



Volatile Substance Related Deaths in Western Australia 1997 – 2001

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1. Introduction

Registration of deaths in Australia is the responsibility of the Registrar of Births, Deaths and Marriages in each state and territory. Individual registrars provide information from the medical certificate of cause of death to the Australian Bureau of Statistics (ABS) for coding and compilation of statistics on causes of death.

The ABS codes causes of death according to the rules specified in the International Statistical Classification of Diseases and Related Health Problems (ICD) produced by the World Health Organisation (WHO). The primary purpose of cause of death coding is to identify the underlying (primary) cause or circumstance of death. *“The underlying cause of death is defined as the disease or injury which initiated the train of morbid events leading directly to death. To be classified as a drug induced death, the coroner must state that the death was a direct result of drug use.”*³

Prior to 1997, the underlying cause of death was the only cause of death information available from the ABS. With the introduction of the tenth revision of ICD (ICD-10) and the automated coding system for processing deaths registered from 1st January 1997, multiple causes of death became available.

Multiple causes of death allows identification of deaths where the use of drugs is not only the underlying cause of death but may also be a contributory factor. The ABS usually defines drug-induced deaths as those cases where the underlying cause of death is directly attributable to drug use.

Deaths where drugs are a contributory cause, for example, deaths from motor vehicle accidents where drugs were mentioned as an extra cause of death, or deaths from medical conditions caused by long-term drug use, would be excluded.

This paper expands the method outlined in the ABS report on drug-induced deaths⁴ to examine deaths where volatile substances⁵ are mentioned as an underlying and/or an extra cause of death and attempts to answer the question. *“What role, if any, do volatile substances play as either an underlying or contributory cause of death?”*

This question can now be addressed as the ICD-10 system has the potential to provide a greater degree of detail about the extent to which the abuse of volatile substances may be involved in mortality in this State. This range of substances which may be involved is considerable, many of whom are in wide use, including:

adhesives like airplane glue, rubber cement or PVC cement which contain toluene, hexane or trichloroethylene;
aerosols like spray paint, hair sprays, deodorants, room fresheners, vegetable oil sprays for cooking or fabric protector sprays which contain butane, propane or fluorocarbons;

³ Australian Bureau of Statistics. *Drug-induced deaths – a guide to ABS causes of death data*. ABS Catalogue No. 4809.0.55.001. Canberra, Australian Bureau of Statistics, 2002, 22.

⁴ Australian Bureau of Statistics. *Drug-induced deaths – a guide to ABS causes of death data*. ABS Catalogue No. 4809.0.55.001. Canberra, Australian Bureau of Statistics, 2002.

⁵ The term volatile substance is used in this paper as it identifies that there are a wide range of volatile substances, such as petrol, glues, toluene, freon, etc which may be abused and thus may cause serious health problems and in some circumstances cause premature death. Other terms such as solvent or inhalant abuse may also be used to refer to this phenomenon.

cleaning agents like dry cleaning fluids or spot removers which contain tetrachloroethylene, trichloroethane or trichloroethylene;
solvents like nail polish removers, paint thinners, felt tip marker fluids, correction fluid, fuel gas, lighter fluid or fire extinguishers which contain acetone, ethyl acetate, methylene chloride, toluene, butane, isopropane or bromochlorodifluoromethane;
gases used in medical anaesthetic, commercial refrigeration or household products like whipped cream dispensers which contain ether, chloroform, halothane, nitrous oxide or freon;
automotive fuels containing benzene, aromatic hydrocarbons, benzene, ethanol, methanol or methyl tertiary butyl ether.

The above products typically vapourise at room temperature and act directly on the central nervous system and thereby alter mood, whereas nitrites, another group of volatile substances, act primarily to dilate blood vessels and relax muscles are primarily used as sexual enhancers. Nitrites contain cyclohexyl nitrite, isoamyl (amyl) nitrite and isobutyl (butyl) nitrite.

The approach to coding according to the ICD-10 system in relation to mental and behavioural disorders due to psychoactive substance use is that

“The main diagnosis should be classified, whenever possible, according to the substance or class of substances that has caused or contributed most to the presenting clinical syndrome. Other diagnoses should be coded when other psychoactive substances have been taken in intoxicating amounts ... or to the extent of causing harm ... dependence ... or other disorders.”⁶

The ABS has developed a definition of a drug induced death as being

“Any death where the underlying cause of death was due to:

An acute episode of poisoning or toxicity to drugs. Included are deaths from accidental overdoses due to misuse of drugs, intentional self harm, assault and deaths undetermined as to intent.

An acute condition caused by drug use where the deceased person was identified as drug dependent.”⁷

The definition of a “drug” refers to drugs, medicaments or biological substances which may be used for medicinal or therapeutic purposes or be used to produce a psychoactive effect. The term “drug” excludes alcohol, tobacco and volatile substances but includes the misuse of regulated licit pharmaceutical drugs, drugs that may be purchased without a prescription and illegal substances.

The multiple cause of death coding that is available through the ICD-10 approach to coding supports research into the contribution of specific drugs as well as circumstances where drug use is a contributory cause. Multiple cause coding can provide additional information about deaths not coded as drug induced but nevertheless where drugs were reported in the coroner’s certificate of the cause of death.

For instance, the ABS paper gives the example of a person who may have taken an overdose of methadone and died as a result of accidental drowning. In this example the underlying cause would be coded as accidental drowning and the multiple cause data would be used to provide information about the methadone overdose.

⁶ World Health Organisation. *ICD-10. International statistical classification of diseases and related health problems, tenth revision. Volume 1.* Geneva, World Health Organisation, 1992, 320.

⁷ Australian Bureau of Statistics. *Drug-induced deaths – a guide to ABS causes of death data.* ABS Catalogue No. 4809.0.55.001. Canberra, Australian Bureau of Statistics, 2002, 2.

2. Method

Death records for Western Australia over the period 1997 to 2001 were extracted where there was any mention of volatile substances in the underlying cause of death and/or the multiple cause of death fields, based on any of the following ICD-10 codes:

F18 (*Mental and behavioural disorders due to use of volatile substance*); or
Y16 (*Poisoning by and exposure to organic solvents and halogenated hydrocarbons and their vapours – undetermined intent*); or
X46 (*Accidental poisoning by and exposure to organic solvents and halogenated hydrocarbons and their vapours*); or
X66 (*Intentional self poisoning by and exposure to organic solvents and halogenated hydrocarbons and their vapours*); or
T52 (*Toxic effect of organic solvents*); or
T59.8 (*Toxic effect of other specified gases, fumes and vapours*).

3. Results

In the period 1997 to 2001 a total of 38 cases in Western Australia were identified where there was any mention in the underlying cause of death or any extra cause of death field which involved any of the following volatile substance related ICD-10 codes: F18, Y16, X46, X66, T52 or T59.8 (Table 1).

3.1 Underlying cause of death

Volatile substances were found to be responsible⁸ as the underlying cause for only **three** deaths over the study period, all involving ICD-10 code X46 (*Accidental poisoning by and exposure to organic solvents and halogenated hydrocarbons and their vapours*).

3.2 Multiple cause of death

There was a total of 41 volatile substance related causes of death reported as a multiple cause of death, as follows:

F18 – 5 mentions;
X46 – 1 mention;
T52 – 5 mentions;
T59.8 – 30 mentions.

Overall there were a total of 84 multiple causes of death associated with the 38 deaths selected, an average of 2.1 multiple codes per death. Of these deaths:

30 (35.7%) involved the code T59.8 (*Toxic effect of other specified gases, fumes and vapours*);
5 (6.0%) involved the code F18 (*Mental behavioural disorders due to use of volatile substance*);
5 (6.0%) involved the code T52 (*Toxic effect of organic solvents*); and
1 (1.2%) involved the code X46 (*Accidental poisoning by and exposure to organic solvents and halogenated hydrocarbons and their vapours*).

More detailed information about cases involving cases attributed to the code X46 is presented in the case narratives below.

⁸ ie the underlying cause of death.

3.3 Case narratives

Case 1

This death occurred in the Perth metropolitan area in 1999 and was coded as X46 (*Accidental poisoning by and exposure to organic solvents*). The official verdict by the Coroner was that death was due to “*Solvent inhalation abuse (accident)*”.

This case involved a 34 year old male found collapsed and deceased on the floor of his dwelling over a large container of enamel thinner. Toxicology results detected toluene, xylenes and ethylbenzene in body tissue.

Information gathered as part of coronial investigations gave a history of substance abuse from early teens and abuse of most substances to excess. (However there was no history of injecting drug use.) Case notes record troubled family circumstances, including being the driver of a motor vehicle which resulted in the death of his sister. In early adult years there was a diagnosis of bi polar affective disorder/schizophrenia and an admission to hospital in 1989 due to a manic depressive episode.

A short period of non use of volatile substances was recorded in the mid twenties whilst he was in a residential support facility for 11 months. However there were a number of episodes of solvent abuse which recurred after discharge from the residential support facility, leading to the failure of a business. A series of marital separations also occurred, with the relationship finally breaking down due to mental health and other problems associated with his abuse of volatile substances.

There was a further admission to hospital in 1998, followed by a transfer to a residential hostel for persons with long standing psychiatric problems. He visited his surviving parent on weekend leave and on these occasions excessive use of alcohol occurred.

In the following year this man left the residential psychiatric hostel and rented accommodation. He came to the attention of other residents where he was living on a number of occasions because he was heavily under the influence of volatile substances and possibly other drugs and unkempt. One week after moving to this living situation he was found deceased.

Case 2

This death occurred in a remote area of Western Australia in 2000 and was coded as X46 (*Accidental poisoning by and exposure to organic solvents*). The official verdict by the Coroner was that death was due to “*Aspiration associated with petrol effect (accident)*”.

This case involved a 29 year old Aboriginal man who had extensive history of chronic petrol sniffing from about the age of 12.

He returned home during the evening smelling of petrol as he was forbidden by his spouse from sniffing petrol at the family home. After he returned home he had a light meal and went to bed where he was found deceased in the morning by his spouse.

He had an extensive history of offences involving the possession of deleterious substances under a provision of the Police Act 1892 which has now been repealed. There was a total of 13 convictions for this particular offence from early 1990. His most recent conviction occurred one month prior to his death, which was for supplying a deleterious substance (petrol).

The case notes record that there was no record of medical treatment for petrol sniffing over the 17 years of petrol sniffing. Toxicology results detected that there were “Gross levels of petrol were detected in mortuary blood, brain, lung and fat samples.”

Case 3

This death occurred in the non metropolitan area in 1997 and was coded as X46 (*Accidental poisoning by and exposure to organic solvents*). The official verdict by the Coroner was that death was due to “*Aliphatic hydrocarbon effect (inhalation of petrol/solvents)*”.

This case involved a 26 year old man who had a history of abuse of petrol and LPG gas over the preceding three year period. Toxicology results detected the presence of petrol, alcohol, toluene and ethylbenzene.

This man had a significant drinking problem from the age of about 19 and at 23 years of age was diagnosed as being alcohol dependent. His abuse of volatile substances was considered to have been a substitute for alcohol. There were also a number of convictions from the age of about 19 involving offences such as driving under the influence, drink driving, other motor vehicle offences, stealing and disorderly conduct.

His family had been concerned about his abuse of volatile substances and had taken measures to restrict his access to these, such as constructing locked cages around LPG gas cylinders which were used for domestic purposes and petrol containers kept in a locked shed.

He was able to access LPG gas by disconnecting the gas main from a gas hot water system and was found collapsed with the end of the gas pipe in his hand on his family’s return from a weekend trip.

The case notes record that in the past he had a number of admissions to psychiatric hospitals, apparently related to his abuse of alcohol and volatile substances. These may have been related to some of his court appearances.

Table 1: Number of deaths with any mention of volatile substance related causes in death fields by broad groups of underlying causes of death, WA, 1997-2001

ICD-10 codes	Broad groupings based on underlying cause of death	Multiple causes of death									
		n	%	F18	Y16	X46	X66	T52	T59.8	Other	Total
F19.2	Dependence syndrome due to multiple drug use and use of other psychoactive substances	1	2.6	1		1		1		3	6
J43.9	Unspecified emphysema	1	2.6						1	1	2
V47.5	Driver injured in collision with fixed or stationary object	1	2.6						1	1	2
V87.8	Person injured in other specified non collision transport accident involving motor vehicle (traffic)	1	2.6						1		1
V95.9	Unspecified aircraft accident injuring occupant	2	5.3						2	3	5
X00	Exposure to uncontrolled fire in building or structure	9	23.7						9	5	14
X03	Exposure to controlled fire not in building or structure	1	2.6						1	2	3
X08	Exposure to other specified smoke, fire and flames	2	5.3						2	3	5
X09	Exposure to unspecified smoke, fire and flames	5	13.2						5	3	8
X44	Accidental poisoning by and exposure to other and unspecified drugs, medicaments and biological substances	3	7.9	2				1	1	10	14
X46	Accidental poisoning by and exposure to organic solvents and halogenated hydrocarbons and their vapours	3	7.9					3		1	4
X47	Accidental poisoning by and exposure to other gases and vapours	4	10.5						4	1	5
X49	Accidental poisoning by and exposure to other and unspecified chemicals and noxious substances	1	2.6	1						4	5
X67	Intentional self-poisoning by and exposure to other gases and vapours	1	2.6						1		1
X76	Intentional self-harm by smoke, fire and flames	2	5.3						2	2	4
Y04	Assault by bodily force	1	2.6	1						4	5
	Total	38	100.0	5	-	1	-	5	30	43	84

4. Coronial database

4.1 Introduction

An examination was undertaken to identify other deaths where volatile substance use was either a direct or indirect cause of death in cases contained in the Coronial Database. The Coronial Database was established in 1995 in collaboration with the Chemistry Centre of WA and the Coroner's Court to enable investigation of illicit drug related deaths in Western Australia. It is presently managed by Drug and Alcohol Office (DAO).

Its purpose is to overcome the limitations of the ICD system by accessing additional forensic and toxicological information to identify the contribution of volatile substance use and other circumstances as a cause of death. A shortcoming of the ICD coding system is that it is based on a limited amount of information available to the ABS. This consists of the death certificate which has the Coroner's finding and a small amount of additional information. The ABS does not have access to the complete set of reports and associated forensic data contained in the records held by the Coroner.

As the Coronial Database includes information extracted from forensic, demographic and toxicological data it permits the identification of factors associated with to all volatile substances and

other illicit drug deaths. This method of case selection provides a comprehensive set of data about HRDs and other drug deaths to support preventive measures.

4.2 Results

All deaths that occurred between 1997 and 2001 were examined for any mention of volatile substance use, or a mention of any of the names of specific volatile substances. This identified a total of 4 cases confirmed by the Coroner where volatile substances directly caused the death and a further 6 cases where volatile substances were related to the death.

In relation to the 4 confirmed cases where volatile substances were a direct cause of death, the following verdicts were given by a Coroner:

“Acute inhalation of butane”

(17 year old male who died in October 1998 in the Perth metropolitan area).

“Unascertainable (likely acute butane inhalation toxicity)”

(13 year old male who died in March 1999 in the Perth metropolitan area).

“Solvent inhalation abuse”

(34 year old male who died in April 1999 in the Perth metropolitan area).

“Aspiration associated with petrol effect”

29 year old male who died in May 2000 in a remote area of the State)

4.3 Confirmed volatile substance related deaths

In relation to the 6 confirmed cases where volatile substances were a related cause of death, the following verdicts were given by a Coroner.

“Ligature compression of the neck (suicide)”

(13 year old female, who died in November 1998 in the Perth metropolitan area)

“A. Early pneumonia associated with pulmonary oedema and aspirated vomitus.

B. Myocardial impairment associated with focal coronary arteriosclerosis and amphetamine effect (natural causes)”

(21 year old male, who died in February 1999 in the Perth metropolitan area)

“Ligature compression of the neck”

(15 year old female, who died in February 1999 in the Perth metropolitan area)

“Combined toxic effects of halothane and ketamine”

(17 year old male, who died in February 1999 in the Perth metropolitan area)

“Ligature compression of the neck (suicide)”

(16 year old male, who died in May 1999 in the Perth metropolitan area)

Male16, May 2000, Mandurah

“Early pneumonia with combined drug effect (accident)”

(16 year old male, who died in May 2000 in a major regional centre)