RECORDING ACUTE POISONING DEATHS

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Abstract

Recording deaths from acute poisoning/substance abuse is not straightforward. The International Classification of Diseases (ICD), used to code mortality statistics, is aimed towards recording underlying cause of death such as suicide or drug dependence rather than gathering data on poisoning *per se*. Despite the inherent difficulties clear trends can be observed from the data available for England & Wales. There have been marked changes in the compounds featuring in suicidal poisoning in the last 35 years reflecting changes in the availability of poisons, notably carbon monoxide and prescription barbiturates. However, although the number of poisoning suicides has decreased in recent years, suicides from other means have increased in males (1999 suicides 75 % male) hence there has been little change in the annual total of suicides. There are also striking differences in drug abuse- and volatile substance abuse (VSA)-related deaths between males and females. Drug abuse-related fatal poisoning [83 % male 1979-99, European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) definition which does not include suicide], largely attributable to heroin and methadone, increased markedly during the 1990s, with a sharp rise in deaths attributed to accidental poisoning, although deaths involving methadone are now declining. VSA-related deaths (90 % male, 1971-99, almost entirely accidental deaths), nowadays predominantly from abuse of fuel gases (liquefied petroleum gas, LPG) from, for example, cigarette lighter refills, have declined from a peak in the early 1990s and are now becoming manifest in an older age group. These two latter instances especially provide examples where ICD-derived fatal poisoning data are inadequate and a 'poisons oriented' approach to data collection and analysis is necessary.

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Introduction

Acute poisoning due to the accidental or deliberate ingestion, injection, or inhalation of drugs or other chemicals is a common medical emergency. However, it is difficult to obtain reliable information on the morbidity and mortality resulting from poisoning, even in countries with comparatively advanced population health data collection systems.

Enquiries made by health care professionals, and in many instances also by members of the public, to poisons information centres/services (also called poison control centres, PCCs) provide some information on acute poisoning. Statistics derived from such enquiries can provide information on newly identified causes of poisoning or changes in the population(s) affected. However, many enquiries concern suspected or potential cases of poisoning rather than confirmed incidents. Moreover, few centres have the resources to obtain reliable follow-up data, and thus the clinical course and outcome of even confirmed episodes of poisoning are often unknown. The number of poisoned patients about whom enquiries are ***not*** made remains unknown, and the population or area from which the calls originate may not be clear. Toxicological analysis to confirm exposure is rarely performed except with common poisons such as paracetamol (acetaminophen) where the results may influence treatment. Even if use of the International Programme on Chemical Safety (IPCS) INTOX harmonised PCC call data collection system (http://www.intox.org/) becomes widespread, the essential uncertainties surrounding the data will still remain.

Similar difficulties to those encountered when using data generated by PCCs are experienced when hospital activity data are used to gather information on acute poisoning. Not all cases of poisoning or suspected poisoning are referred to hospital, and not all poisoned patients referred are admitted (Dennis et al., 1990). Detailed toxicological investigation is performed infrequently. The number of deaths from poisoning recorded by hospitals or PCCs is especially misleading because most such deaths occur outside hospital.

Fatal poisoning

Deaths involving drugs or other poisons may occur under a range of different circumstances with varying public health, legal, and policy implications. For example, a deceased may have been a patient with a long history of depression or someone with no history of mental illness, or a long-term drug addict, an occasional ‘recreational’ user, or someone who had never been known to have used illicit drugs. The poisons involved may have been controlled substances, prescription only drugs/medicines (PoMs), over-the-counter (OTC) medicines, or even complex mixtures such as traditional remedies. The death may be due to direct, indirect, or even long-term effects of exposure to a particular poison or group of poisons. Exposure may have been deliberate or accidental. The death may have been an accident, suicide, or possibly even homicide. Within this broad spectrum, different users of mortality data tend to be interested in different types of poisoning deaths. However, it is not always possible to make these distinctions from the information available from death registrations, or to stratify this information to answer questions posed by different users of mortality data. Additional complications arise when attempting to quantify deaths due to specific drugs or other poisons as many deaths involve more than one compound, often in combination with alcohol.

It is important to study poisoning deaths in general, at least initially. Simply concentrating on ‘drug overdose’ or ‘drug poisoning’ deaths (ONS, 1999) or substance abuse deaths (np-SAD, 2000) underestimates the true incidence of fatal poisoning even in Western countries where drugs (prescription and illicit) do indeed

predominate, especially if voluntary reporting is used (np-SAD, 2000). Even worse was the practice of simply citing accidental poisonings since this practice ignored poisoning suicides, for example (Fingerhut & Cox, 1998). The term ‘acute poisoning deaths’ is used here to refer to all deaths where drugs or other poisons were cited as a causal factor in the event leading to death, with the exception of deaths due to the adverse effect(s) of drugs in seemingly appropriate therapeutic use. In the UK, information on such occurrences is coordinated by the Medicines Control Agency (MCA). Deaths from the long-term consequences of abuse of alcohol, tobacco, and the injection of drugs such as heroin are also excluded from the discussion.

One factor that applies to both PCC and fatal poisoning data is that in some countries investigation of suspected poisoning may be hampered by laws prohibiting suicide/attempted suicide. Similar considerations may apply if illicit or controlled substances are thought to have been involved even if there is no criminal involvement in the death. Even if a comparatively rigorous system for investigating and reporting the cause of death exists in a particular country, reliance on the circumstances surrounding the death and/or the immediate pathological findings without reliable analytical toxicological investigations can lead to the wrong poison or combination of poisons being cited as the cause of death. In order to understand and interpret routine statistics on poisoning deaths, some knowledge of how such deaths are investigated, certified, registered, and coded is needed. These processes, and the laws governing them, vary markedly between countries and affect between country comparability of mortality data.

This paper explores some of these problems by discussion of statistics on deaths from acute poisoning produced by the Office for National Statistics (ONS) for England & Wales. Particular emphasis is given to the method by which the underlying cause of death is selected and coded according to the International Classification of Diseases (ICD).

Death Registration - England & Wales

In England & Wales, all deaths due to injury or poisoning must be referred to the coroner before they can be registered. Nearly all deaths due to accidents or violence, except some falls and fractures in the elderly, are certified by coroners after a post mortem and an inquest (Devis & Rooney, 1999). If poisoning is suspected, the post-mortem may, but does not necessarily, include a toxicological examination. Even when a toxicological analysis is performed, there is no guarantee that all substances present in the body will be identified; only those poisons that are looked for will be detected and then only if appropriate samples are available. Costs may limit the range of tests authorized by the coroner. If initial results seem to confirm the substance initially suspected, tests for additional compounds may not be performed. Where drugs are indirectly responsible for a death, for example in the case of road traffic accidents, not even drivers are routinely tested for drugs (DETR, 1998; Christopherson et al., 1998).

The death is then registered using information from the coroner’s certificate by the local Registrar of Births and Deaths. The registrar forwards an electronic copy of the register entry to ONS together with the paper ‘Part V’ on which the coroner may provide further details about how the death occurred. The coroner’s certificate usually records the poisons implicated in poisoning deaths, and the coroner’s verdict, but rarely gives any information about whether and what poisons were tested for, the route of administration of/mechanism of exposure to the poison, or how any drugs involved were obtained (prescribed, over the counter, or illicitly).

Coroners may record a verdict of death from drug dependence, or abuse, or they may give another verdict, but record abuse or dependence elsewhere on the certificate.

Coding the cause of death

All deaths registered in England & Wales are coded centrally by ONS to the current revision of the International Classification of Diseases (ICD). Table 1 shows the years for which earlier versions were used in England & Wales. Each version provided a coding frame for cause of death that differed, to varying degrees, from the previous version. ICD-9 (WHO, 1977) was used from 1979 and was replaced by ICD-10 (WHO, 1992) in January 2001. Inquest deaths are coded clerically, though most other deaths have been coded automatically using software produced by the US National Centre for Health Statistics since 1993 (Rooney & Devis, 1996; Rooney & Smith, 2000). The software and the clerical coders follow the instructions for mortality coding published in the ICD, in particular the ICD rules for selecting and modifying the underlying cause. Most mortality statistics are based on this single 'underlying cause' code for each death. Many national vital statistics offices only record and analyse deaths using this single underlying cause code.

Table 1. Years for which each ICD revision was implemented in England & Wales

ICD Revision	Years
1*	1901-10
2†	1911-20
3†	1921-30
4†	1931-39
5†	1940-49
6	1950-57
7	1958-67
8	1968-78
9	1979-00
10	2001-

* An unnumbered list was used in England & Wales rather than the then new ICD during this period

† As amended for use in England & Wales

In deaths from injury and poisoning, WHO has recommended the use of an additional 'nature of injury code' since publication of ICD-6, and this has been done in England & Wales since 1950. The underlying cause code identifies the mechanism or agent of injury (for example motor vehicle collision, fire, fall, or poisoning) and intent (accident, suicide, homicide or 'undetermined intent'). The nature of injury code (called 'secondary cause' in ONS publications) gives the type of damage (fracture, open wound, burn, poisoning, etc.) and, for some types of injury, the part of the body affected. In the case of accidental deaths from poisoning, the underlying cause and secondary cause codes give similar information about the substances involved (for example ICD-9 E854.0: accidental poisoning by antidepressant, and 969.0: poisoning by antidepressants). For suicides, homicides and 'undetermined intent' (open verdict) poisonings, the ICD only classifies poisons in very broad groups, but the secondary cause code may provide more detail. For example, in ICD-9 E950.0: 'suicide by poisoning with analgesics', secondary cause codes can be used to indicate an opiate (965.0) or paracetamol (965.4, 'aromatic analgesic') as the single drug involved. There are, however, some obvious inconsistencies. Thus 965.0 'opiates and related narcotics' included not only heroin and morphine, but also methadone and pethidine - opioids and

narcotics, although not strictly opiates. However, dextropropoxyphene, an opioid and a narcotic, was coded to 965.7 ('other non-narcotic analgesics').

In published ONS mortality figures by underlying cause of death, five main groups of ICD-9 codes covered deaths from acute poisoning (Christopherson et al., 1998):

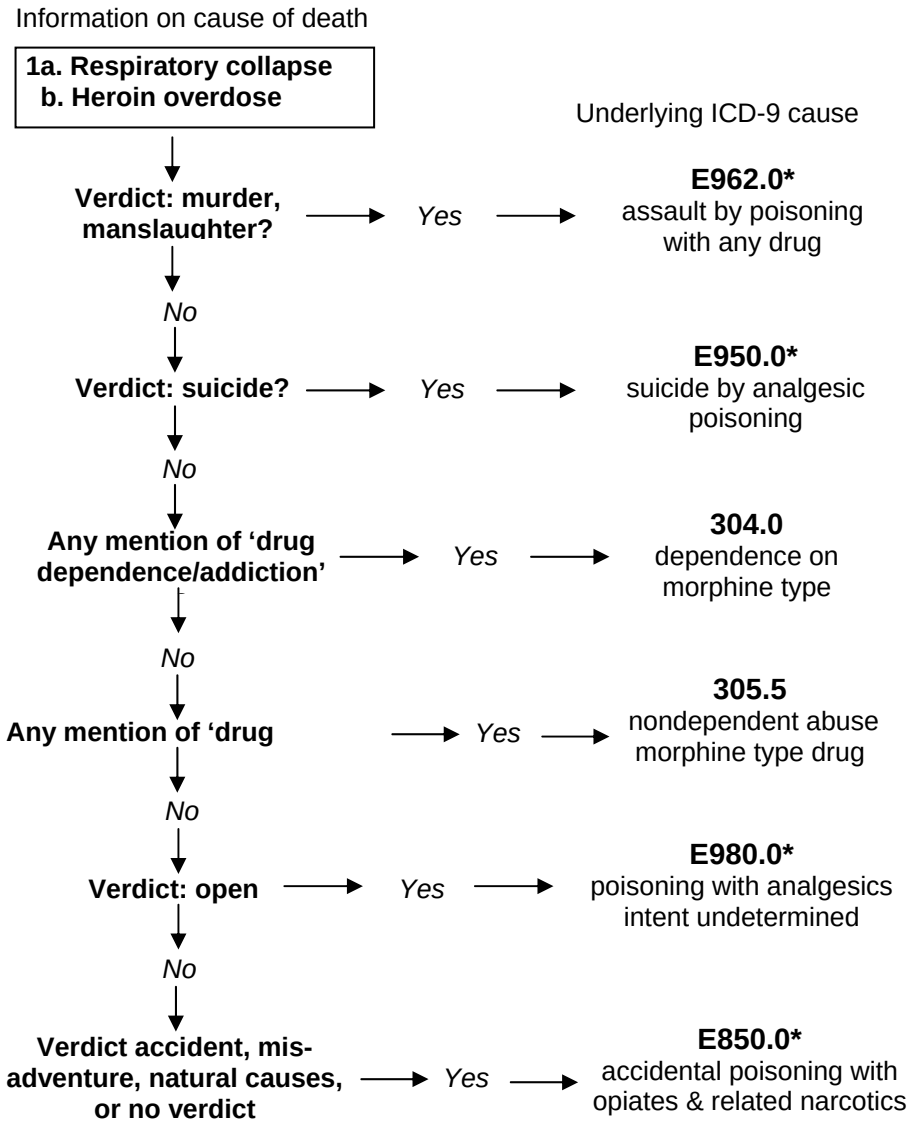
304	Drug dependence
305.2-9	Non-dependent abuse of drugs
E850-59	Accidental poisoning by drugs, medicaments & biologicals, gases & vapours, etc.
E860-69	Poisoning by substances chiefly non-medicinal in use
E950-2	Suicide & self-inflicted poisoning by solid or liquid substances
E980-2	Poisoning by gases, or by solid or liquid substances, undetermined whether accidentally or purposely inflicted

In addition, a few deaths were coded to drug psychoses (ICD-9 292), whilst some deaths from the toxic effects of carbon monoxide (CO) or other gases (secondary cause codes 986 and 987) are due to the effects of fires as their underlying cause (E890-99). In recent years, ONS had included deaths coded to assault by poisoning (E962) with drug abuse deaths, because most of the small number of deaths so coded were overdoses in which the supplier of the drug had been successfully prosecuted for manslaughter or other offence (Christopherson et al., 1998). With the conviction of general practitioner Dr Harold Shipman for murdering 15 of his patients by use of diamorphine (O'Neill, 2000), and ongoing investigation into the deaths of many more of his patients, this grouping will have to be changed.

The underlying cause code will depend on the coroner's verdict, and whether any indication that the deceased was dependent on drugs or abused drugs is given (see Fig. 1). In recent years, about 90 % of deaths coded to ICD-9: 304 and 305.2-.9 in England & Wales were certified as due to acute poisoning, with a coroner's verdict of drug dependence or abuse, or information to this effect elsewhere on the certificate (Christopherson et al., 1998). The remaining 10 % of deaths included some complications of drug use, but many were simply certified as 'drug dependence/abuse' without further detail. Deaths from the long-term consequences of intravenous drug use, such as blood borne virus infection, are normally coded to the infection even if drug abuse/dependence is mentioned on the death certificate.

The way deaths involving a particular drug are coded may not be apparent to casual users of ICD-derived mortality data, and such users may have difficulty identifying the deaths they are interested in. For example, in ICD-9 poisoning due to cocaine is indexed to 968.5 'poisoning with surface and infiltration anaesthetics' as secondary cause. The underlying cause could be E855.2, 'accidental poisoning with local anaesthetics', E950.4 or E980.4, 'suicide, or undetermined, poisoning with other specified drugs and medicaments'. Users have sometimes mistakenly interpreted these literally as deaths from complications of operations under local anaesthesia (Phillips et al., 1998; Rooney, 1998). Conversely, these codes are sometimes excluded from definitions of drug abuse-related deaths such as that used by the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) (ACMD, 2000). Only if drug dependence or abuse is written on the certificate, cocaine is the only drug mentioned, and the coroner's verdict is not suicide or homicide, will it be obvious that the death was due to cocaine from the underlying cause code (ICD-9 304.2: cocaine dependence, or 305.6: abuse of cocaine-type drug).

Figure 1. The use of ICD-9 to code deaths from heroin alone in England & Wales



** Secondary cause code 965.0 (poisoning with opiates and related narcotics) for deaths where the underlying cause is an E-code only*

When more than one substance (other than alcohol) is implicated in a poisoning death, there is usually no indication on the death certificate which substance was principally responsible for the death. In these cases, the underlying and secondary cause ICD codes indicate that a combination of substances was taken. If both substances would normally be coded to the same 3 character category, the combination is coded to the 'other specified' (*.8) subdivision of that category. For example, accidental poisoning with heroin and paracetamol would be coded to ICD-9: E850.8 'accidental poisoning with other specified analgesics, antipyretics and antirheumatics' as underlying cause (and 965.8 as secondary cause). If the substances would normally be coded to different 3-character categories, for example heroin (E850.0) and cocaine (E855.2), the combination is coded to E858.8 'accidental poisoning with other specified drugs' (and 977.8 'poisoning by other drugs and

medicaments' as secondary cause). Table 2 shows the variety of underlying cause codes which would be applicable to deaths involving temazepam, depending on the coroner's verdict, information on abuse or dependence on the certificate, and whether taken alone or in combination with other drugs. This also shows that the grouping by type of drug is not the same in different parts of the ICD.

Table 2. Coding a temazepam-related death (ICD-9)

Temazepam alone or with alcohol:	
304.1	Drug dependence - barbiturate type
305.4	Non-dependent abuse of drugs - barbiturates and tranquillizers
E852.8	Accidental poisoning - other sedatives and hypnotics
E950.2	Suicide - other sedatives and hypnotics
E980.2	Undetermined intent - other sedatives and hypnotics
Temazepam with other drug(s):	
304.7	Drug dependence - combinations of morphine type drug with any other
304.8	Drug dependence - combinations excluding morphine type drug
305.9	Non-dependent abuse of drugs - other, mixed or unspecified
E582.5	Accidental poisoning - mixed sedatives, not elsewhere classified
E858.8	Accidental poisoning - other
E950.4	Suicide - other mixed or unspecified
E980.4	Undetermined intent – other specified drugs and medicaments

Since 1993, ONS has coded all the diseases, injuries, and external causes, including poisons, mentioned on the death certificate as well as the underlying and secondary causes. Up to eight 'multiple cause ICD codes' are stored electronically in the ONS national mortality database. This means that it is relatively easy to go beyond the combination codes, to get information on deaths with ICD codes that do identify individual poisons or types of poison.

ONS Drug deaths database

The ICD classification of drugs is fairly coarse. For example, it is not possible using ICD codes in any revision to distinguish between different antidepressant drugs, or between heroin and methadone, which are both coded as 'opiates/opioids'. Text from the death certificate has been stored electronically by ONS since 1993. ONS takes an annual 'drug and poisoning' extract from the national mortality database. This includes all deaths with an underlying cause of drug dependence, drug abuse, accidental, suicidal, homicidal, or 'undetermined intent' poisoning (coroner's 'open' verdict) with any drug or medicine. The extract includes age, sex, date of death, underlying and multiple cause ICD codes, cause of death text, any text from the coroner's description of how the 'accident' occurred, and coroner's verdict. Each individual drug mentioned is derived from the text, using standard names (for example 'paracetamol' for any generic or brand name of a product containing paracetamol). The name of each drug and the class to which it is allocated in the British National Formulary (BNF, 2001) are stored in additional fields. Using this database, annual reports on the numbers and rates of deaths from drug-related poisoning are published in Health Statistics Quarterly (ONS, 2001). In addition to underlying cause figures, the HSQ report provides statistics on deaths involving specific compounds of public

health or policy interest. These include heroin/morphine, methadone, cocaine, amphetamines, paracetamol, and any other drug contributing a substantial number of deaths.

ONS Dynamic mortality database

Up to 1992 the year of registration of the death was used in published mortality data for England & Wales, but since that time the year of occurrence of the death has been that recorded. This does mean that annually-published data are subject to change if a death is assigned retrospectively to a specific year, but updated statistics for past years have been published regularly since 1994 when a dynamic database facility was introduced.

Mortality - England & Wales

Of approximately 555,000 deaths annually in England & Wales (1999 population c. 53 million), some 170,000 (± 31 %) are referred to coroners. The coroner certifies approximately 120,000 (22 %), virtually all of which have post-mortem examination (necropsy). An inquest is held in some 20,000 cases (c. 3.6 % of all deaths), and about 16,000 (c. 3 % of all deaths) deaths are attributed to 'accident and violence'. In the mid-1980s, only approximately 1,400 necropsies were performed each year on 'suspicious' deaths, i.e. deaths where criminal involvement in the death was thought a possibility (Knight, 1985), but this figure is now thought to be nearer 2,500 (R Shepherd, personal communication, 2002). There are now about 700 homicides annually, though they may not be registered as such till the legal proceedings have been completed months or years later. There were about 800 deaths in 1999 for which no disease, injury, poisoning, or external cause was given on the certificate (underlying cause code ICD-9: 799.9 'unknown cause'). About 100 of these were elderly people certified as dying from 'multi-system failure' or a similar phrase. Just over 700 (c. 0.13 % of all deaths) were certified explicitly as 'cause unascertainable/could not be determined'. The coroner's certificates for all these deaths indicated that they had undergone both post-mortem and inquest. However, there is no indication whether toxicology or any other specific tests had been done or not.

Fatal Poisoning – England & Wales

Despite the problems discussed above, much valuable information can be derived from published mortality data. In adults most deaths from poisoning are self-inflicted, whereas in children and adolescents most are attributed to accidents. Poisoning is an important cause of premature death in the UK, especially in males - volatile substance abuse (VSA) is the largest single cause of death in males aged 14-18 years after road traffic accidents and acute poisoning accounts for some 20 % of deaths in men aged 20-29 years. Recent data from the US has emphasized that acute poisoning is the third leading cause of injury-related mortality after road traffic accidents and firearms injuries (16,306 ICD-9 'E-code' poisoning deaths, 2,242 and 306 deaths from nondependent and dependent abuse of drugs, respectively, in 1995 - Fingerhut & Cox, 1998).

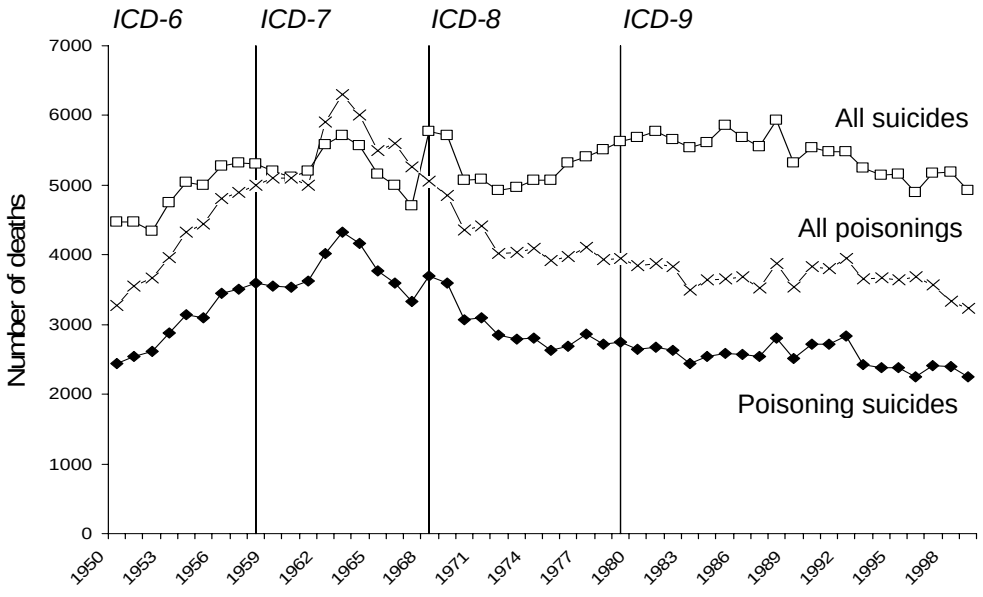
Suicidal vs. accidental poisoning

Total deaths from poisoning (accident, suicide and 'undetermined intent'), total suicides, and suicides by poisoning in England & Wales (population some 45 million in 1956, 49 million in 1971, 51 million in 1991, 53 million in 1999), 1950-99, are shown in Fig. 2. It is conventional to include injury and poisoning deaths of undetermined intent as probable suicides in analysis of England & Wales mortality data. This is because

coroners here require a high level of proof that the deceased intended to die before returning a suicide verdict. It can be impossible to say with certainty that a death from self-poisoning in an adult was suicide in the absence of other evidence such as a suicide note. This is not usually the case with other more violent methods of committing suicide such as shooting or hanging. A category for undetermined intent was first introduced in ICD-8, and a clear rise in total 'suicide and probable suicide' can be seen when it was implemented (Fig. 2). Before 1968, open verdict deaths would have been coded as accidental deaths.

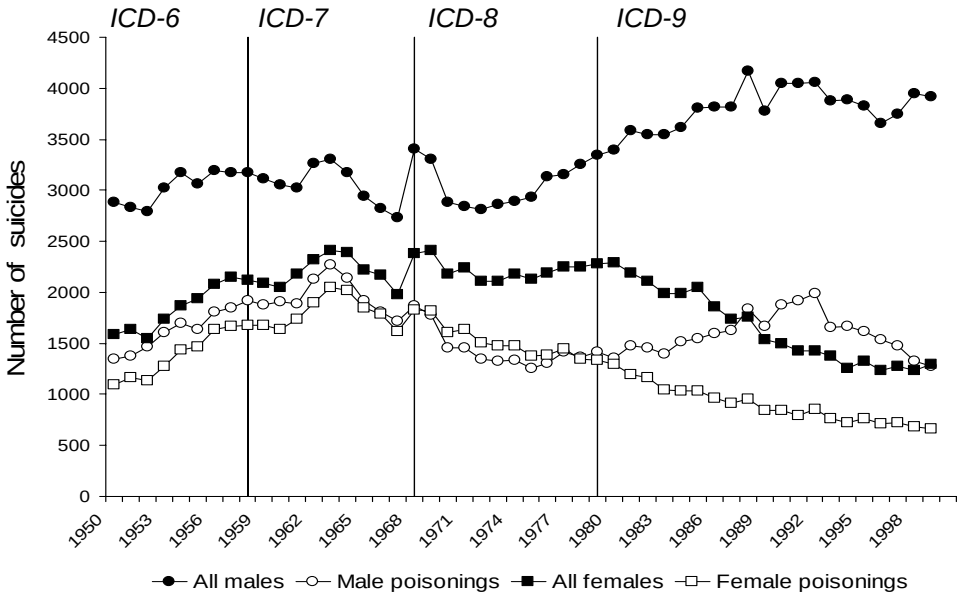
Figure 2. Suicide/fatal poisoning: England & Wales 1950-99

	ICD-6	ICD-7	ICD-8	ICD-9
Suicide	E970-E979	E970-E979	E950-E959 E980-E988	E950-E959 E980-E988 except E988.8
Fatal poisoning	N960-N979	N960-N967	N960-989	960-989
Poisoning suicides	E970-E973	E970-E973	E950-E952 E980-E982	E950-E952.9 E980-E982.9



In England & Wales at present (i) some 70 % of all acute poisoning deaths (all external causes as denoted by 'E' codes) are suicides and (ii) some 45 % of suicides are poisonings. This picture has remained relatively constant for the last 20 years, although there has been a slight trend downwards in all three parameters. The picture is very different if males and female suicides are studied separately, however (Kelly & Bunting, 1998; Gunnell et al., 1999; Fig. 3). In 1950 some 35 % of all suicides were in females whereas nowadays the corresponding figure is 25 %. Suicide rates in women of all ages (poisoning and physical methods) have fallen since 1979, as have rates in older men, but suicides in young men have risen (Kelly & Bunting, 1998). Female poisoning suicides (largely drug overdoses) have also fallen consistently since 1979. In contrast male poisoning suicides increased during the 1980s, only to fall during the 1990s (Fig. 3).

Figure 3. Suicide: England & Wales, 1956-99 (ICD: as Fig. 2)



The decline in fatal carbon monoxide (CO) poisoning in England & Wales from a peak in the early 1960s (Fig. 4) has been attributed to replacement, on purely economic grounds, of traditional sources of domestic gas supply such as coal gas (c. 20 % v/v carbon monoxide) with 'natural' gas (largely methane) or gas from other sources with a much lower carbon monoxide content (Hassall & Trethowan, 1972; Kreitman & Platt, 1984). This attribution is still cited to show that a single preventive measure can reduce both unintentional and suicidal poisoning by a particular agent without a corresponding increase in suicide by other means (Baker, 2000). The reduction in the toxicity of domestic gas supplies probably did decrease the number of poisoning deaths especially in women. However, this change coincided with therapeutic innovations such as the introduction of effective psychoactive drugs, notably the phenothiazines and tricyclic antidepressants, and in the event the decline in fatal poisoning that began in the mid-1960s leveled out somewhat in the early 1970s (Fig. 2) despite a continued fall in fatalities from carbon monoxide in women. In the period 1979-99, deaths from carbon monoxide poisoning increased from 965 in 1979 to 1537 in 1990, almost entirely due to suicides in young men by inhaling car exhaust, but have since shown a steady decrease (666 deaths in 1999; Fig. 4). A possible contributory factor here has been the fitting of catalytic exhaust convertors to new cars, although the simple expedient of altering the diameter of exhaust pipes so that it did not match the diameter of domestic vacuum cleaner hose and changes in the design of 'hatchbacks' may also have been important.

Extracting data on fatal carbon monoxide poisoning using ICD codes is relatively easy as this poison is usually recorded alone on death certificates and has its own ICD nature of injury code. As discussed above it, is not as easy to extract precise information on some of the other compounds encountered in fatal poisonings using the ICD code for the underlying and secondary causes of death, but some important trends can still be demonstrated. The dramatic success of the UK 1970s campaign advocating restricted prescribing of barbiturates and non-barbiturate hypnotics such as glutethimide (Campaign for the Use and Restriction of

Barbiturates, CURB) in reducing mortality and by extrapolation morbidity, from these compounds is illustrated in Fig. 5. Deaths involving these compounds ingested either alone or together with alcohol (ethanol) decreased from 832 in 1979 to 72 in 1999.

Figure 4. Deaths due to carbon monoxide poisoning: England & Wales 1956-99 (ICD-6: N968, ICD-7: N968, ICD-8: N986, ICD-9: 986)

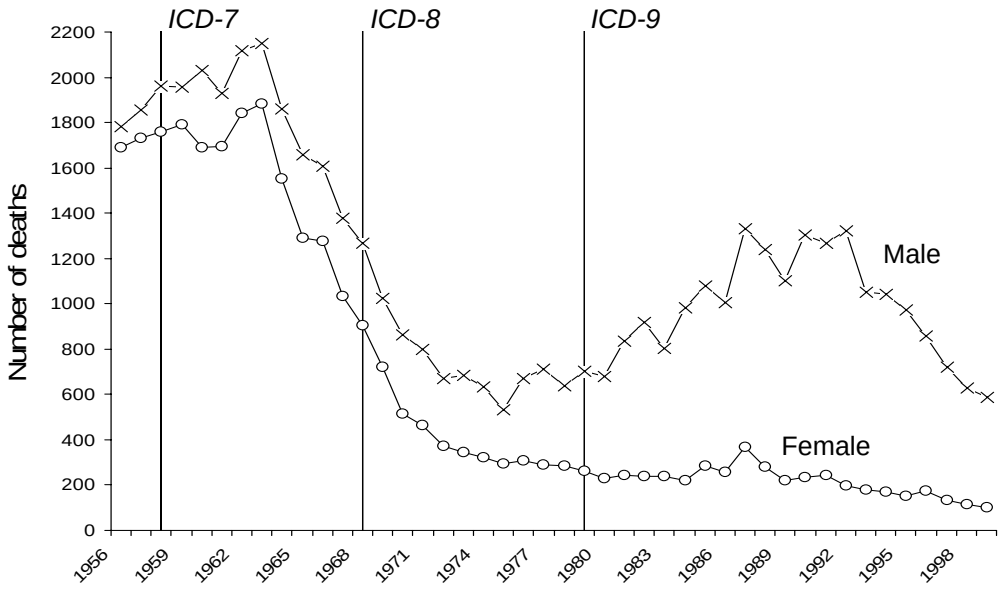
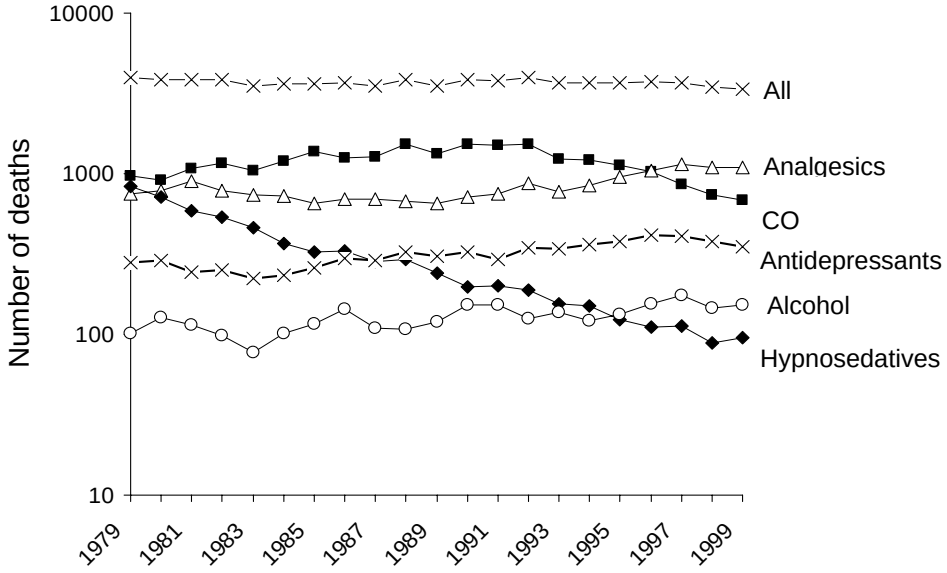
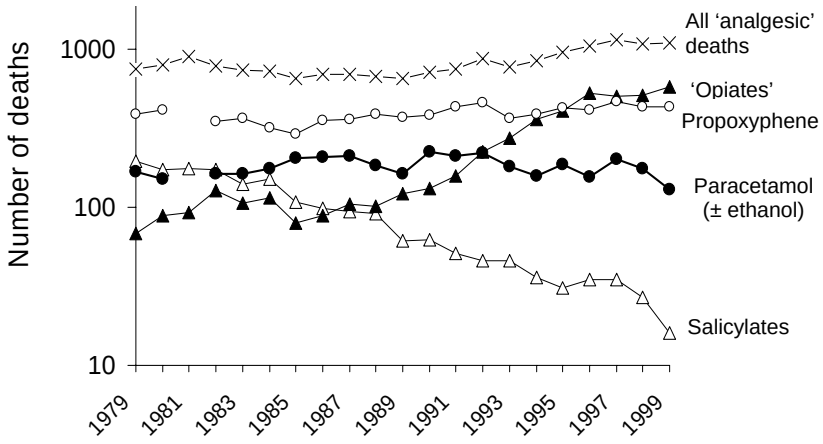


Figure 5. Fatal poisoning: England & Wales, 1979-99 [ICD-9: 960-989 all poisonings, 965 analgesics, 986 carbon monoxide (CO), 969.0 antidepressants, 980 alcohol, 967 sedatives and hypnotics]



Deaths attributed to poisoning with ‘analgesics’ either alone or with ethanol increased from 754 in 1979 to 1093 in 1999 (Figs. 5 & 6), but there were marked trends in the numbers of deaths attributed to specific substances or groups of substances. Deaths due to salicylates alone (± ethanol) decreased from 195 in 1979 to just 16 in 1999, whilst deaths due to ‘opiates and related narcotics’ (± ethanol – ICD-9 definition: does not include dextropropoxyphene) increased from 68 to 577 in this same period. Much of the increase in opiate-related deaths is associated with an increase in drug abuse-related deaths as discussed further below.

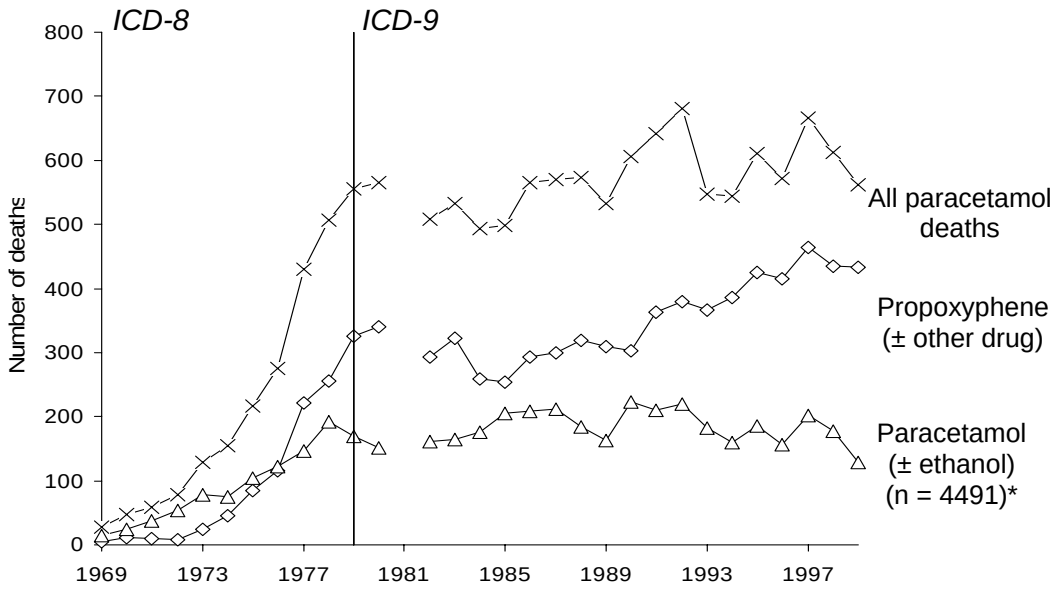
Figure 6. ‘Analgesic’ deaths: England & Wales, 1979-99 [ICD-9: 965 analgesics, 965.0 opiates, 965.1 salicylates; manual search and ONS drugs database (dextro)propoxyphene and paracetamol] (* No data for 1981 for paracetamol and for propoxyphene because of industrial action by Registrars of Births and Deaths)



Paracetamol alone (± ethanol) still accounts for some 100-200 deaths annually (4491 in total, 1969-99, no data for 1981) (Figs. 6 & 7). Although a few patients who have taken paracetamol alone may die relatively quickly and before reaching hospital (Dixon, 1976), most die in hospital from liver failure. Paracetamol poisoning thus remains the largest single cause of death from acute poisoning in hospital in the UK despite (i) the introduction of effective antidotes (methionine 1974, N-acetylcysteine 1979 - Flanagan & Meredith, 1991) for those presenting to hospital within 12-15 h of the overdose, and (ii) recent advances in the treatment of liver failure, which have reduced mortality in those with paracetamol-induced fulminant hepatic failure from 50 % to 20 % or so (Makin et al., 1995). Note that these deaths are only some 30 % of those involving paracetamol. The rest are largely people who have ingested compound tablets containing paracetamol and the opioid analgesic dextropropoxyphene (propoxyphene) (Fig. 7). In such instances death usually occurs outside hospital and is usually attributable to dextropropoxyphene toxicity, especially if ethanol has been co-ingested. The very steep rise in dextropropoxyphene-related deaths between 1969 and 1979 prompted the introduction of blister-packaging for the then most popular paracetamol/dextropropoxyphene mixture (Distalgesic, Dista). Whilst this measure may have arrested the sharp increase in dextropropoxyphene-related deaths experienced up to 1979, the trend is still

upwards (433 deaths in 1999; Fig. 7). [N.B. Note that 'all paracetamol deaths' (Fig. 7) includes deaths where only (dextro)propoxyphene and/or nor(dextro)propoxyphene was mentioned on the death certificate since this indicates ingestion of a dextropropoxyphene/paracetamol mixture.]

Figure 7. Paracetamol-related deaths: England & Wales, 1969-99 (manual search, substances recorded on coroner's certificate and ONS drugs database) (* No data for 1981 because of industrial action by Registrars of Births and Deaths)



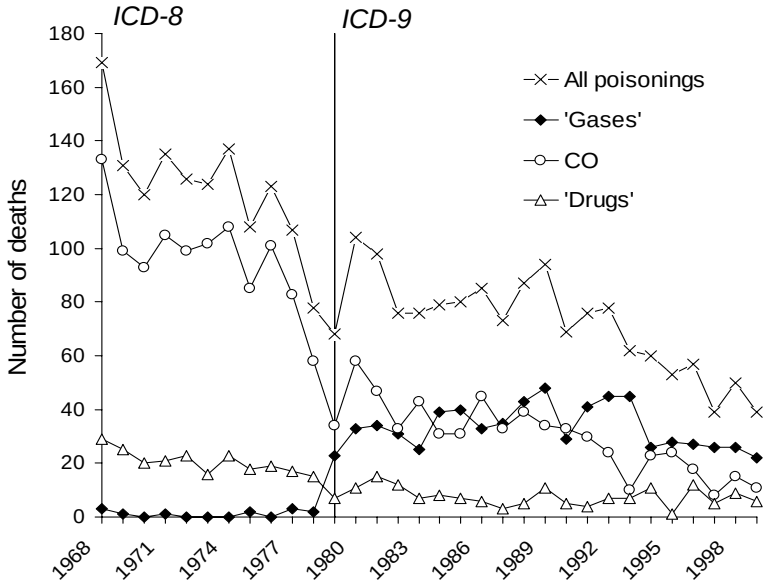
Although there continues to be concern about possible toxicity from environmental and occupational exposure to pesticides in the UK, such compounds are responsible for less than 1 % of deaths from acute poisoning in England & Wales. In contrast, acute pesticide poisoning is nowadays a major problem in developing countries. In Sri Lanka, agrochemicals account for nearly 60 % of all poisonings (Hettiarachchi & Kodithuwakku, 1989). Agrochemicals (principally organophosphorus compounds, organochlorines and other pesticides) also predominate in hospital admissions and deaths due to poisoning (Fernando, 1990). In Costa Rica between 1980 and 1986 there were at least 3,330 hospital admissions and 429 deaths attributed to pesticide poisoning (Wesseling et al., 1993). Aluminium phosphide is a common cause of fatal poisoning in India (Siwach & Gupta, 1995). Paraquat is the major cause of fatal self-poisoning in Trinidad and Tobago (Daisley & Hutchinson, 1998).

Poisoning in childhood

Fatal poisoning is now rare in England & Wales in those less than 10 years of age (39 deaths in 1999, mostly deaths in fires). The introduction of ICD-9 was associated with a change in the coding of deaths in fires attributed to fatal poisoning. Fewer deaths from smoke inhalation were coded to carbon monoxide in ICD-9 and more to poisoning by 'other gases, fumes, and vapours' (Fig. 8). Coding of fatal poisoning from 'drugs, and other solid and liquid substances', which have declined steadily in children since the 1960s, was unaffected by the introduction of ICD-9. Factors which have helped reduce mortality and also morbidity from poisoning in this age group include: (i) the widespread introduction of child resistant closures (CRCs), (ii) greater emphasis on safety in

the home, (iii) improved access to poisons information, (iv) improved treatment, (v) the withdrawal of hazardous preparations such as Safapryn (paracetamol and enteric coated aspirin), (vi) the increased use of blister packaging, and (vi) changes in prescribing patterns. Childhood deaths from aspirin poisoning, for example, which were often iatrogenic in origin, are now virtually non-existent in the UK because use of aspirin in childhood is now generally contraindicated. Serious poisoning from drugs and other ingested agents is now rare in children in the UK and this coupled with an increased awareness of 'Munchausen syndrome-by-proxy' and non-accidental poisoning in childhood mean that serious poisonings in children are usually subject to careful investigation (McClure et al., 1996). Most fatal poisonings with these agents in children in England & Wales (Fig. 8) are now either homicide, or an open verdict is recorded. With paracetamol especially serious accidental poisoning is almost unknown in young children - the amount ingested is usually small, and hepatic sulphation capacity and glutathione stores are increased compared to those of adults. Serious liver damage and death have only been reported in children after chronic paracetamol poisoning (Penna & Buchanan, 1991).

Figure 8. Fatal poisoning, age <10 yr: England & Wales, 1968-99 (ICD-8: N960-989 all poisonings, N986 carbon monoxide (CO), N987 'other gases, fumes & vapours', N960-979 drugs; ICD-9: 960-989 all poisonings, 986 carbon monoxide (CO), 987 'other gases, fumes & vapours', 960-979 drugs)



Homicidal poisoning by health-care workers

Homicide has not traditionally featured prominently in fatal poisoning statistics in the UK. However, in 1991 nurse Beverly Allitt was convicted of murdering 4 patients, at least one by use of insulin (James & Leadbeatter, 1997; Repper, 1995). Lignocaine was also administered to some patients and may have contributed to some deaths. More remarkably, general practitioner Dr Harold Shipman, having been convicted of several offences relating to the misuse of pethidine in 1976 and giving a written undertaking not to return to general practice, was convicted in 2000 of murdering 15 of his patients by administration of diamorphine (pharmaceutical heroin) during the 1990s (O'Neill, 2000). It is not known how many more patients (possibly

several hundred) suffered a similar fate at his hands. This is now the subject of a public enquiry (http://www.the-shipman-inquiry.org.uk/), after which revised mortality data will be published. Serial homicide by either nurses or doctors, which often involves poisoning, is not confined to the UK (Stark et al., 1997; Kinnell, 2000; Stark et al., 2001).

Drug abuse-related deaths

Defining drug abuse-related poisoning deaths is not easy, for the reasons discussed above. The European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) has defined a standard list of ICD-9 codes for comparison of drug abuse-related mortality across Europe. This list is used to extract deaths from mortality data based on a single underlying cause only. However, the list does not take into account the way in which many poisoning deaths are coded or the variability in the type and amount of information available in different countries. It effectively counts only deaths certified as due to a single controlled substance, or explicitly certified as 'drug abuse/drug dependence'.

The ECMDDA list includes the ICD-9 codes for drug psychosis (292); dependent/non-dependent abuse of drugs (304/305.2-9); accidental poisoning by opiates and related narcotics (E850.0), psychodysleptics (E854.1), and psychostimulants (E854.2) (ACMD, 2000). However, this list excludes all suicides and 'undetermined intent' poisonings (even with opiates or other controlled drugs); assaults by poisoning; all deaths involving more than one poison (other than alcohol); and many deaths due to other drugs that are often abused such as barbiturates, cocaine, and temazepam if drug abuse/dependence was not written on the death certificate. Using the EMCDDA list to extract data for England & Wales, deaths increased from some 140 per year in 1979-81 to 1076 in 1998; most (83 %) were in males (Figs. 9 &10). The proportion of deaths coded to 304 and 305.2-9 has increased in the last few years (Fig. 10). There has also been a steady increase in mortality due to illicit drug use without mention of dependence on the death certificate since the mid 1980s.

Some idea of the extent to which the EMCDDA approach to recording drug abuse-related deaths underestimates the incidence of poisoning deaths in which an illicit (controlled) substance was involved is given by the UK Home Office (HO) figures for all deaths involving a controlled substance (1988-94; Fig. 9) which are some 2-3 times the EMCDDA list-derived figures. The HO definition included deaths certified as due to drug abuse/dependence and also poisonings (accident, suicide, or 'undetermined intent') in which a controlled drug was mentioned on the death certificate and relied on manual text searches. This definition may have over-estimated the number of deaths that were due to drug dependence/abuse in the strictest sense since deaths from deliberate or accidental overdose of opiates prescribed for pain control in terminal illness could have been included. The HO stopped producing statistics on drug abuse-related deaths in 1994. A definition of 'drug abuse-related deaths' or deaths related to the use of controlled drugs (based on the HO definition above) has been agreed recently between the HO, the UK Department of Health, the HO Advisory Council on the Misuse of Drugs (ACMD), ONS, and academic advisors. ONS has undertaken to produce annual statistics based on this definition derived from text from death certificates stored electronically (Fig. 9).

Figure 9. Fatal poisoning, drug abuse: England & Wales, 1979-99 (EMCDDA definition: ICD-9: 292, 304, 305.2-9, E850.0, E854.1-2. HO definition: manual search of deaths with underlying cause 292, 304, 305, or secondary cause 960-979 for mention of controlled substance on coroner's certificate. ONS definition: ICD-9: 304, 305.2-9, 965.0, 965.8, 967, 968.5, 969, 977.8-9)

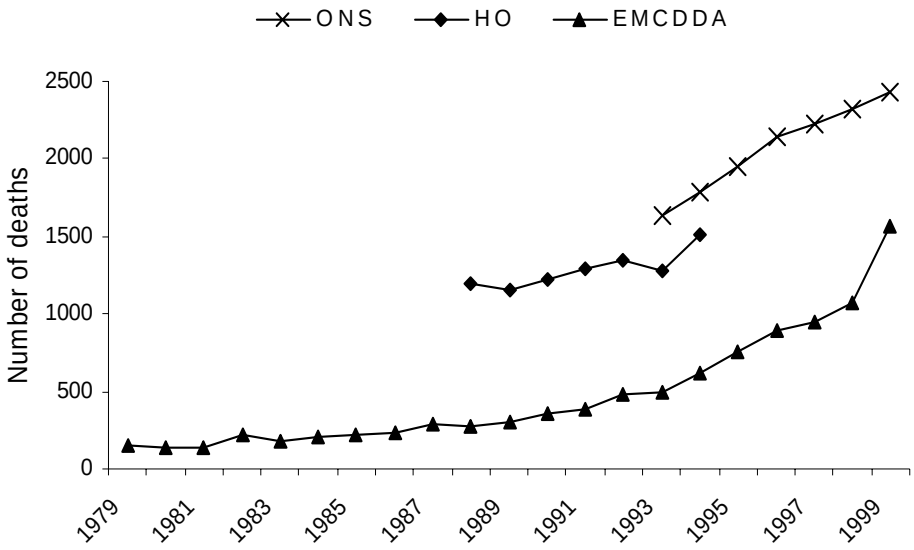
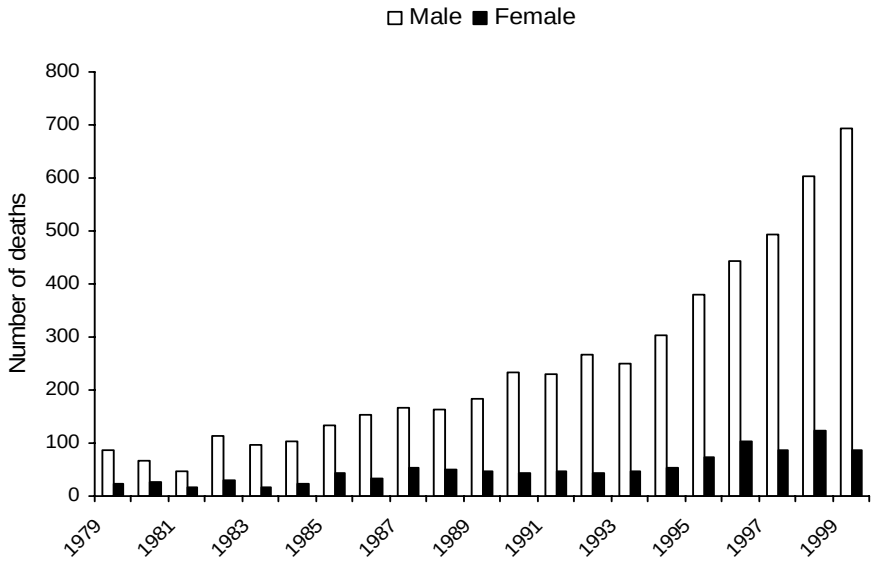


Figure 10. Fatal poisoning, dependent/non-dependent abuse and related codes: England & Wales, 1979-99 (ICD-9: 292, 304, 305.2-9, E962.0)



All deaths coded to ICD-9 E850-8, E950 and E980 are due to acute poisoning. In addition, over 90 % of the deaths with an underlying cause of death coded to 304 or 305.2-9 (drug dependence and non-dependent abuse of drugs, respectively) are due to acute poisoning, although they are not included in the data summarized in Figs. 2-8. Analysis of the ONS poisoning-related deaths database, which includes deaths coded to ICD-9 304

and 305, shows that deaths involving heroin (heroin and/or morphine recorded on the death certificate) have risen steadily since 1993, reaching 754 in 1999. Most (74 %) of these deaths were recorded as being due to heroin either alone (n = 365) or with alcohol (Fig. 11). If this trend continues and deaths involving carbon monoxide continue to fall (688 in 1999; Fig. 4), heroin could eventually overtake carbon monoxide as the leading single cause of fatal poisoning in England & Wales. On the other hand, deaths involving methadone, either alone or with other drugs/poisons, peaked at 421 in 1997 (Fig. 12), and have since been falling, possibly as a result of measures aimed at making it more difficult to take the drug other than as prescribed.

Figure 11. Heroin-related deaths (drug abuse, dependence or poisoning deaths where heroin and/or morphine recorded on the death certificate): England & Wales, 1993-9 (ONS drugs database)

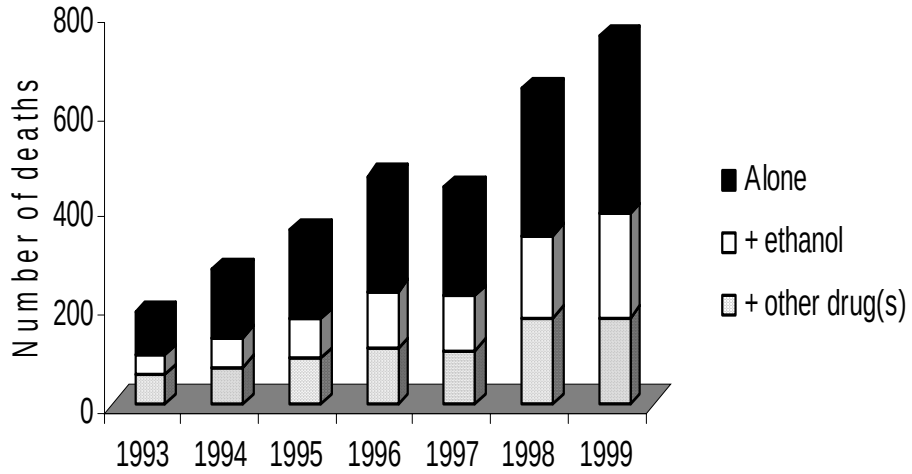
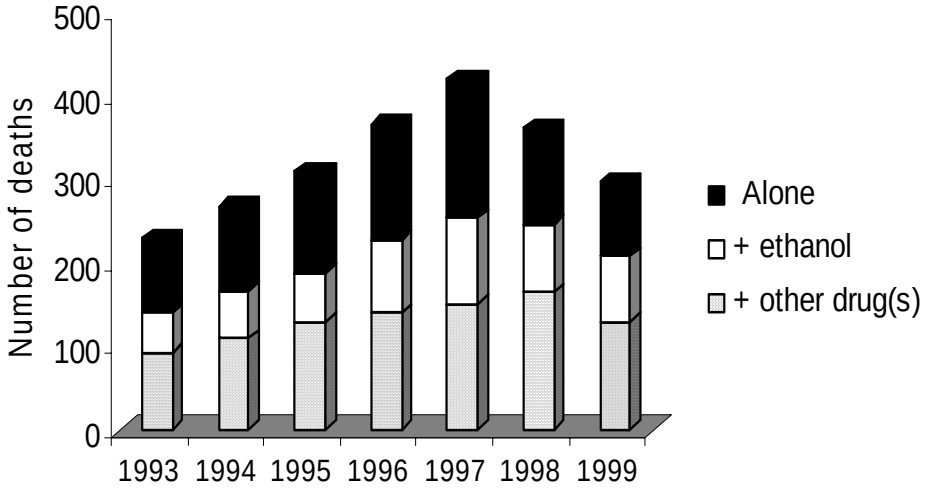


Figure 12. Methadone-related deaths (drug abuse, dependence or poisoning deaths where methadone recorded on the death certificate): England & Wales, 1993-9 (ONS drugs database)



Other controlled drugs are implicated in relatively small numbers of deaths although there is considerable media interest in some compounds or groups of compounds, notably the hallucinogenic amphetamines. Deaths involving these compounds [methylenedioxyamphetamine (MDA, 'adam'), methylenedioxymethlyamphetamine (MDMA, 'ecstasy'), and methylenedioxyethlyamphetamine (MDEA, 'eve')] ranged from 11 to 28 annually 1993-9 (Table 3); overall 50 % involved one or more additional poisons other than ethanol. The acute toxicity of these compounds does not seem to be clearly related to dose. Of deaths involving non-hallucinogenic amphetamines (between 18 and 55 annually, 1993-9), 57 % involved one or more additional poisons other than ethanol. Deaths involving barbiturates ranged from 20 to 47 per year over this same period; most (74 %) involved barbiturates alone or with ethanol. The only clear trend apparent (Table 3) was in deaths involving cocaine, which increased from 12 in 1993 to 88 in 1999. Of the cocaine-related deaths, 155 (58 %) involved one or more poisons other than ethanol. Note that 'alcohol' (ethanol) is recorded as the sole cause of fatal poisoning in some 100-150 deaths annually (Fig. 5).

Table 3. Fatal poisoning: controlled drugs other than heroin and methadone, England & Wales, 1993-9 (ONS poisons database)

	Cocaine			**MDMA, MDA, MDEA**			**Other amphet-amines**			**Barbitur-ates**		
	Total	+ ethanol	+ other drugs	**Total**	+ ethanol	+ other drugs	**Total**	+ ethanol	+ other drugs	**Total**	+ ethanol	+ other drugs
1993	**12**	0	4	**13**	2	2	**23**	4	15	**44**	10	11
1994	**24**	4	12	**28**	3	13	**18**	3	12	**47**	5	10
1995	**19**	2	10	**11**	1	4	**37**	5	20	**46**	0	8
1996	**19**	6	9	**19**	4	10	**28**	6	15	**30**	7	10
1997	**39**	5	22	**14**	2	11	**36**	1	19	**20**	1	6
1998	**66**	18	41	**16**	2	6	**55**	5	32	**35**	5	12
1999	**88**	12	57	**26**	3	18	**54**	4	31	**26**	3	7

Where drugs or other poisons are indirectly responsible for a death, the direct cause, for example HIV infection or road traffic accident, is generally selected as the underlying cause of death. The involvement of drugs is recorded on the ONS database if it is mentioned on the coroner's certificate. However, where drug use contributed to a death this is often not known to or recorded by the certifier. For example, only 3 of 2,122 deaths attributed to HIV infection in England & Wales 1993-6 mentioned drug abuse as a contributory cause on the death certificate. Data from the UK Communicable Disease Surveillance Centre (CDSC) show that the proportion of individuals dying from HIV infection who contracted the disease as a result of intravenous drug use is much higher than this. Similarly, over the same period, only 22 of the 13,687 deaths due to transport accidents [ICD-9 E800-848] mentioned use of drugs other than alcohol as a contributory cause on the coroner's certificate. A recent study for the Department of the Environment, Transport and the Regions (DETR) found toxicological evidence of prior illicit drug use, not necessarily impairment, in 16 % of persons killed in road traffic accidents (passengers and pedestrians as well as drivers) and ethanol in 34 % (DETR, 1998). At present drugs

are not routinely tested for following violent accidents or deaths from other causes where illicit drug use may be indirectly responsible. Moreover, where it is known that illicit drug use was indirectly involved in a death this may sometimes be omitted from the death certificate, possibly for compassionate reasons. Therefore, it is currently not possible to compile comprehensive figures on deaths **indirectly** caused by use of illicit drugs.

Volatile Substance Abuse-related Deaths - UK

Recording sudden volatile substance abuse (VSA; inhalant abuse, solvent abuse, 'glue sniffing')-related deaths provides an example of the problems that may arise when the terminal event is such that the underlying cause of death can be missed when the death is certified or the data are coded. Sudden VSA-related deaths, i.e. deaths where the immediate cause of the event leading to death was VSA, usually assumed to be accidental deaths, should be recorded as ICD-9 304.6/305.9 (dependent/nondependent abuse of volatile substances), although this would not give other information such as the substances involved or the mode of death. However, this is rarely done, in part because of the variety of circumstances under which death may occur [physical injury whilst intoxicated, fire/explosion due to abuse of flammable materials, suffocation associated with use of a plastic bag, asphyxiation due to inhalation of vomit, or direct toxicity, probably cardiotoxicity (Flanagan & Meredith, 1996)], and therefore could also be assigned to a range of 'E' codes. All apart from deaths due to fire/explosion or suicide by hanging or shooting (a relatively small number) are poisoning deaths. VSA-related deaths are not included in the data on drug-abuse related deaths presented above as the compounds/products abused are not controlled substances.

In the UK (1999 population c. 57 million), information on VSA-related sudden deaths is gathered directly from coroners, press cuttings, and other sources in addition to information supplied by ONS for England & Wales and by equivalent bodies in other parts of the UK to ensure that the total number of such deaths are counted, whatever the actual cause of death (Field-Smith et al., 2001). This process is feasible because the number of such deaths is relatively small (currently some 50-70 per year) and is justifiable because the practice remains especially prevalent in children aged 14-18 years. Despite this exhaustive effort, information on any deaths due to chronic VSA is not captured and the involvement of VSA in road traffic accidents, for example, is unknown.

Sudden deaths from VSA in the UK steadily increased during the 1970s and 80s, reaching a peak of 152 deaths in 1990. Thereafter deaths declined to 67 in 1994 and have stayed at about 75 per year since then (Fig. 13). Most (90 %) sudden VSA-related deaths are in males. Although traditionally most common in those aged less than 20 years, the most recent data suggest a relative decrease in sudden deaths in this latter age group with corresponding increases in older age groups (Fig. 14). Whether this represents continuing abuse into adulthood of a practice begun in childhood, or whether VSA is becoming more popular amongst adults is unknown.

Figure 13. VSA-Related sudden deaths: UK, 1971-99 (Field-Smith et al., 2001)

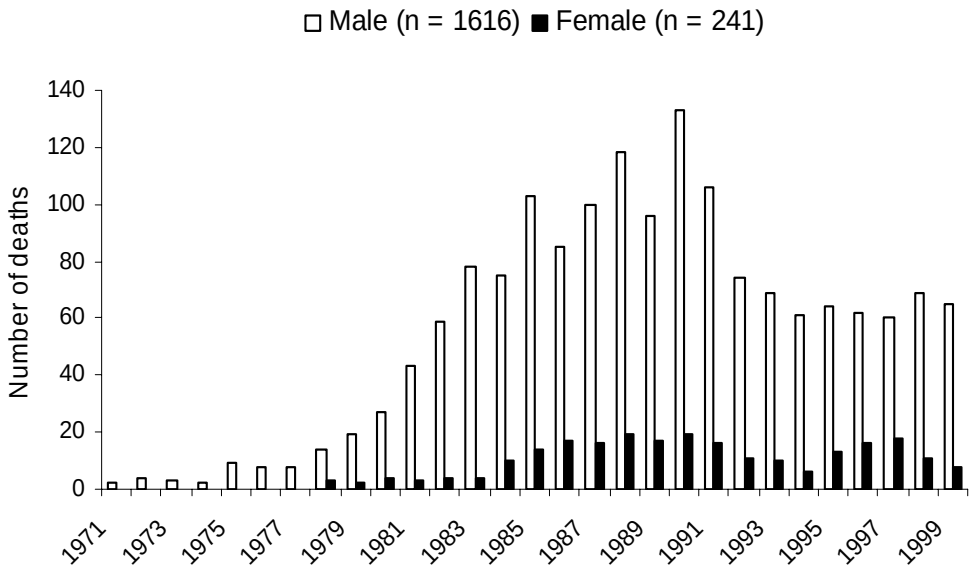
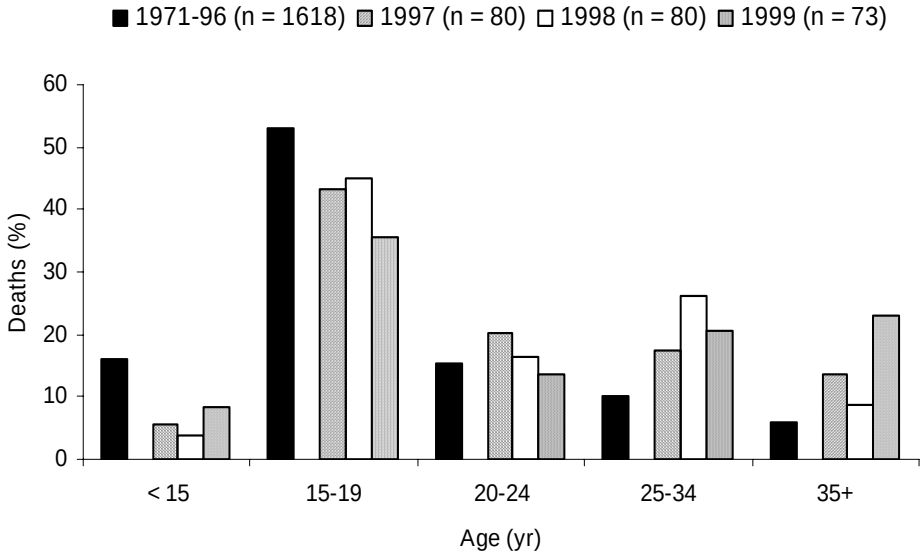
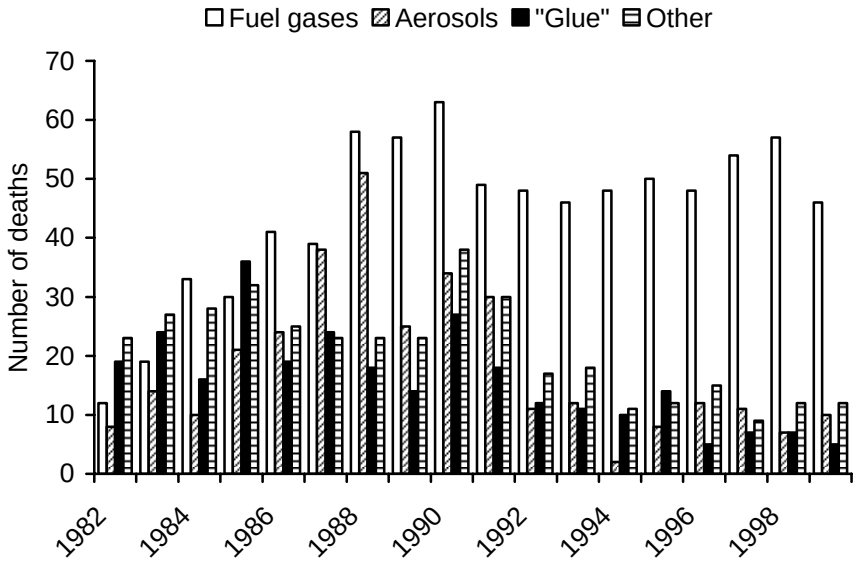


Figure 14. VSA-Related sudden deaths: UK, 1971-99 by age group (Field-Smith et al., 2001)



Most UK VSA-related deaths are associated with the abuse of one product. Fuel gases, mainly liquefied petroleum gas (LPG, largely composed of butane, isobutane and propane) cigarette lighter refills, but also other sources of LPG such as blow-torch cylinders, have predominated in VSA-related deaths throughout the 1990s (Fig. 15). Current moves at harm reduction aim to restrict the size of cigarette lighter refills as well as enforcing legislation prohibiting sales to those aged less than 18 years. Bromochlorodifluoromethane (BCF)-containing fire extinguishers are no longer commercially available hence one source of intoxicant has been removed. Reformulation of 1,1,1-trichloroethane-containing paper correcting fluids using non-chlorinated solvents has removed a further source of intoxicant that was easily available to school children.

Figure 15. VSA-Related sudden deaths: UK, 1982-99 by product abused (Field-Smith et al., 2001



Future Developments

Impact of ICD-10

Deaths in England & Wales registered since the beginning of January 2001 have been coded to ICD-10. ONS has also coded 1999 mortality data for England & Wales (already published coded in ICD-9) to ICD-10 in order to quantify any differences between the two versions. ICD-10 is alphanumeric hence all the codes differ from those in ICD-9. In broad terms, however, the classification of deaths related to poisoning is unchanged - blocks of codes identify deaths due to drug dependence, non-dependent substance abuse, and accidental, suicidal/self-inflicted, homicidal, and 'undetermined intent' poisoning. In ICD-10 as published and currently used in England & Wales, and in Scotland (WHO, 1992), deaths involving more than one drug are still be assigned to combination or 'other specified' categories. However, a working group of the WHO network of Collaborating Centres for the family of International Classifications is considering proposals for an alternative hierarchical assignment based on the single most toxic substance involved. If approved through the procedures set down by WHO, this could be incorporated into a future version of ICD-10.

The way specific drugs are grouped has changed in ICD-10, with the most frequently abused being grouped together rather than by therapeutic class. For example X42 'accidental poisoning by narcotics and psychodysleptics' includes heroin, methadone, other opiates, cocaine, LSD, and cannabis, but not amphetamines. While this may make it easier to identify total deaths from drugs of abuse, it makes breakdown by type of drug impossible if only the underlying cause of death is available. The secondary cause/nature of injury codes allow each substance listed to be identified. Codes T36-T50, cover 'Poisoning by drugs, medicaments and biological substances' (WHO, 1992). They provide a more useful, though far from perfect, breakdown of drugs commonly abused, taken in overdose, or contributing to deaths than was available in ICD-9. ONS will continue to code and publish injury mortality data for England & Wales by underlying and secondary

cause, but many countries do not. ONS will also continue to use text to identify drugs and poisons of particular public health, toxicological, or policy interest.

Reliability of toxicological data

There are no agreed 'best practice guidelines' to assist UK coroners and pathologists when requesting toxicological analyses, and no guidelines for laboratories as to appropriate methodology for use with specimens obtained post mortem. There is no accreditation scheme for UK laboratories performing post mortem toxicology, and no requirement for such laboratories to enrol in external quality assessment (EQA) schemes. Similarly, there is no requirement for the staff in laboratories performing post-mortem toxicology to be certified for the task. Accreditation, certification, EQA, etc. is left to individuals/individual laboratories. The situation is different in some other countries. In Australia, for example, not only must all laboratories and personnel performing forensic toxicology be accredited for the purpose, but also all reporting officers are interviewed every 2 years to assess their training and competence (O. Drummer, personal communication, 2001). Operation within nationally or internationally agreed accreditation/procedural guidelines would probably improve the scope and validity of data on deaths involving drugs and other poisons.

Procedures associated with death certification

Many of the procedures used for investigating, certifying, and coding deaths are governed by a variety of laws, regulations, and guidelines that are not easily or lightly changed. However, there is some scope for improvement in the quality of information flowing from coroners without major legislative change. More complete information on what tests for poisons have been done and the results obtained, including poisons/groups of poisons looked for and either found or excluded, could improve the quality and interpretation of national mortality data especially in deaths for which no cause could be found. Information on the route of exposure to drugs or other poisons, if known, and more complete recording of a history of drug dependence or abuse, would also be useful. A consultation paper on modernising the UK registration service (ONS, 1999) has suggested that families might in future be offered a 'short death certificate', without information on the cause of death, which they could use as legal proof of a death. They would still have the option of a full 'certified copy of the death register entry' with the cause of death as written by the certifying doctor or coroner. The 'short' option might make certifiers and families accept the inclusion of information on potentially stigmatising conditions in the cause of death. Other opportunities for improving the system of death investigation and certification in the UK may arise from various enquiries and reviews of death certification (Home Office Review of Death Certification: http://www.homeoffice.gov.uk/ccpd/deathcert.htm, ONS consultation on changes to vital registration: http://www.mimas.ac.uk/surveys/news/ons_nov99.html), the role of coroners, and the conduct of post-mortem examinations following the Shipman (http://www.the-shipman-inquiry.org.uk/) and the Bristol Royal Infirmary incidents (http://www.bristol-inquiry.org.uk/).

ICECI/ICE

The WHO programme on Injury Prevention, together with international collaborators, has produced a draft International Classification of External Causes of Injury (ICECI) (http://www.iceci.org). Although this is primarily a research tool for studies of injury, some of the additional detail may be incorporated into updated versions of ICD-10 in time. A flexible system for coding poisoning deaths, which facilitated identification of (i) the

chemical substance(s) involved, (ii) the therapeutic/structural class(es) of drugs, (iii) whether the substances were controlled or not, as well as information on (iv) intent/circumstances, and (v) route of exposure would be extremely useful. The International Collaborative Effort (ICE) on Injury Statistics, sponsored by the US National Centre for Health Statistics (http://www.cdc.gov/nchs/advice.htm) has developed a matrix for reporting injury mortality. This recommends shifting the primary axis of tabulation of injury mortality from intent (verdict) to mechanism, or agent in the case of poisoning (Fingerhut & Cox, 1998). It appears that better comparability between countries may be obtained this way because the means of determining intent vary enormously. In planning prevention programmes, it may also sometimes be more useful to look at all deaths due to drowning, or to poisoning, for example, than dividing them into accidents, suicides, 'undetermined intent', etc. In the case of drug-related poisonings in England & Wales, intent does not appear to be consistent between coroners or over time (Neeleman & Wessely, 1997).

Although many classification systems for prescription and OTC drugs are available, these are of limited use within ICD since other poisons are not covered. The International Programme on Chemical Safety (IPCS) has produced a hierarchical poisons classification scheme as part of its INTOX programme (http://www.intox.org) that is intended for international use and is also intended to be flexible in that new compounds can be added as they appear on the market, an important factor as far as both prescription and illicit drugs are concerned. The fact that a classification system for non-drug poisons has been developed is valuable as most serious poisoning encountered in less developed countries involves pesticides, natural products, and other materials that are not intended for use as pharmaceuticals. The INTOX classification system could provide the basis for a poisons coding system to be used in classifying fatal poisoning.

MUNCCI/NCIS

There are approximately 18,000 deaths reported to coronial offices in Australia each year. Of these, approximately 7,000 per year (39 %) are due to accidents and violence, which includes homicide and suicide. In contrast, in England & Wales only about 10 % of deaths referred to coroners are certified as due to accidents and violence. A National Coroners Information System (NCIS) has been established at the Monash University National Centre for Coronial Information (MUNCCI) and aims to provide comprehensive and up-to-date information deaths investigated by coroners to other coroners, public policy makers, and researchers (http://www.vifp.monash.edu.au/ncis/). By making reliable coronial data more accessible, it is envisaged that investigation of individual deaths will be facilitated and eventually reductions in preventable death and injury will be achieved. There is a 'drugs module' that aims to enhance the amount, consistency, accessibility and timeliness of data available on the role of drugs and alcohol in deaths referred to Australian coroners. Parts of this programme may be applicable in other countries.

Conclusions

There are many difficulties associated with classifying and quantifying deaths involving drugs and other poisons. These include incomplete or inconsistent information about the poison(s) involved, the reliability and extent of any toxicological analyses, the route of administration or exposure, and the underlying reason for exposure. The variety of ICD codes that can be assigned to deaths involving the same substance and the broad categories of drugs covered by single underlying cause codes make it difficult to gather information on the

particular types of death/poisons of interest. International data on numbers of poisoning deaths are almost certainly not fully comparable at present. It is especially difficult to derive consistent, comprehensive, accurate figures on categories such as drug abuse- or VSA-related deaths. However, comprehensive, population-based mortality statistics across the whole range of causes are essential for a wide variety of medical, legal, public health, and policy purposes. The ICD, the rules for selecting the single underlying cause, the WHO style certificate of cause of death, and the guidelines for completing the certificate have been essential tools for maximizing the consistency of routine mortality statistics between countries and over time. A 'poisons oriented' approach to data analysis such as that we have outlined in this paper, built upon a sound system for collecting and recording the data, is needed in order to facilitate proper provision of national let alone international fatal poisoning statistics. A simple means whereby deaths involving more than one drug or poison can be handled within the ICD would, however, be useful. The availability of accurate, clearly defined fatal poisoning data has clear implications for planning, evaluating, and funding policies to reduce poisoning deaths. Similarly, although fatal poisoning statistics provide no information on the number of toxicological investigations performed on behalf of the coroner – many investigations are performed in cases not eventually certified as poisoning deaths – such data do provide some indication of the size of the problem for resource allocation.

References

ACMD (Advisory Council on the Misuse of Drugs). Reducing drug related deaths. London: Stationery Office, 2000:54.

Baker SP. Where have we been and where are we going in injury control? In: *Injury Prevention and Control*, Ed. Mohan D, Tiwari G. London: Taylor & Francis, 2000:13-26.

BNF (British National Formulary). Edition 42. London: British Medical Association and Royal Pharmaceutical Society of Great Britain, 2001 (September).

Christopherson C, Rooney C, Kelly S. Drug-related mortality: methods and trends. Population Trends 1998;issue 93:1-9.

Daisley H, Hutchinson G. Paraquat poisoning. Lancet 1998;352:1393-4.

Dennis M, Owens D, Jones S. Epidemiology of deliberate self-poisoning; trends in hospital attendances. Hlth Trends 1990;22:125-6.

DETR (Department of the Environment, Transport and the Regions). Government acts on drug-driving enforcement. Press Notice 94/Transport. London: DETR, 11 February 1998.

Devis T, Rooney C. Death certification and the epidemiologist. Hlth Sci Quart 1999 (Spring):21-33

Dixon MF. Paracetamol hepatotoxicity. Lancet 1976;i:35.

Fernando R. National poisons information centre in a developing Asian country - the first year's experience. *Human Exp Toxicol* 1990;9:161-3.

Field-Smith ME, Taylor JC, Norman CL, Bland JM, Ramsey JD, Anderson HR. Trends in deaths associated with abuse of volatile substances 1971-1999. London: St George's Hospital Medical School, 2001 (*http://www.sghms.ac.uk/depts/phs/vsamenu.htm*).

Fingerhut L, Cox CS. Poisoning mortality. Public Hlth Rep 1998;113:218-33.

Flanagan RJ, Meredith TJ. Use of N-acetylcysteine in clinical toxicology. Am J Med 1991;91(3C):131S-9S.

Flanagan RJ, Meredith TJ. Volatile substances with special reference to volatile substance abuse. In: *Human Toxicology*, Ed. Descotes J. Amsterdam: Elsevier, 1996:577-622.

Gunnell D, Wehner H, Frankel S. Sex differences in suicide trends in England & Wales. Lancet 1999;353:556-7.

Hassall C, Trethowan WH. Suicide in Birmingham. Br Med J 1972;1:717-8.

Hettiarachchi J, Kodithuwakku GCS. Pattern of poisoning in rural Sri Lanka. Int J Epidemiol 1989;18:418-22.

James DS, Leadbeatter S. Detecting homicide in hospital. J R Coll Physicians Lond 1997;31:296-8.

Kelly S, Bunting J. Trends in suicide in England & Wales, 1982-96. Population Trends 1998;issue 92:29-41.

Kinnell HG. Serial homicide by doctors: Shipman in perspective. Br Med J 2000;321:1594-7.

Knight B. Forensic pathology: the chronic crisis. Br Med J 1985;291:1145-6.

Kreitman N, Platt S. Suicide, unemployment, and domestic gas detoxification in Britain. J Epidemiol Community Hlth 1984;38:1-6.

Makin AJ, Wendon J, Williams R. A 7-year experience of severe acetaminophen-induced hepatotoxicity (1987-1993). Gastroenterology 1995;109:1907-16.

McClure RJ, Davis PM, Meadow SR, Sibert JR. Epidemiology of Munchausen syndrome by proxy, non-accidental poisoning, and non-accidental suffocation. Arch Dis Childh 1996;75;57-61.

np-SAD (National Programme on Substance Abuse Deaths). Drug-related deaths as reported by coroners in England & Wales: Annual report 1999. London: St George's Hospital Medical School, 2000 (http://www.sghms.ac.uk/addictive-behaviour/frames.htm).

Neeleman J, Wessely S. Changes in classification of suicide in England and Wales: time trends and associations with coroners' professional backgrounds. Psychol Med 1997;27:467-72

O'Neill B. Doctor as murderer. Death certification needs tightening up, but it still might not have stopped Shipman. Br Med J 2000;320:329-30.

ONS (Office for National Statistics). Deaths related to drug poisoning: England and Wales, 1995-99. Hlth Stats Q 2001;Issue 9:70-2.

ONS (Office for National Statistics). Registration: modernising a vital service. London: Stationery Office, 1999.

Penna A, Buchanan N. Paracetamol poisoning in children and hepatotoxicity. Br J Clin Pharmacol. 1991;32:143-9.

Phillips DN, Christenfeld N, Glynn LM. Increase in US medication-error deaths between 1983 and 1993. Lancet 1998;351:643-4.

Repper J. Munchausen syndrome by proxy in health care workers. J Adv Nurs 1995;21:299-304.

Rooney C. Increase in US medication-error deaths. Lancet 1998;351:1656-7.

Rooney C, Devis T. Mortality trends by cause of death in England & Wales 1980-94: the impact of introducing automated cause coding and related changes in 1993. Population Trends 1996;86:29-36.

Rooney CIF, Smith SK. Implementation of ICD-10 for mortality statistics in England & Wales from January 2001. Heath Stats Q 2000;Issue 8:41-50.

Siwach SB, Gupta A. The profile of acute poisonings in Harayana-Rohtak Study. J Assoc Physicians India 1995;43:756-9.

Stark C, Paterson B, Henderson T, Kidd B, Godwin M. Counting the dead. Nursing Times 1997 93;46:34-7.

Stark C, Paterson B, Kidd B. Opportunity may be more important than profession in serial homicide. Br Med J 2001;322:993.

Wesseling C, Castillo L, Elinder C-G. Pesticide poisonings in Costa Rica. Scand J Work Environ Hlth 1993;19:227-35.

WHO (World Health Organization). Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, based on the recommendations of the Ninth Revision Conference, 1975. Geneva: WHO, 1977.

WHO (World Health Organization). Manual of the International Statistical Classification of Diseases and Related Health Problems, based on the recommendations of the International Conference for the Tenth Revision of the International Classification of Diseases, 1989. Vol. 1. Geneva: WHO, 1992.