 25-34 age group.

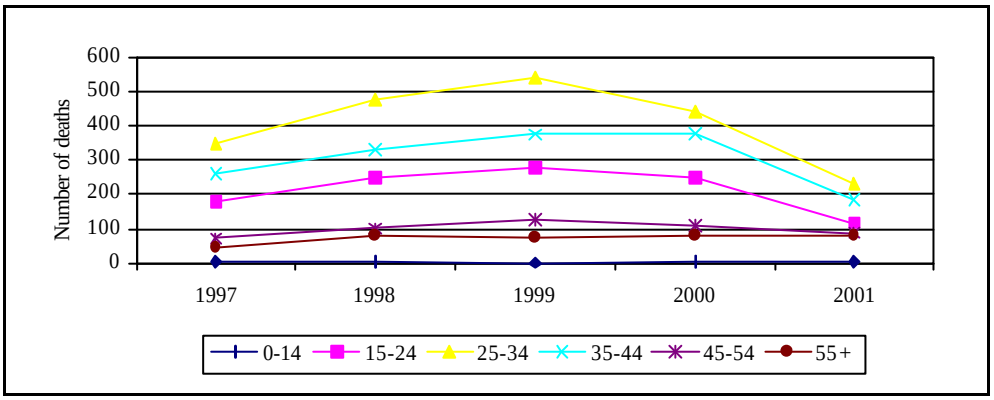

Figure 3: Trends in the numbers of accidental drug-induced deaths by age group, Australia 1997-2001.

Figure 4 demonstrates that unlike accidental deaths, there does not appear to be any consistent pattern in suicidal deaths by age group over time.

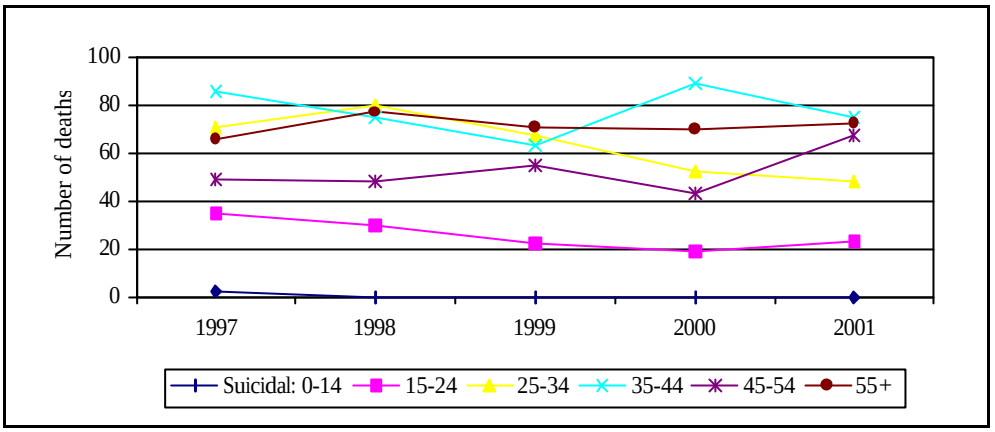

Figure 4: Trends in the numbers of suicidal drug-induced deaths by age group, Australia 1997-2001.

3.3 Underlying causes of death

Table 4 displays the specific codes that were the primary cause of accidental drug-induced deaths for the 1997 to 2001 period (N=5539). It is apparent that the most frequently applied codes for accidental deaths were: X44 - accidental poisoning due to multiple drug use (29%), X42 – accidental poisoning due to narcotics (23%), F11 –opioid use disorder (23%) and F19 – multiple drug use disorder (17%). In addition, when grouped collectively, deaths due to accidental poisoning - X40-X44 - contributed to the majority (59%) of accidental drug-induced deaths in contrast to deaths due to drug use disorder (including dependence) - F11-F16, F19, F55.

Table 4: Number and proportion of underlying cause of death codes for accidental drug-induced deaths, 1997-2001.

ICD-10 Code	Definition	N	%
X44	Accidental poisoning by multiple drugs	1606	29
X42	Accidental poisoning by narcotics	1247	23
F11	Opioid use disorder	1249	23
F19	Multiple drug use disorder	948	17
X41	Accidental poisoning by sedative-hypnotics	341	6
	Other[1]	148	2.67
	Total accidental drug-induced deaths	**5539**	**100**

1. See Barker & Degenhardt, 2003 for a detailed breakdown of this category.

Table 5 demonstrates the number and proportion of each of the codes that contribute to suicidal drug-induced deaths (N=1455) for the 1997 to 2001 period. It is apparent that the most frequently applied underlying COD codes for suicidal deaths were: X64 – suicidal poisoning by multiple drug use (53%), X61 – suicidal poisoning by sedative-hypnotics (29.4%), X62 – suicidal poisoning by narcotics (14%).

Table 5: Number and proportion of underlying cause of death codes for suicidal drug-induced deaths, 1997-2001.

ICD-10 Code	Definition	N	%
X64	Suicidal poisoning by multiple drug use	771	53
X61	Suicidal poisoning by sedative-hypnotics	427	29.4
X62	Suicidal poisoning by narcotics	205	14
X63	Suicidal poisoning by other drugs acting on the autonomic nervous system	28	2
X60	Suicidal poisoning by nonopioid analgesics	24	1.6
	Total suicidal drug-induced deaths	**1455**	**100**

3.4 Drugs noted in toxic quantities at time of death

Table 6 shows that the drugs most commonly noted in toxic quantities at time of death for accidental and suicidal drug-induced deaths were opioids, sedative-hypnotics and antidepressants; however there was a different pattern in the proportion of drug poisoning.

In particular, opioid poisoning was much more likely to occur in an accidental than a suicidal poisoning (72% vs. 35%; OR 4.94; 95%CI: 4.37, 5.57). Heroin poisoning constituted 76% of the opioid drugs noted for both accidental and self -intentional drug-induced deaths. In contrast sedative-hypnotic (35% vs. 24%; OR 0.59; 95%CI: 0.53, 0.68) and antidepressant poisoning (32% vs. 11%; OR 0.27; 95%CI: 0.24, 0.31) were more likely to occur in a suicidal death.

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Benzodiazepines constituted the majority of sedative-hypnotic related accidental and suicidal deaths (95% versus 85%). Tricyclic and tetracyclic[8] antidepressants made up the majority of antidepressant related accidental and suicidal deaths (60% versus 70%), with selective serotonin uptake reinhibitors[9] (39% versus 34%) deaths and monoamine oxidase inhibitors[10] (8% versus 10%) constituting the remainder.

Accidental drug-induced deaths had higher proportions of alcohol (15% vs. 12.9%; OR 0.97; 95%CI: 0.96, 0.97), amphetamines (4.8% versus 1%; OR 4.86; 95%CI: 2.88, 8.21), hallucinogens (2.9% versus 0.8%; OR 3.98;95%CI:2.16,7.35) and cocaine (2.3% verus 0.3%; OR 8.44;95%CI:3.12,22.89) than suicidal drug-induced deaths.

Suicidal drug-induced deaths had higher proportions of non-opioid poisoning (12% vs. 6%; OR 0.42; 95%CI:0.35,0.51), psychotropic poisoning (7% versus 4%; OR 0.55;95%CI:0.43,0.70) and autonomic nervous system medicaments (4.7% verus 1.4%) than accidental drug-induced deaths.

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[8] E.g. Tofranil, Sinequan & Anafranil.
[9] E.g. Prozac, Zoloft & Aropax.
[10] E.g. Nardil & Parnate.

Table 6: Proportion of accidental and suicidal drug-induced deaths in which selected drugs were noted in toxic quantities, Australia 1997-2001.

Drugs noted in toxic quantities	Accidental (%)	Suicidal (%)	OR
Opioids	72.4	34.6	4.94
Sedative-hypnotics	24.4	35.1	0.59
Antidepressants	11.3	32	0.27
Non-opioids	5.6	12.4	0.42
Amphetamines	4.8	1	4.86
Hallucinogens	2.9	0.8	3.98
Cocaine	2.3	0.3	8.44
Psychotropics	3.8	6.8	0.55
Autonomic Nervous System agents	1.4	4.7	0.65
Alcohol	15	12.9	4.35

Table 7 shows the proportions of the most common three drugs for accidental and suicidal deaths broken down by drug combinations. There have a different pattern in the proportion of drug poisoning.

As mentioned, opioids were present in 72% and 35% of all accidental and suicidal drug-induced deaths respectively. Opioids were present in toxic levels on their own (i.e. without any other drug) in half of opioid accidental deaths and more than one third of opioid suicidal deaths (37.3%). For all opioid accidental and suicidal deaths, the following drug combinations were present: opioids and alcohol in 16.4% and 10.9% of deaths; opioids and sedative-hypnotics in 27.9% and 38.4% of deaths; opioids and anti-depressants in 9.5% and 25.1% of deaths; opioids and non-opioids in 5.2% and 22.8% of deaths; and opioids and psychotropics in 3.3% and 4.9% of deaths. Thus, for opioid deaths accidental deaths were more likely to have opioids alone whereas suicidal deaths were more likely to have sedative-hypnotics, antidepressants, and non-opioids in combination.

As mentioned, sedative-hypnotics were present in 25.4% and 35.1% of all accidental and suicidal drug-induced deaths. Sedative-hypnotics were present in toxic levels on their

own (i.e. without any other drug) in less than 10% of sedative-hypnotic accidental deaths and more than one fifth of sedative-hypnotic suicidal deaths (23.3%). For all sedative-hypnotic accidental and suicidal deaths, the following drug combinations were present: sedative-hypnotic and alcohol in 19.7% and 17.7% of deaths; sedative-hypnotic and opioids in 82.8% and 37.9% of deaths; sedative-hypnotic and antidepressants in 21.7% and 34.2% of deaths; sedative-hypnotic and non-opioids in 10.7% and 16.5% of deaths; and sedative-hypnotic and psychotropics in 8.2% and 10.8% of deaths. Thus, for sedative-hypnotic deaths accidental deaths were much more likely to have opioids in combination whereas suicidal deaths were more likely to have sedative-hypnotics alone, and anti-depressants in combination.

As mentioned, antidepressants were present in 11.3% and 32% of all accidental and suicidal drug-induced deaths. Antidepressants were present in toxic levels on their own (i.e. without any other drug) in less than one fifth of antidepressant accidental deaths (16.8%) and more than one third of antidepressant suicidal deaths (36.9%). For all antidepressant accidental and suicidal deaths, the following drug combinations were present: antidepressants and alcohol in 15.9% and 14.1% of deaths; antidepressants and opioids in 61.1% and 27.2%; antidepressants and sedative-hypnotics in 23.0% and 18.1% of deaths; antidepressants and non-opioids in 12.4% and 14.4% of deaths; and antidepressants and psychotropics in 8.8% and 6.6% of deaths. Thus, for antidepressant deaths, accidental deaths were more likely to also have opioids noted, whereas suicidal deaths were more likely to have antidepressants alone.

Table 7: Proportions of accidental and suicidal drug-induced deaths in which the major drugs were noted in toxic quantities, Australia 1997-2001.

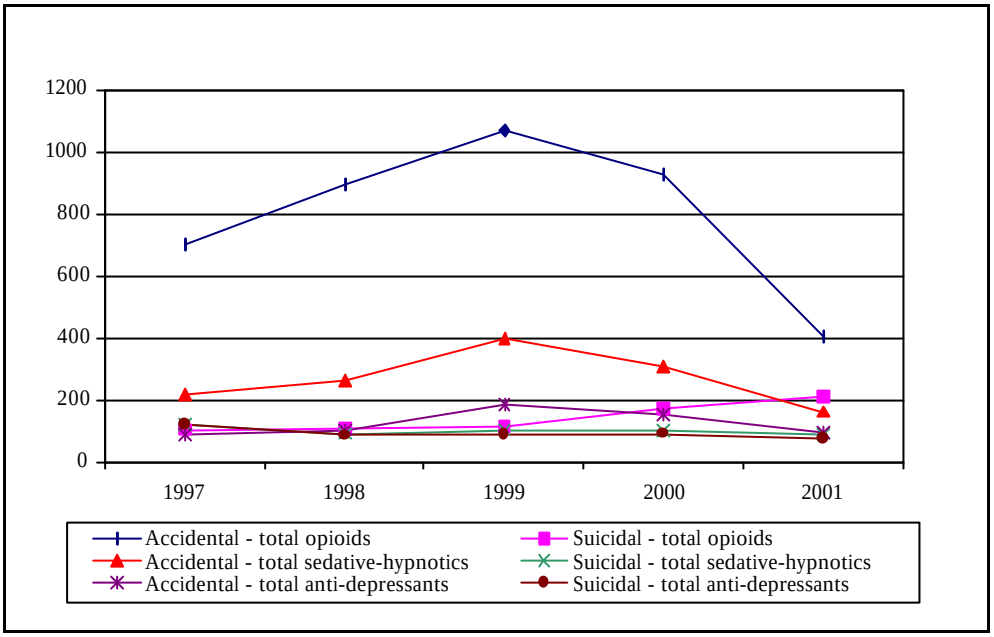
Drug Combinations[11]	Accidental (%)		Suicidal (%)	
Opioids	**72.4**		**34.6**	
_Opioids alone	49.4	(35.8)[12]	37.3	(12.9)[13]
_Opioids & alcohol	16.4	(11.9)	10.9	(3.8)
_Opioids & sedative-hypnotics	27.9	(20.2)	38.4	(13.3)
_Opioids & antidepressants	9.5	(6.9)	25.1	(8.7)
_Opioids & nonopioids	5.2	(3.8)	22.8	(7.9)
_Opioids & psychotropics	3.3	(2.4)	4.9	(1.7)
Sedative-hypnotics	**24.4**		**35.1**	
_Sedative-hypnotics alone	6.1	(1.5)	23.4	(8.2)
_Sedative-hypnotics & alcohol	19.7	(4.8)	17.7	(6.2)
_Sedative-hypnotics & opioids	82.8	(20.2)	37.9	(13.3)
_Sedative-hypnotics & antidepressants	21.7	(5.3)	34.2	(12.0)
_Sedative-hypnotics & nonopioids	10.7	(2.6)	16.5	(5.8)
_Sedative-hypnotics & psychotropics	8.2	(2.0)	10.8	(3.8)
Antidepressants	**11.3**		**32.0**	
_Antidepressants alone	16.8	(1.9)	36.9	(11.8)
_Antidepressants & alcohol	15.9	(1.8)	14.1	(4.5)
_Antidepressants & opioids	61.1	(6.9)	27.2	(8.7)
_Antidepressants & sedative-hypnotics	23.0	(2.6)	18.1	(5.8)
_Antidepressants & nonopioids	12.4	(1.4)	14.4	(4.6)
_Antidepressants & psychotropics	8.8	(1.0)	6.6	(2.1)

Figure 7 shows the total number of the main drugs found in accidental and suicidal drug-induced deaths from 1997 to 2001 in Australia. It is clear that the majority of trends (accidental total opioid accidental deaths; accidental total sedative-hypnotic deaths) either show decreases over time (i.e. increasing from 1997 to 1999 and then decreasing from

[11] The drug subcategories are not mutually exclusive.
[12] Proportion in brackets refers to proportion of drug(s) in all accidental drug-induced deaths.
[13] Proportion in brackets refers to proportion of drug(s) in all suicidal drug-induced deaths.

1999 to 2001) or are stable. In contrast total opioid suicidal deaths showed increases over time.

Figure 7: Total numbers of main drugs found in toxic quantities for accidental and suicidal drug-induced deaths over time, Australia 1997-2001



3.5 Contributing causes of death

Table 8 shows the proportion of selected contributing causes[14] of death for accidental and suicidal drug-induced deaths.

Mood disorders were present in 4.7% of accidental and 19.1% of suicidal deaths. Similar rates of schizophrenia were reported 2.3 and 3.0 respectively. Both sexes had the same proportion of schizophrenia reported (2%). Acute hepatitis C was present in 6.0% of accidental and 1.5% of suicidal deaths whereas HIV was present in smaller comparable proportions (0.5% and 0.7% respectively).

[14] Contributing causes of death can belong to any of the 21 chapters in ICD-10.

Table 8: Proportion of accidental and suicidal drug-induced deaths for which contributing causes, by ICD-10 chapter, were noted Australia 1997-2001.

ICD-10 Chapter	Accidental (%)	Suicidal (%)
Mental & behavioural Disorders		
Mood disorders	4.7	19.1
Schizophrenia	2.3	3.0
Infectious Diseases		
Acute hepatitis C	6.0	1.5
HIV	0.5	0.7

4. Discussion

In Australia from 1997 to 2001, there were substantial differences in the numbers and characteristics of accidental and suicidal drug-induced deaths. This report suggests that these two types of drug-induced deaths represent distinct groups of people and circumstances of death. This supports recent Australian research (Darke & Ross, 2001) and is contrast to the assertion that accidental and suicidal deaths, especially among drug users, should be considered as a unitary phenomenon (Farrell, Neeleman, Griffiths, & Strang, 1996).

Accidental deaths have contributed to a much greater proportion of drug-induced deaths and have also varied considerably over time when compared to suicidal deaths. This is consistent with international research that has found that accidental deaths are the most frequent cause of drug-induced death in the world (Gossop et al., 2002; Oliver & Keen, 2003; Preti, Miotto, & de Coppi, 2002; Seymour et al., 2001; Steentoft et al., 2001). It also supports the finding that overdoses among drug users are accidental the vast majority of the time (Darke & Ross, 2001). The marked variation in accidental deaths over time is also consistent with data from other sources within Australia suggesting a significant increase in the availability of heroin in the mid to late 1990's, and a subsequent reduction in availability in 2001 (Topp et al., 2002). Researchers at NDARC are currently investigating this change in the supply of heroin.

As mentioned, suicidal drug-induced deaths remained stable over time. This is not surprising given that suicidal drug-induced deaths are less likely to be affected by the availability of illicit drugs; since these deaths are less likely to have illicit drugs noted in toxic quantities as well as including those deaths of people who do not use illicit drugs. However, this is in contrast to suicide trends in Europe, America, Asia and Australia that suggest increases in the rates of completed suicides. However these increases are influenced by the increasing rates of other methods of suicide (Darke & Ross, 2002).

The majority of accidental deaths were likely to be male whereas suicidal deaths were generally equivalent between the sexes. The predominance of males in both Australian studies of drug users and international reviews of accidental deaths is well documented

(Coffin et al., 2003; Oliver & Keen, 2003; Seymour et al., 2001; Steentoft et al., 2001; Topp et al., 2002). The proportion of males and females who have completed suicide is in contrast to the general trends in suicide where males are three times more likely to complete suicide than females (Darke & Ross, 2002). However it is unknown how this rate compares with general population death data on suicides by drugs. The age groups with the largest proportion of deaths also differed with accidental deaths being concentrated in the 15-44 age groups whereas suicidal deaths predominated in the 25-55+ age groups. This finding is consistent with prior research (Aghanwa, 2001).

Although the majority of accidental and suicidal occurred in the Australia's most populous jurisdictions (NSW, VIC and QLD), there were a greater proportion of accidental deaths in NSW and VIC, whilst suicidal deaths were more evenly spread between the three jurisdictions. The finding regarding accidental deaths is consistent with evidence that identifies these two jurisdictions as having the most enduring and significant heroin markets in Australia (Topp et al., 2002).

The most common drugs noted in toxic quantities were the same for accidental and suicidal deaths; that is opioids, sedative-hypnotics and antidepressants. However while opioids accounted for the vast majority of accidental deaths opioids, sedative-hypnotics and antidepressants were present in similar proportions (around one third) for suicidal deaths. The finding that opioids predominated accidental drug-related deaths is consistent with international research (Gossop et al., 2002; Oliver & Keen, 2003; Seymour et al., 2001; Steentoft et al., 2001). The finding that opioids are in relatively equal proportions to licit drugs is partially supported by Australian research on suicide amongst methadone clients which suggests that non-opioid drugs (such as benzodiazepines) were the most common methods of suicide (Darke & Ross, 2000; Darke & Ross, 2002). The finding that the majority of accidental and suicidal deaths involved multiple drugs supports international research (Coffin et al., 2003; Darke & Ross, 2002; Gossop et al., 2002; Gueye et al., 2002; Oliver & Keen, 2003; Risser et al., 2000).

The frequency of HIV was shown to be very low in this Australian sample of accidental and suicidal drug-induced deaths. This low frequency is likely to be attributable to Australia's harm minimisation approach to injecting drug use. However, the high

frequency of acute hepatitis C recorded for accidental deaths when compared to general population data and suicidal drug-induced deaths suggests that this remains a problem that requires ongoing attention (National Centre in HIV Epidemiology and Clinical Research, 2002). The high frequency of mood disorders reported for suicidal deaths is consistent with the relationship between suicide and depression (Darke & Ross, 2002).

4.1.1 Limitations

It is important to note that with regard to amphetamine derivative drugs, it is not possible to make more specific groupings of these drugs within ICD-10. Thus it is outside the scope of this data collection system to provide specific information on number of deaths related to MDMA, methamphetamine subtypes (such as ice) or PMA. However this may be possible from NCIS. In addition ICD-10 is unable to categorise emerging drugs, such as GHB or ketamine.

Although the introduction of multiple cause of death coding greatly enhances the data available for surveillance purposes, it does not alleviate the problem of limited case information (Harrison & Steenkamp, 2002) and concerns about the completeness of the COD data collected by the ABS. For example, due to the nature of deaths due to drug use (such as opioids) it is presumed that the majority of people who die from these deaths are drug dependent, however generally less than half of these deaths (41% from 1997-2001) have drug dependence recorded (Wellington, 2003).

The ABS recognises that this is an issue of education, and that the ICD definition of underlying COD for drug-induced deaths is obviously not congruent with what coronial staff perceive it to be. This is perhaps not surprising, given that the only limited information[15] is provided to medical practitioners for completing COD certificates in Australia. The ABS recognises that more innovative methods are required to increase medical practitioners awareness of recording accurately according to ICD guidelines and the impact of accurate recording on drug-induced death trend data (Wellington, 2003).

[15] A booklet provided to medical students, published by the ABS entitled "Cause of Death Certification", which includes only one brief paragraph in this booklet devoted to drug-induced deaths.

The reliability of suicide reporting remains a concern; problems include procedural deficiencies, ambiguous evidence and the determination of intent (Cantor, Mc Taggart, & De Leo, 2001). However the extent of the under-reporting of suicide is difficult to assess accurately (Australian Bureau of Statistics, 2002c). In keeping with previous research, an Australian study found that deaths by overdoses were one of the methods most likely to be misclassified. The researchers suggest that uncertainty of intent is more pronounced for deaths by opioid ingestion since it is a recreational activity (as opposed to death by non-opioid) and since there may also be a greater degree of ambivalence on the persons part due in part to their substance dependence and subsequent circumstances. Based on their comparison of coronial and national mortality data the authors concluded that suicide by drug overdoses involving recreational drugs were particularly difficult to distinguish from accidents. Furthermore they suggested that when monitoring drug-related deaths it is important to monitor categories of undetermined and accidental deaths in addition to suicidal deaths (Cantor et al., 2001).

4.1.2 Conclusions

The majority of drug-induced deaths in Australia are accidental. Accidental drug-induced deaths have significantly decreased in Australia from 1999 to 2001 whereas suicidal deaths have remained stable. Opioids, particularly heroin, continue to contribute to the majority of accidental drug-induced deaths whereas suicidal deaths involve opioids, benzodiazepines and antidepressants in similar proportions. Males aged 25-35 continued to predominate accidental drug-induced deaths in states that are populous for opioid-related use. However, suicidal deaths were equivalent among males and females, more concentrated in older age groups and were more evenly dispersed among Australia's most populous jurisdictions.

Multiple drug deaths were common for both types of deaths. Mono-intoxication was more likely for opioids in accidental deaths whereas benzodiazepines and antidepressants were more common for suicidal deaths. Licit drugs, such as benzodiazepines featured in a notable proportion of accidental and suicidal drug-induced deaths. A high prevalence of acute hepatitis C was demonstrated for accidental deaths whereas a high prevalence of mood disorders was recorded for suicidal deaths.

Accidental and suicidal drug-related mortality are significant public health issues, but are clearly separate issues that require different public health strategies. Consistent, accurate and timely monitoring of the changes in the patterns of these deaths over time provides an opportunity to inform key stakeholders so as to contribute to appropriate responses to this issue.

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Appendix A

Table 9: Drug-related codes from ICD -10 Chapter V – Mental and Behavioural Disorders

ICD Codes	Descriptors
F10	Mental and behavioural disorders due to psychoactive substance use - alcohol
F11	Mental and behavioural disorders due to psychoactive substance use - opioids
F12	Mental and behavioural disorders due to psychoactive substance use - cannabinoids
F13	Mental and behavioural disorders due to psychoactive substance use - sedatives or hypnotics
F14	Mental and behavioural disorders due to psychoactive substance use - cocaine
F15	Mental and behavioural disorders due to psychoactive substance use - other stimulants
F16	Mental and behavioural disorders due to psychoactive substance use - hallucinogens
F17	Mental and behavioural disorders due to psychoactive substance use - tobacco
F18	Mental and behavioural disorders due to psychoactive substance use - volatile substances
F19	Mental and behavioural disorders due to psychoactive substance use - multiple and other psychoactive substances
F55	Harmful use of non-dependence producing substances[16]

[16] 4th character denotes type of substance i.e. anti-depressants, laxatives, analgesics, antacids, vitamin, steroids or hormones, folk/herbal remedies, other and unspecified substances

Table 10: Fourth character descriptor for Mental and Behavioural Disorders (F10-F19) due to psychoactive substance use.

4th character	Descriptors
0	Acute intoxication
1	Harmful use
2	Dependence syndrome
3	Withdrawal use
4	Withdrawal state with delirium
5	Psychotic disorder
6	Amnesic syndrome
7	Residual and late onset psychotic disorder
8	Other mental and behavioural disorders
9	Unspecified mental and behavioural disorder

Appendix B

Table 11: Drug-related codes from ICD-10 Chapter XX – External Causes of Morbidity and Mortality.

ICD Codes	Descriptors
X40	Accidental poisoning by and exposure to nonopioid analgesics, antipyretics and antirheumatics
X41	Accidental poisoning by and exposure to antiepileptic, sedative-hypnotic, anti-parkinsonism and psychotropic drugs, NEC
X42	Accidental poisoning by and exposure to narcotics and psychodysleptics (hallucinogens), NEC
X43	Accidental poisoning by and exposure to other drugs acting on the automatic nervous system
X44	Accidental poisoning by and exposure to other and unspecified drugs, medicaments and biological substances
X60	Intentional self-poisoning by and exposure to nonopioid analgesics, antipyretics and antirheumatics
X61	Intentional self-poisoning by and exposure to antiepileptic, sedative-hypnotic, anti-parkinsonism and psychotropic drugs, NEC
X62	Intentional self-poisoning by and exposure to narcotics and psychodysleptics (hallucinogens), NEC
X63	Intentional self-poisoning by and exposure to other drugs acting on the automatic nervous system
X64	Intentional self-poisoning by and exposure to other and unspecified drugs, medicaments and biological substances
X85	Assault by drugs, medicaments and biological substances
Y10	Poisoning by and exposure to nonopioid analgesics, antipyretics and antirheumatics, undetermined intent
Y11	Poisoning by and exposure to antiepileptic, sedative-hypnotic, anti-parkinsonism and psychotropic drugs, NEC, undetermined intent
Y12	Poisoning by and exposure to narcotics and psychodysleptics (hallucinogens), NEC, undetermined intent
Y13	Poisoning by and exposure to other drugs acting on the automatic nervous

	system, undetermined intent
Y14	Poisoning by and exposure to other and unspecified drugs, medicaments and biological substances, undetermined intent

Appendix C

Table 12: Drug-related codes from ICD-10 Chapter XIX – Injury, poisoning and other certain consequences of external causes[17].

ICD Codes	Descriptors
T40.0	Opium
T40.1	Heroin
T40.2	Other opioids
T40.3	Methadone
T40.4	Other synthetic narcotics
T40.5	Cocaine
T40.6	Other and unspecified narcotics
T40.7	Cannabis
T40.8	Lysergide
T40.9	Other and unspecified hallucinogens (mescaline, psilocin, psilocybin)
T42.3	Barbiturates
T42.4	Benzodiazepines
T43.0	Tricyclic and tetracyclic antidepressants
T43.1	Monoamine oxidase inhibitor antidepressants
T43.2	Other and unspecified anti-depressants
T43.6	Psychostimulants with potential for use disorder

[17] Poisoning by drugs, medicaments and biological substances includes codes from T36-T50, thus this list is not an exhaustive list of all possible codes. Refer to ICD-10 or the ABS Information paper on drug-induced deaths for further information on poison codes.

Appendix D

Table 13: Number and type of drug-induced deaths in Australia, 1997-2001.

Underlying COD	1997	1998	1999	2000	2001	Total
Accidental	913	1241	1403	1272	710	**5539**
Suicidal	309	310	278	273	285	**1455**
Undetermined	94	86	56	21	39	**296**
Assault	4	6	2	1	4	**17**
Total	**1320**	**1643**	**1739**	**1567**	**1038**	**7307**