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Accidental drug-induced deaths in Australia 1997-2001.

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ACCIDENTAL DRUG-INDUCED DEATHS IN AUSTRALIA 1997-2001

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EXECUTIVE SUMMARY

Aims:

This report compares trends in the characteristics of male and female accidental 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. This report also aims to review the current method for determining the number of accidental opioid deaths in Australia.

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. The ABS definition of drug-induced death (including accidental) was utilised. COD data coded according to ICD-9 was also obtained from the ABS for the years 1997 to 1998 to permit opioid-induced death mapping analyses between the two versions.

Results:

(a) Accidental drug-induced deaths

From 1997 to 2001 there were 5539 accidental drug-induced deaths. Accidental deaths were the leading cause (68%) of drug-induced deaths registered in 2001. In 2001, the rate of accidental drug-induced deaths continued to decrease from 1999, where it peaked at 93.3 to 45.9 deaths per million people aged 15 years and over.

(b) Demographic characteristics

The majority of accidental drug-induced deaths were likely to be male (74%). Males and females aged 25-34 made up the largest proportion of accidental deaths over time. The majority (around 70%) of male and female accidental drug-induced deaths occurred in NSW and Victoria.

(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 drug use (X44 - 29%), accidental poisoning due to narcotics (X42 - 23%), opioid drug use disorder (F11 - 23%) and multiple drug use disorder (F19 - 17%).

(d) Drugs noted in toxic quantities at death

The most common drugs noted in toxic quantities at time of death was the same for males and females. However there was a different pattern in the proportion of drug poisoning: opioids (77% vs. 60%), sedative-hypnotics (22% vs. 30%) and antidepressants (8% vs. 22%).

(e) Contributing causes of death

For contributing causes of death, mood disorders were present in 3.3% of males and 8.7% of females, and acute hepatitis C was present in 6.8% of male and 5.2% of female deaths. Other contributing diseases were not commonly mentioned.

(f) Classifying accidental opioid deaths

Three lines of evidence supported the inclusion of multiple drug use disorder (F19) cross-classified with opioids (opioid poisoning and opioid use disorder) when calculating the number of accidental opioid deaths: its equivalent code multiple drug poisoning (X44) cross classified with opioids was already included; multiple drug use disorder (F19) often had opioid poisoning as a contributing cause in the majority of deaths; and the mapping analysis showed that opioid codes in ICD-9 mapped to multiple drug use disorder cross-classified with opioids in ICD-10. While the revised calculation of accidental opioid deaths increased the total number of accidental drug-induced deaths attributed to opioids in Australia, the general trends did not change. In 2001 the rate of accidental opioid deaths in Australia was 40 per million persons aged 15 to 44 years, a 67% decrease compared to the rate in 1999 (which was 122 per million).

Discussion:

There has been a steady increase and resulting decrease in the number and rate of accidental opioid drug-induced deaths among Australians between 1997, 1999 and 2001. This is consistent with data from other sources that suggest coinciding changes in the supply of heroin in Australia over this period. Males aged 25-35 continued to predominate accidental drug-induced deaths in states that are populous for opioid-related use. A high incidence of acute hepatitis C was demonstrated. Multiple drug deaths were common. Mono-intoxication was likely in opioid-related deaths and very unlikely in other drug-deaths. Benzodiazepines featured in a notable proportion of accidental drug-induced deaths. Finally, accidental drug-related deaths, particularly opioids, are a preventable public health problem. 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

The high rate of mortality amongst drug users is well documented (1-3). Deaths caused by accidental overdoses (i.e. acute poisoning) are the most frequent cause of drug-induced death in the world, including Australia (3-7).

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 (8-10). 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, using intravenously and the concomitant use of alcohol and benzodiazepines (11). The presence of one or more drugs (such as benzodiazepines, cocaine, alcohol, anti-depressants) in addition to opioids is a consistent feature of accidental opioid deaths worldwide (1, 5-7, 12-14).

Opioids are not necessarily the major source of drug-related harm in all countries: the United States, for example, has had a considerable problem with cocaine-related deaths *and* morbidity (15). Furthermore, substantial public attention has been devoted to cases of death where psychostimulant drugs such as "ecstasy" (16-22) and PMA (21, 23-26) may be involved, although it is not yet clear to what extent these are prevalent problems.

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(27).

Estimating and comparing the rate of drug-related deaths between countries is difficult. This is due to differences in the definitions and population parameters that are utilised (2). 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 (28).

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 - of the 128,544 deaths registered in Australia in 2001 drug-induced deaths accounted for 0.8% (1038) of all deaths (27).

1.1 Aims

To date, there has been no comprehensive examination of accidental drug induced deaths in Australia. Recent changes in the processing and classification of deaths in Australia has led to more consistent and detailed information being available for deaths where drugs were an underlying or contributing factor (28). Given these changes, and the lack of published epidemiological data on accidental drug-induced deaths in Australia, we aimed to do the following:

a) Examine the number and characteristics of accidental drug-induced deaths
b) Examine the types of drugs noted in these deaths;
c) Consider the contributing causes of death noted in these cases; and
d) Map codes for drug-induced deaths from ICD-9 to ICD-10 to consider comparability between the two classification systems in classifying accidental opioid deaths;
e) Revise estimates of Australian rates of ICD-10 accidental opioid drug-induced deaths, based upon this evaluation.

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 (29).

Data from the ICD-9 coded deaths was used to map across the classification systems.

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) (30). 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 (28).

[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.

However, 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 (31).

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 (28).

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 (28).

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 (28).

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 (31).

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 with one of the available poison codes for drugs, medicaments and biological substances (T36-T50) – see Appendix C (28).

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 (28). 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 (31).

[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 (28).

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 (31).

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 (28).

Accidental opioid deaths

Based on expert advice, NDARC used the following ICD codes to determine the number of accidental opioid deaths.

For ICD-9, the underlying COD was:

- 304.0 (Opioid drug dependence);
- 304.7 (Combined opioid and other drug dependence);
- E850.0 (Accidental poisoning by heroin); and
- E850.1 (Accidental poisoning by methadone).

For ICD-10, the underlying COD was:

- F11 (Opioid use disorders);
- X42 with T40.0-4, T40.6 (Accidental narcotic poisoning including opium, heroin, other opioids, methadone or other synthetic narcotics); and
- X44 with T40.0-4, T40.6 (Accidental multiple poisoning including opium, heroin, other opioids, methadone or other synthetic narcotics).

Preliminary analyses of F19 (Multiple drug use disorders) as the underlying COD suggested that F19 may have included opioid deaths and should be considered for inclusion in analyses of accidental opioid induced deaths. In order to assess the feasibility of including F19 with opioid use disorder or opioid poisoning mapping from ICD-9 to ICD-10 was undertaken. This was completed for deaths in 1997 and 1998, which were dual coded in ICD-9 and ICD-10, and analysed after extensive case matching by date of death, DOB, sex, marital status, state of residence and statistical local area of residence.

It is important to note that deaths identified by the above criteria may also have other drugs identified in toxic levels, but these deaths have been included as primarily due to opioids.

3. RESULTS

3.1 Trends in drug-induced deaths

Figure 1 shows trends in the number of drug-induced deaths (n=7307) in Australia between 1997 and 2001. The number of drug-induced deaths continued to decline in 2001. The increasing trend recorded for drug-induced deaths since 1997 (n=1320) peaked in 1999 at 1739 (an increase of around 32%), before falling by 40% to a total of 1038 deaths in 2001. Accidental overdoses continue to be the leading cause of drug-induced deaths in 2001, accounting for 68% of the total number of drug-induced deaths registered followed by suicide with nearly a third (27%) very small numbers of undetermined and homicidal deaths, approximately 4% and 0.4% respectively. Males continue to account for approximately 70% of the total number of drug-induced deaths registered since 1997.

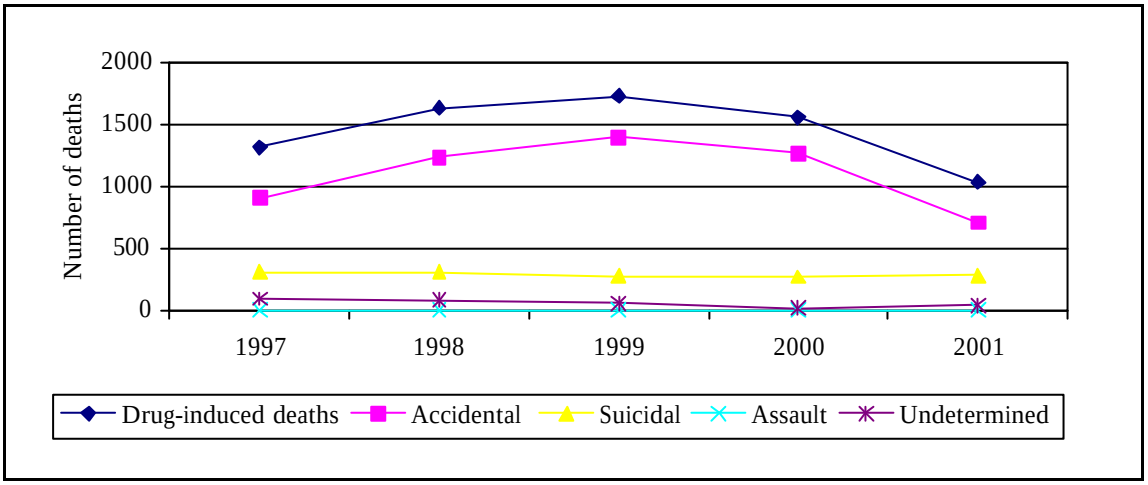

Figure 1: Trends in the numbers of drug-induced deaths by year of registration, Australia 1997-2001.

Table 2 presents the corresponding rates for drug-induced deaths broken down by category for 1997 to 2001 in Australia. Overall the rate for drug-induced deaths has decreased since 1997 from 90 deaths per million people aged 15 years and over to 67 deaths per million people aged 15 years and over in 2001.

Table 2. Rate of drug-induced death per million persons aged 15 and over 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 Accidental: demographic characteristics

Table 3 displays the number of accidental drug-induced deaths from 1997 to 2001 for males and females.

Table 3: Number of accidental drug-induced deaths in Australia by gender, 1997-2001.

Underlying COD	1997	1998	1999	2000	2001	Total
Male	669	958	1044	920	480	**4071**
Female	244	283	359	352	230	**1468**
Total Accidental	913	1241	1403	1272	710	**5539**

Table 4 shows the characteristics of accidental drug-induced deaths. The majority of accidental drug-induced deaths were likely to be male (74%). Males and females aged 25-34 made up the largest proportion of accidental deaths (followed by 35-44 and 15-24). However there were a couple of gender differences in age groups. Females were more likely than males to be older, with 21% older than 45 years. Whereas males were more concentrated in the 25-34 age group, with 40%. The majority of accidental drug-induced deaths for both males and females occurred in NSW and Victoria, followed by QLD and WA (with around 10% in each).

Table 4. Characteristics of accidental drug-induced deaths in Australia, 1997-2001.

	Male	Female
Age (%)		
0-14	0.3	0.5
15-24	19.6	19.2
25-34	40.4	27.1
35-44	28.2	26.1
45-54	7.7	12.9
55+	3.8	14.2
Jurisdiction of usual residence (%)		
NSW	41.7	36.0
VIC	28.3	30.2
QLD	10.6	11.6
SA	6.2	7.8
WA	9.7	10.6
TAS	1.0	2.0
NT	1.0	0.5
ACT	1.4	1.2

Figure 2 highlights that the largest proportion of accidental drug-induced deaths for males occurred within the 25 to 34 age group. Deaths among most age groups increased between 1997 and 1999 and declined between 1999 and 2001. For those under 45 years the number of deaths in 2001 was less than the number of deaths in 1997.

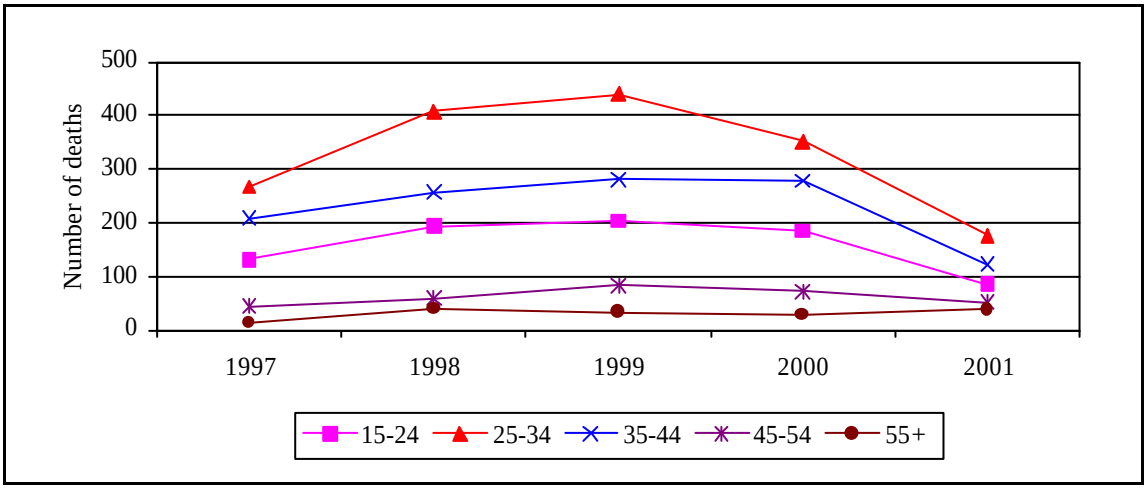

Figure 2: Trends in the numbers of male accidental drug-induced deaths by age group, Australia 1997-2001.

Figure 3 shows female accidental drug-induced deaths by age group over time. The largest proportion of accidental drug-induced deaths for females occurs within the 25-34 year age group. Deaths among most age groups increased between 1997 and 1999, and declined between 1999 and 2001. For the 15-24 and 25-34 age groups the number of deaths in 2001 was less than the number of deaths in 1997.

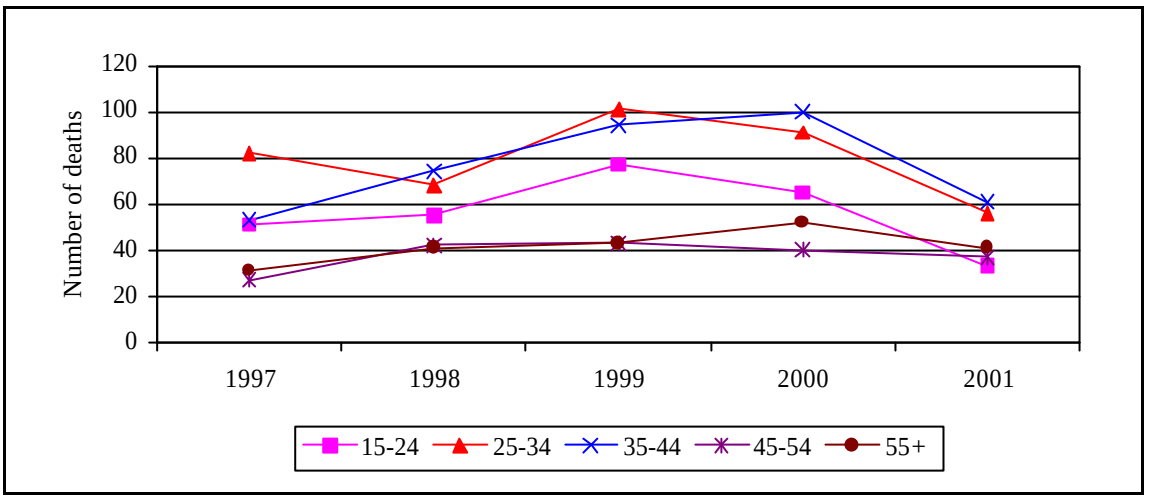

Figure 3: Trends in the numbers of female accidental drug-induced deaths by age group, Australia 1997-2001.

3.3 Accidental: underlying causes of death

Table 5 shows the number and proportion of each of the codes that contribute to accidental drug-induced deaths (N=5539) for the 1997 to 2001 period. It is apparent that the most frequently applied underlying COD codes for accidental drug-induced deaths were: X44 – accidental poisoning due to multiple drug use (29%), X42 – accidental poisoning due to narcotics (23%), F11 – opioid drug misuse disorder (23%) and F19 – multiple drug misuse 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 disorders (F11-F16, F19, F55). Furthermore deaths due to an underlying cause of drug dependence made up the majority of drug use disorder[8] deaths (96%).

[8] Other 4th character breakdowns available for mental and behavioural disorders (F11-F16, F19) include acute intoxication, harmful use, psychosis, withdrawal state, withdrawal state with delirium, psychotic disorder, amnesic syndrome, residual & late onset disorder, other disorder, unspecified disorder.

Table 5: 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
			2.67
F12	Cannabis use disorder	8	
F13	Sedative/hypnotic use disorder	14	
F14	Cocaine use disorder	7	
F15	Other stimulants use disorder	10	
F16	Hallucinogen use disorder	26	
F55	Harmful use of non-dependence producing substances [9]	5	
X40	Accidental poisoning by non-opioid analgesics	55	
X43	Accidental poisoning by other drugs acting on the autonomic nervous system.	23	
	Total accidental drug-induced deaths	**5539**	**100**

Figure 4 illustrates the trends over time for accidental drug-induced deaths by drug use disorder (F11-16, F19, F55), drug dependence (F11.2-F16.2, F19.2) and accidental poisoning (X40-44). Deaths due to accidental poisoning sharply increased from 1997 (n=312) to 1999 (n=1016) and steadily declined until 2001 (n=586). Deaths due to drug use disorder were at their highest point in 1998 (n=627) when they sporadically decrease until 2001 (n=124). The majority (96%) of deaths due to drug use disorder were coded as due to drug dependence.

[9] This code could refer to any one of the following: antidepressants, laxatives, analgesics, antacids, vitamin, steroids or hormones, specific herbal or folk remedies, other substances that do not produce dependence, unspecified.

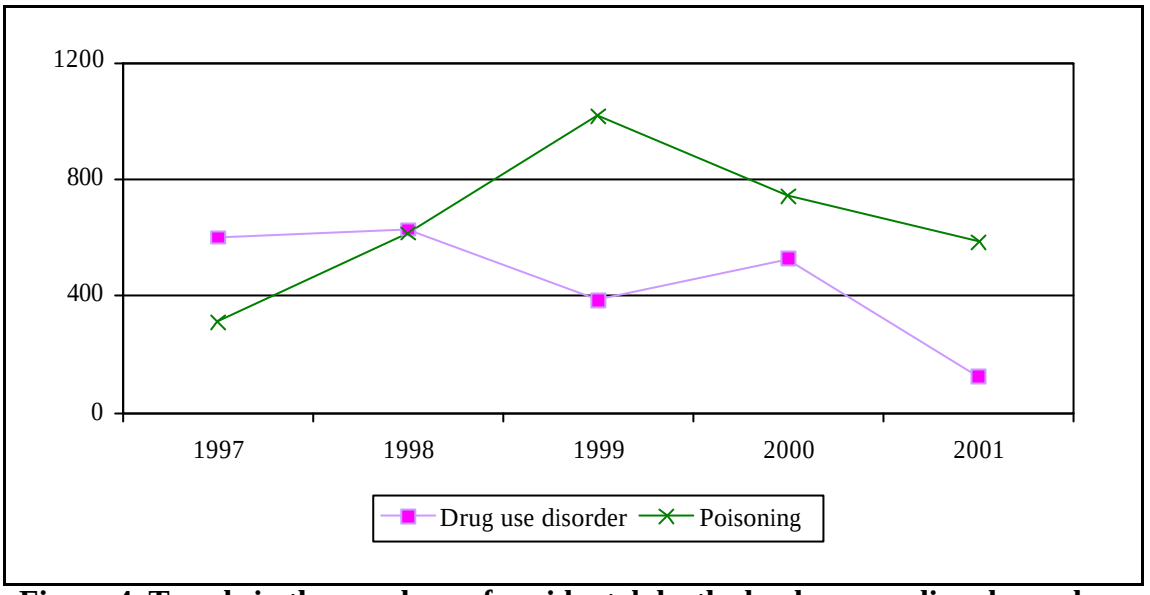

Figure 4: Trends in the numbers of accidental deaths by drug use disorder and poisoning, Australia 1997-2001.

The data presented in Table 4 suggest that eight and 26 deaths were due to cannabis use disorder (F12) and hallucinogen use disorder (F16), respectively. Based on the definition of underlying COD (disease or injury that initiated the train of morbid events leading directly to death), it was not clear when an underlying COD of F12 or F16 would be warranted. Thus an exploration of the multiple cause data associated with these deaths was undertaken.

Of the eight cannabis use disorder deaths, five of the deaths also had accidental poisonings coded; three of which had opioids in toxic levels and one each with amphetamines and alcohol. The remaining three cases had no other drugs mentioned. Instead the following conditions were noted: (1) acute endocarditis and abscess of lung without pneumonia; (2) other and unspecified convulsions; and (3) foreign body in respiratory tract and inhalation of gastric contents.

Every death coded to an underlying cause of hallucinogen use disorder involved poisoning; with 25 being opioid poisoning and the remaining death being multiple drug poisoning.

3.5 Accidental: drugs noted in toxic quantities at time of death

The drugs most commonly noted in toxic quantities at time of death for male and female accidental drug-induced deaths were opioids, sedative-hypnotics and antidepressants; however there was a different pattern in the proportion of drug poisoning by gender.

Sedative-hypnotic drugs accounted for 22% and 30% of male and female accidental drug-induced deaths, and antidepressant poisoning accounted for 8% and 22% of deaths respectively. Minorities of accidental deaths involved other drugs (Table 6). Alcohol accounted for 16% and 12% of deaths respectively.

Benzodiazepines constituted the majority of male and female sedative-hypnotic-related accidental deaths (95% and 94%). Tricyclic and tetracyclic antidepressants made up the majority of male and female accidental deaths where toxic amounts of antidepressants were noted (58% and 62%). Selective serotonin uptake reinhibitors (SSRIs, 41% and 38%) and monoaxime oxidase inhibitors (MAOs, 8% each) constituted the remainder.

Almost half of the male accidental deaths involving toxic amounts of opioids also involved other drugs (48%) and the majority of female accidental deaths involving opioids involved other drugs (60%). The rate of other drugs noted in deaths where sedative-hypnotics were noted in toxic quantities was much higher: 95% of male deaths involving these drugs, and 93% of female deaths. The same was observed for deaths where antidepressants were noted: 84% of male deaths and 82% of female deaths involving these drugs involved other drugs.

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

Drugs noted in toxic quantities	Males (%)	Females (%)
Opioids	77.1	59.1
Sedatives, hypnotics	22.3	30.4
Antidepressants	7.5	21.8
Non-opioids	3.7	10.9
Amphetamines	4.7	5.2
Hallucinogens	3.3	2
Cocaine	2.6	1.4
Psychotropics	3.1	5.9
Anaesthetics	0.6	0.9
Autonomic nervous system agents	1.1	2.1
Alcohol	16.1	12

Figure 5 shows trends in numbers of deaths for males and females between 1997-2001 by drugs noted at death. Male opioid-related deaths predominated the accidental drug-induced deaths, and similar patterns were observed for all three drugs: an increase from 1997 to 1999 followed by a decrease from 1999 until 2001.

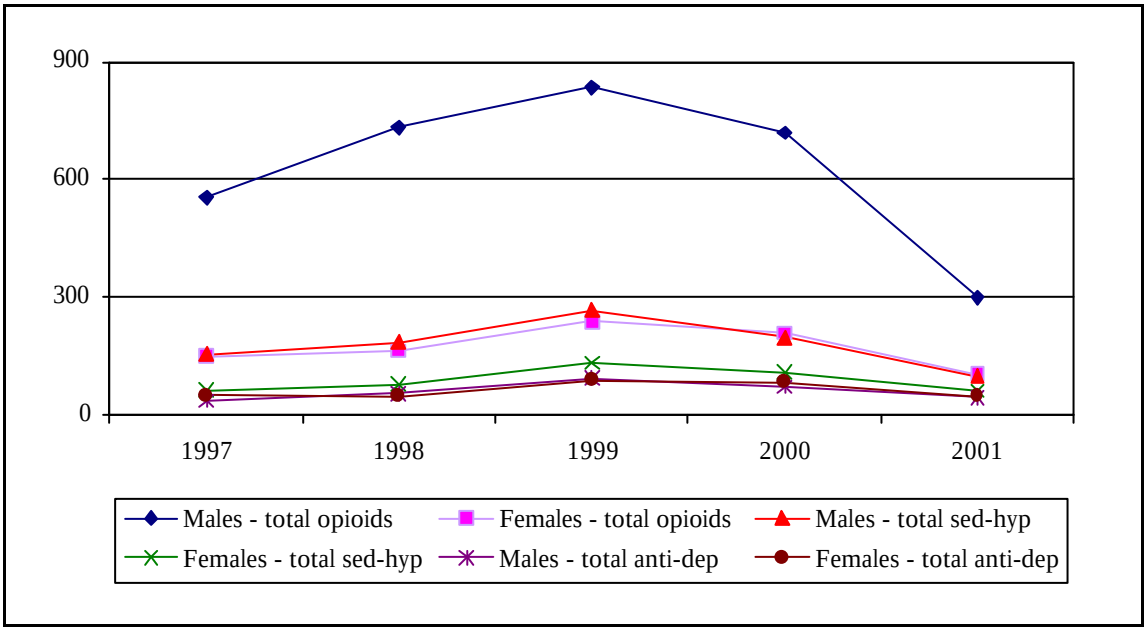

Figure 5: Numbers of male and female accidental drug-induced deaths by the total top three drugs noted in toxic quantities at time of death, Australia 1997-2001.

3.5 Accidental: contributing causes of death

Table 7 shows the proportion of selected contributing causes[10] of death for male and female accidental drug-induced deaths.

Mood disorders were present in 3.3% of males and 8.7% of females. Both sexes had the same proportion of schizophrenia reported (2%). Hepatitis C was present in 6.8% of male and 5.2% of female deaths whereas HIV was present in smaller proportions (0.6% and 0.3% respectively).

Table 7: Selected contributing causes of death for male and female accidental drug-induced deaths, Australia 1997-2001.

ICD-10 Chapter	Males (%)	Females (%)
Mental & behavioural Disorders		
Schizophrenia	2.4	2.1
Mood disorders	3.3	8.7
Infectious Diseases		
Hepatitis C	6.8	5.2
HIV	0.6	0.3

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

3.6 Accidental: classifying opioid deaths

Table 8 shows that the majority[11] of codes contributing to accidental drug-induced deaths involve opioid poisoning, with heroin being the main drug noted, even when deaths were due to a drug use disorder.

Table 8: Accidental drug-induced deaths with opioid poisoning and opioid use disorder, 1997-2001.

ICD-10 code for underlying COD	Cross classified by:	%
F11 - Opioid use disorder	Opioid poisoning (heroin)	84.3 (67.7)
F12 - Cannabis use disorder	Opioid poisoning (heroin) Opioid use disorder	37.5 (25.0) 0
F13 - Sedative/hypnotic use disorder	Opioid poisoning (heroin) Opioid use disorder	50.0 (14.3) 0
F14 - Cocaine use disorder	Opioid poisoning (heroin) Opioid use disorder	71.4 (42.9) 0
F15 - Other stimulant use disorder	Opioid poisoning (heroin) Opioid use disorder	50.0 (30.0) 20
F16 - Hallucinogen use disorder	Opioid poisoning (heroin) Opioid use disorder	96.2 (76.9) 0
F19 - Multiple drug use disorder	Opioid poisoning (heroin) Opioid use disorder	77.1 (57.2) 5.3
X41 - Accidental poisoning by sedative/hypnotics	Opioid poisoning (heroin) Opioid use disorder	0.6 (0) 2.1
X42 - Accidental poisoning by narcotics	Opioid poisoning (heroin) Opioid use disorder	98.6 (72.9) 15.4
X44 - Accidental poisoning by multiple drugs	Opioid poisoning (heroin) Opioid use disorder	59.0 (45.9) 5.9

[11] Apart from F12, F55, X40 and X43.

Accidental poisoning due to narcotics (X42) was the underlying COD code most predictive of an opioid poisoning code (Table 8). Deaths due to multiple drug use disorder (F19), which was not been traditionally included when calculating the number of accidental opioid deaths, contained a greater proportion of opioid-related deaths than accidental deaths due to multiple drug poisoning (X44) which is included. 'Opioid use disorder' was present in fewer deaths than opioid poisoning.

Figure 6 shows the total number (n=5539) of accidental drug-induced deaths in Australia between 1997 and 2001. Of these 5539 drug-induced deaths, 4239 (77%) had an opioid mention (i.e. opioid poisoning or drug use disorder). Of the 4239 opioid-related deaths *3426* (81%) were classified as having an *opioid underlying cause of death* (based on the original calculation). However when F19 (multiple drug use disorder) was also included in the calculation (cross tabulated with: (i) opioid T codes; and (ii) opioid drug use disorder) the total number of accidental drug-induced deaths where *opioids were the underlying COD* was *4176* (99%). Thus, using the revised definition, 99% of the time an opioid was mentioned in an accidental drug-induced death it was also the underlying COD. Figure 7 also highlights that for all accidental drug-induced and opioid-related deaths, there was a steady increase from 1997 to 1999 and from 1999 to 2001 there was a steady decrease.

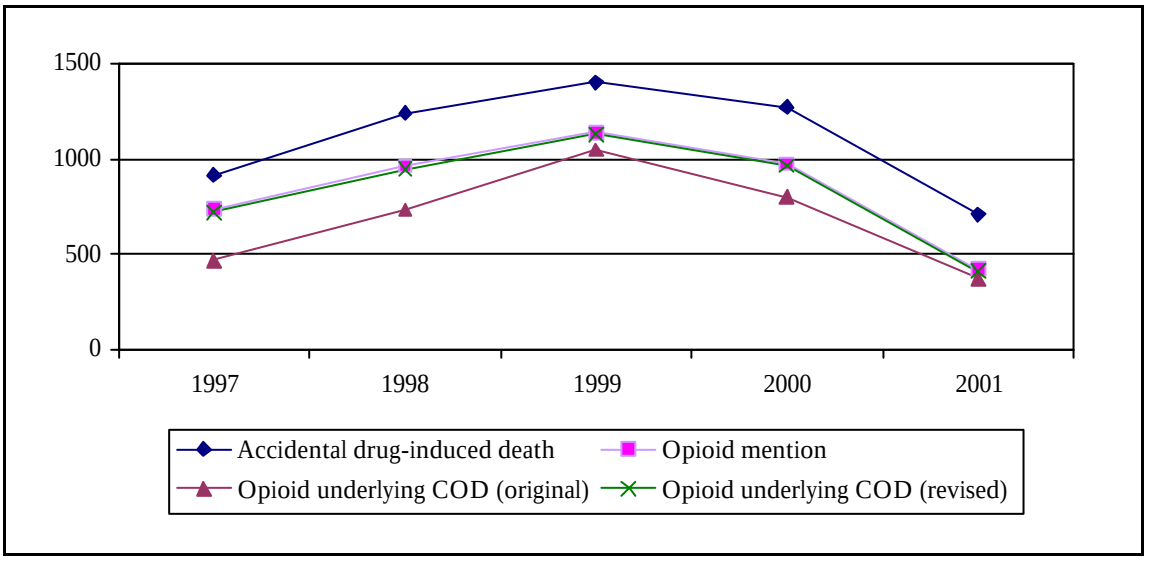

Figure 6: Number of accidental drug-induced deaths where opioids were mentioned and where opioids were coded as the underlying COD, Australia 1997-2001.

The majority of the remaining non opioid-related deaths (N=1300) were a result of: accidental poisoning due to multiple drug use (X44 – 50%); accidental poisoning due to sedative-hypnotics (X41-25%); and multiple drug use disorder (F19 – 14%).

Table 9 illustrates the corresponding numbers for Figure 7.

Table 9: Number of accidental drug-induced deaths where opioids were mentioned and where opioids were coded as the underlying COD, Australia 1997-2001.

Accidental drug-induced deaths	1997	1998	1999	2000	2001	Total
Opioid underlying COD (original)	468	733	1050	800	375	**3426**
Opioid underlying COD (revised)	721	947	1129	966	413	**4176**
Opioid mention	738	963	1140	974	424	**4239**
Total	913	1241	1403	1272	710	**5539**

3.6.1 Mapping from ICD-9 to ICD-10

Table 10 shows the results of analysing the mapping of data from ICD-9 to ICD-10, using data from 1997 and 1998. Deaths involving opioids in ICD-9 (i.e. 304.0 and 304.7) mapped to both opioid use disorder (F11) and multiple drug use disorder (F19) cross-classified with opioids in ICD-10. This provides support for a revised method for calculating the number of accidental drug-induced deaths where opioids were the underlying cause that includes multiple drug use disorder (F19) cross-classified with opioids (F11 and T40.0-4, T40.6).

Table 10: Mapping of ICD-9 to ICD-10 based on ICD-10 main underlying COD codes for accidental opioid deaths.

	% Opioid use disorder (F11)	% Multiple drug use disorder (F19) with opioid poisoning[1]	% Multiple drug use disorder (F19) with opioid use disorder (F11)	% Accidental poisoning due to narcotics (X42) & opioid poisoning[1]	% Accidental poisoning due to multiple drug use disorder (X44) & opioid poisoning[1]
ICD 9 codes					
304 – Drug dependence	52	37	3	0.1	-
3040 – Opioid	71	24	4	-	-
3041 – Barbiturate	-	-	-	-	-
3042 – Cocaine	25	-	-	-	-
3043 – Cannabis	-	-	-	-	-
3044 – Amphetamine	25	25	-	-	-
3045 – Hallucinogen	-	-	-	-	-
3046 – Drug dependence NEC	-	100	-	-	-
3047 – Opioid/other	17	68	2	-	-
3048 – Combined NEC	12	42	-	-	-
3049 – Drug dependence NOS	-	57	1.6	1.6	-
Other codes 305 – Nondependent drug abuse 305.2 - 305.9 (cannabis, hallucinogen, barbiturate, opioid, cocaine, amphetamine, anti-depressant, drug abuse NOS)	-	-	-	-	-

1. T codes T40.0-.4, T40.6

3.6.2 Revised method for determining accidental opioid deaths

Three lines of evidence supported the inclusion of multiple drug use disorder (F19) cross-classified with opioids in a revised calculation of determining the number of accidental drug-induced deaths attributed to an underlying cause of opioids:

1. Multiple drug *poisoning* cross classified with opioids was already included;
2. Multiple drug use disorder had opioid poisoning as a contributing cause in the majority of deaths (77%) - see Table 8; and
3. Mapping showed that opioid codes in ICD-9 mapped to multiple drug use disorder cross-classified with opioids in ICD-10.

The revised definition for estimating the number of accidental opioid drug-induced deaths includes the following codes:

- Opioid use disorder (F11);
- Accidental poisoning by narcotics (X42) cross-classified with opioid poisoning (T40.0-4, T40.6);
- Accidental poisoning by multiple drugs (X44) cross-classified with opioid poisoning (T40.0-4, T40.6);
- Multiple drug use disorder (F19) cross-classified with opioid use disorder (F11); and
- Multiple drug use disorder (F19) cross-classified with opioid poisoning (T40.0-4, T40.6).

3.6.3 Revised estimates for accidental opioid drug-induced deaths

While the revised calculation increased the total number of accidental drug-induced deaths attributed to opioids in Australia, the general trends have not changed. Deaths in the 15 to 44 year age group made up 83% of all opioid overdose deaths in Australia. This was a decrease relative to previous four years, where deaths in the 15-44 year age group made up 90% to 93% of all accidental opioid deaths.

Table 11 shows there were a total of 342 deaths attributed to opioids in 2001 among those aged 15 to 44 years which was a marked decrease from 2000.

Table 11: Number of accidental opioid drug-induced deaths among those aged 15-44 years by jurisdiction, 1997-2001.

	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	Aust
1997	307	189	36	46	73	2	2	9	**664**
1998	426	231	62	49	74	10	12	14	**878**
1999	431	352	73	61	88	3	8	8	**1024**
2000	314	311	117	43	68	5	2	10	**870**
2001	161	68	48	15	31	5	5	9	**342**

Figure 7 shows the number of deaths attributed to an underlying cause of opioids from 1997 to 2001 for the whole population, the 15-44 age group and the 45-54 age group.

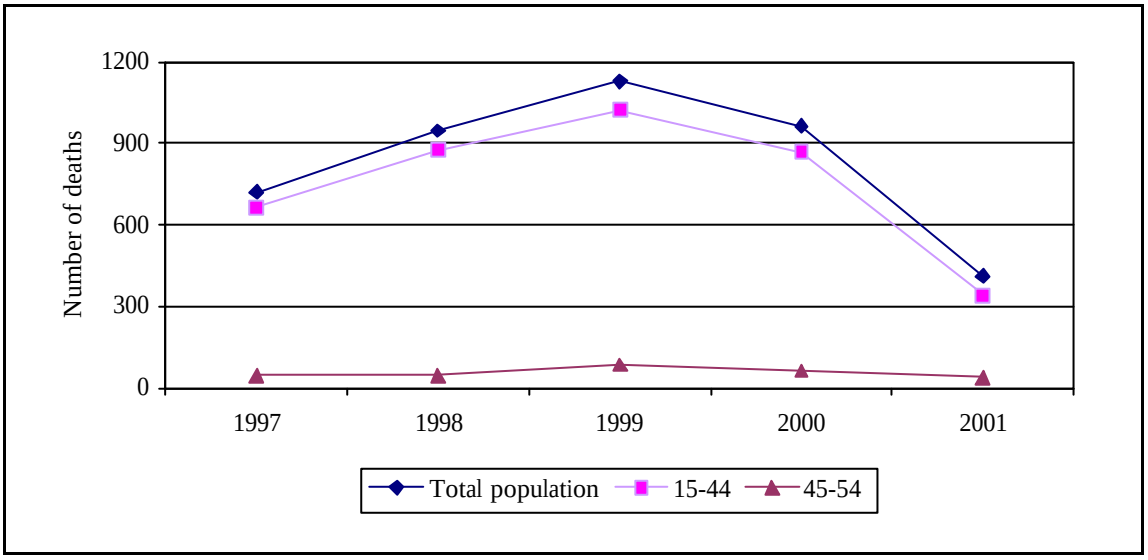

Figure 7: Number of accidental opioid drug-induced deaths among the total population, those aged 15-44 and 45-54, Australia 1997-2001.

Table 12 shows that males formed three quarters of the 15 to 44 year age group (77%). There were a total of 342 deaths attributed to opioids in 2001 among those aged 15 to 44 years. Almost half of these deaths (47%) occurred in New South Wales (161).

Table 12: Number of accidental opioid drug-induced deaths among those aged 15-44 years by gender and jurisdiction, 2001.

Jurisdiction	Males	Females
NSW	125	36
VIC	54	14
QLD	36	12
SA	8	7
WA	24	7
TAS	2	3
NT	5	0
ACT	9	0
Australia	**263**	**79**

Table 13 shows that the rate of accidental opioid deaths from in Australia was 40.2 per million persons aged 15 to 44 years, a 61% decrease compared to the rate in 2000 (which was 103 per million).

Table 13: Rate of accidental opioid drug-induced deaths per million persons among those aged 15-44 years by jurisdiction, 1997-2001.

	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	Aust
1997	109.4	90.8	23.3	71.1	87.7	9.8	20.2	58.6	79.3
1998	157.2	111.0	39.8	76.1	88.4	49.6	120.5	92.2	104.7
1999	152.7	168.6	46.6	95.1	104.6	15.1	79.8	52.9	121.8
2000	110.7	148.1	74.2	67.3	80.5	25.5	19.8	66.1	103.0
2001	56.3	32.1	30.2	23.6	36.5	25.9	49.8	59.0	40.2

Figure 8 shows that there has been a steady increase in the rate of accidental opioid deaths among those aged 45-54 years over the past decade, from 2 per million persons in 1988, to a high of 33.5 per million persons in 1999. The size of the decreases among those aged 45-54 years in 2000 and 2001 were much less marked among than they were among those aged 15-44 years. There was a 40% reduction in the rate among those aged 45-54 years in 2001 (14.7) compared to 2000 (24.6), compared to a 61% reduction among those aged 15-44 years.

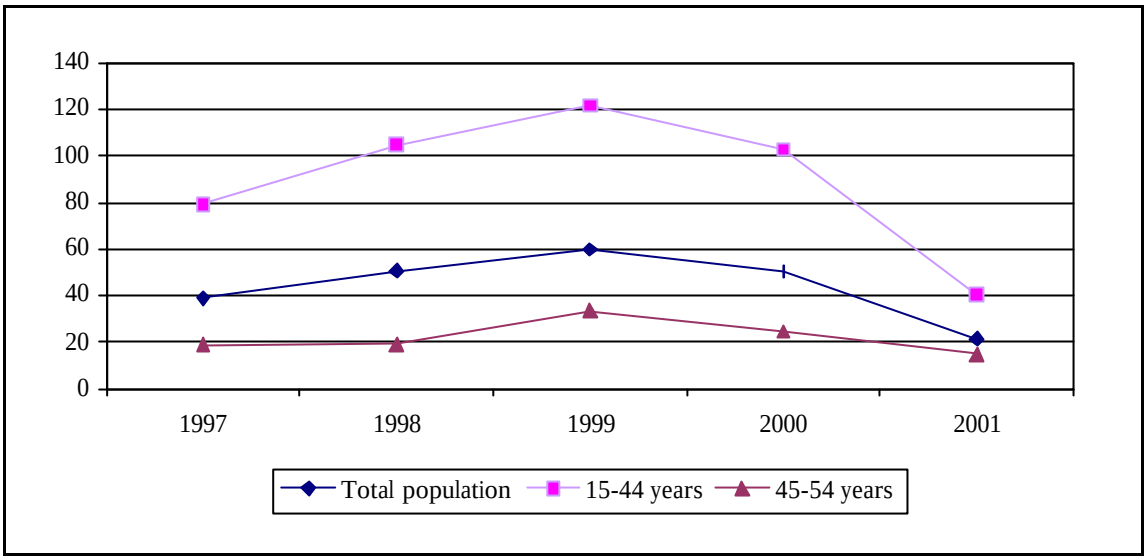

Figure 8: Rate of accidental opioid drug-induced deaths, Australia 1997-2001.

4. Discussion

In Australia from 1997 to 2001, the majority of accidental drug-induced deaths were due to opioids, particularly heroin, poisonings. This is consistent with international studies of accidental drug-related deaths (3, 5-7).

Accidental drug-induced deaths varied over time, consistent with previously documented trends in opioid induced deaths (8). For all accidental drug-induced deaths, there was a steady increase from 1997 to 1999 and from 1999 to 2001 there was a steady decrease. This is 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 (32). Researchers at NDARC are currently investigating this change in the supply of heroin.

In addition the decline in opioid-related mortality in Australia is consistent with recent trends documented in Europe. However it is readily acknowledged that the decline in opioid-related mortality is not well understood. Transition to other less toxic drugs of abuse, enhanced pre-hospital care and increasing use of substitution products have been highlighted as possible contributing factors (12). In addition, despite the identification of a number of risk factors for overdose (such as history of use, abstinence, injecting, polydrug use) there is still no clear relationship between opioid use and associated fatality (5).

The majority of accidental drug-induced deaths occurred among males, with the 25-34 age group having the highest rates. This was consistent with research in other countries (5, 6). However other international research has also found older age groups predominating (7). Of concern is that one fifth of both male and female deaths occurred in the 15-24 age group. The majority of accidental drug-induced deaths occurred in the most populous jurisdictions – NSW and Victoria. This is consistent with evidence that identifies these two jurisdictions as having the most enduring and significant heroin markets in Australia (32).

Consistent with previous findings sizeable proportions of opioid-related deaths involved pharmaceutical drugs, particularly benzodiazepines. Toxic levels of alcohol were also

noted in a number of cases, however at rates lower than international studies, but this may be explained in part by the fact that this study was likely to underestimate the total number of alcohol-related deaths since the alcohol marker utilised only identifies those deaths where toxic levels of alcohol were noted (5-7). It is well documented that the mutual CNS depression exerted by these substances may have contributed to the fatal outcome (7). However it is important to consider that poly-drugs may be markers relating to drug availability rather or in addition to risk factors for opioid overdose (5).

Consistent with other research there was a variance in drug preference amongst male and female accidental drug induced deaths. That is, males had higher rates of opioid-related deaths whereas as females had higher rates of sedative-hypnotics, antidepressant and non-opioid analgesic-related deaths. The differences in drug abuse pattern are likely to be related to drug availability and preference. Of concern among women is the presence of tricyclic antidepressants, which are known for their toxicity. Another concern is the substantial rate of benzodiazepine-related deaths amongst males and females given the recorded negative ramifications of injecting benzodiazepines as well as the potentially cumulative toxic nature of this drug as well. A continuous change in the pattern of benzodiazepines-related deaths may be expected as a result of recent restrictions of gel-based benzodiazepines. Therefore it is important to monitor this situation in the future.

The finding that the majority of deaths involved multiple drugs supports international research (1, 3, 5, 12, 33). It is important to note (as mentioned in the method section) that the application of the ICD multiple drug poisoning code can be potentially misleading when determining the number of deaths where multiple drugs were mentioned. This is because if two drugs recorded belong to the same ICD category then the death will be coded to that individual category as opposed to multiple drug use. Mono-intoxication accounted for around half of opioid-related accidental drug-induced deaths which is consistent with prior research (6, 34).

The frequency of HIV was shown to be very low in this Australian sample of accidental drug-induced deaths. This low frequency is likely to be attributable to Australia's harm minimisation approach to injecting drug use, such as needle and syringe exchanges and education. However, the high frequency of acute hepatitis C recorded (when compared to general population data) suggests that this remains a problem that requires ongoing

attention (35). It is not known how the frequency of mood disorders reported in accidental drug-induced deaths relates to general population data. Further research would assist in elucidating the practical significance of this finding.

It is not clear why an underlying cause of death of cannabis use disorder or hallucinogen use disorder would be assigned. Especially when the majority of these deaths had toxic levels of other drugs recorded. This may be a function of the rule that states that any recorded drug dependence always supersedes drug poisoning as the underlying cause of death. This rule may need to be amended so that it only applies to drugs that are potentially lethal (such as opioids, sedative-hypnotics etc). Further review of the application of non-lethal drugs as the underlying cause of death in the absence of toxic drugs as contributing causes (as was the case for three of the cannabis deaths) is required to ascertain what the most appropriate sequencing of codes is.

An examination of the ICD-10 codes suggested that a broader definition for accidental opioid deaths needed to be included. A review of the codes used to determine accidental opioid deaths showed that the definition would be more accurate and complete if the multiple drug use disorder cross-classified with opioids was also included. While the addition of these deaths altered the number of opioid deaths in Australia, the general trends have not changed.

4.1.1 Limitations

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 (29) 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 from 1997 to 2001 have drug dependence recorded (31).

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 the underlying COD to be. This is perhaps not surprising, given that only

limited information[12] 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 (31).

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.

4.1.2 Conclusions

Accidental drug-induced deaths have significantly decreased in Australia from 1999 to 2001. This trend provides a unique opportunity for research, health and law enforcement agencies. Opioids, particularly heroin, continue to contribute to the majority of accidental drug-induced deaths. Males aged 25-35 continued to predominate accidental drug-induced deaths in states that are populous for opioid-related use. A high incidence of acute hepatitis C was demonstrated. Multiple drug deaths were common. Mono-intoxication was likely in opioid-related deaths and very unlikely in other drug-deaths. Benzodiazepines featured in a notable proportion of accidental drug-induced deaths. Finally, accidental drug-related deaths are a preventable public health problem. 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.

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

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Appendix A

Table 14: 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[13]

[13] 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 15: 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 16: 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 17: Drug-related codes from ICD-10 Chapter XIX – Injury, poisoning and other certain consequences of external causes[14].

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

[14] 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.