Original papers

Patterns and problems of deliberate self-poisoning in the developing world

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Abstract

Deliberate self-harm is a major problem in the developing world, responsible for around 600 000 deaths in 1990. The toxicity of available poisons and paucity of medical services ensure that mortality from self-poisoning is far greater in the tropics than in the industrialized world. Few data are available on the poisons most commonly used for self-harm in different parts of the world. This paper reviews the literature on poisoning, to identify the important poisons used for self-harm in these regions. Pesticides are the most important poison throughout the tropics, being both common and associated with a high mortality rate. In some regions, particular pesticides have become the most popular method of self-harm, gaining a notoriety amongst both health-care workers and public. Self-poisoning with medicines such as benzodiazepines and antidepressants is common in urban areas, but associated with few deaths. The antimalarial chloroquine appears the most significant medicine, self-poisoning being common in both Africa and the Pacific region, and often fatal. Paracetamol (acetaminophen) is used in many countries but in few has it reached the popularity typical of the UK. Domestic and industrial chemicals are responsible for significant numbers of deaths and long-term disabilities world-wide. Self-poisoning with plant parts, although uncommon globally, is locally popular in some regions. Few of these poisons have specific antidotes. This emphasizes the importance of determining whether interventions aimed at reducing poison absorption actually produce a clinical benefit, reducing death and complication rates. Future research to improve medical management and find effective ways of reducing the incidence of self-harm, together with more widespread provision of interventions proven to be effective, could rapidly reduce the number of deaths from self-poisoning in the developing world.

Introduction

Self-harm has often been thought of as a problem particular to the industrialized world. Recent work has, however, begun to emphasize its importance in the developing world: the Global Burden of Disease study[1,2] reported that 593 000 people killed themselves in the developing world during 1990, 75% of the world-wide total of deaths from self-harm.[3]

A recent study demonstrated that 14% of all deaths amongst 10–50-year-old women in Bangladesh were due to poisoning, the majority following suicidal ingestion of pesticides.[4]

Pesticide poisoning from occupational, accidental and intentional exposure is a major developing world public health problem.[5] Millions of people

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are exposed to danger by hazardous occupational practices and unsafe storage.[6] However, it is deliberate self-poisoning that causes the great majority of deaths and the immense strain that pesticides put on hospital services, particularly in Asia.[7,8] In 1990, Jeyaratnam estimated that self-harm resulted in 2 million cases of poisoning each year with 200 000 deaths.[5] In contrast, accidental and occupational exposure were estimated to cause 1 million cases with 20 000 deaths. Many studies have shown that deliberate self-poisoning has a far higher mortality than accidental poisoning.[9–12]

Poisonings are common among young children as they explore their environment and put new objects into their mouth. In some series, children account for as many as 80% of poisoning cases presenting to hospital.[13] Nevertheless, little is normally swallowed and case series (for example references 14–16) show that the mortality rate amongst young children (<10 years old) is generally low in both developing and industrialized nations.

These studies and the World Bank's 1993 World Development Report[17] have repositioned mental health in the centre of international public health. The WHO's *1995 World Health Report* acknowledged that it had previously been afforded a low priority and called for greater attention to mental health.[18] This report coincided with the publication of a book reviewing the problems and priorities in mental health in low-income countries.[19] Together, these publications have generated a wave of interest in suicide in the tropics.[20]

It is clear from many studies that not all people who die following acts of self-harm actually wish to die.[21–24] Instead, the acts are used to express rage or hostility, or to gain revenge by causing distress to another person. In some cultures, this may be seen as the only means with which to express one's anger with someone (references 25,26 and J Marecek, personal communication). People who do want to kill themselves often do not succeed; in contrast, others with little or no suicidal intent die from their act.[27] Many factors affect the outcome, including the degree to which the poison's toxicity was understood, the speed with which the person comes to clinical attention, and the availability of effective medical treatment. It is often difficult to determine whether a person who died actually wished to do so. Therefore, throughout this article, the term 'deliberate self-poisoning' is preferred since it describes the act without presupposing its intention.[27]

Hanging, self-immolation and jumping from high buildings are common methods of self-harm in many Asian cultures and associated with high mortality. However, the toxicity of available poisons[7,28] and the paucity of medical services in the developing world ensure that the mortality rate for deliberate self-poisoning is also high, at 10–20% far higher than the 0.5–1% commonly found in industrialized countries.[29–31]

Reducing deaths from self-harm will require interventions to both reduce the incidence of harmful behaviour and to improve medical management of acute poisoning. As a first stage in this latter approach, this paper aims to identify the common poisons used in different regions of the world by reviewing the world-wide literature on poisoning. By identifying patterns of self-poisoning worldwide, it then becomes possible to identify problems that need to be addressed.

Methods

The Medline database was searched for papers reporting hospital-based surveys of poisoning admissions in the developing world for the years 1980–99. Categorization of countries into developing or industrialized worlds followed the 1993 World Development Report: countries were considered to be part of the developing world if they did not fall into the Established Market Economies (EME) or Former Socialist Economies of Europe (FSE) regions.[17]

It proved impossible to find developing world papers using MESH or keyword searches. Therefore, the title of every paper selected with the keywords *poisoning*, *suicide*, *overdose* and *intoxication* was scanned, and papers reporting self-poisoning selected. Further papers were identified by inspecting references cited in all studies. Regional medical journals not listed on Medline were handsearched at the BMA and London School of Hygiene and Tropical Medicine libraries. Experts associated with the WHO's INTOX project were approached for unpublished studies and hospital patient records handsearched in Sri Lanka and Zimbabwe.

Studies were considered suitable for inclusion in Tables 1–3* if they described a series of (i) patients admitted to hospital (Table 1*); (ii) phone calls to a poison centre (Table 2*), or (iii) postmortems. The description had to be sufficiently explicit to allow extraction of data for the tables; the most common reason to exclude a paper was the failure to describe the type of poisons used for overdose. Studies were restricted to the last 20 years to give a recent picture. However, studies from before 1980 were included if they were the only report for a particular region. Studies reporting case series of particular poisons, and not hospital surveys, are cited in the text rather than the tables.

Data on poisoning cases were extracted from relevant papers. Where possible, paediatric cases were excluded, as were cases of alcohol, recreational drug, and carbon monoxide poisoning. Where possible, intentional poisonings were identified in the original paper and presented alone. Otherwise, if this data could not be extracted, an indication of the percent of cases that were intentional is given in the tables. Data on adult cases alone are presented after analysis of the original paper. However, deliberate self-harm does not only occur in 'adults'.[32,33] In our own work in Anuradhapura and in many of the studies presented here (for example references 14, 34), intentional acts of self-harm were first noticed in children as young as 7 years old[35] and increased in frequency until, by the age of 16, children were harming themselves as often as any age group of adults. The death rate among these adolescents was often high. Unfortunately, these cases will have been excluded if the age range chosen in papers to separate data for adults and children was >16 (e.g. reference 34).

Results

Ninety-six hospital-based studies of acute poisonings from across the developing world were identified and are presented in Table 1*. Nine of these studies were ITU-based; two further studies presented only patients requiring resuscitation or unconscious patients. Five studies restricted themselves to pesticides or medicines, while two presented results of gastric contents screens. These 18 studies, plus three others from Karachi which present the same patients, were excluded from the overall analysis presented in Table 4. Sixteen studies from Poison Control Centres are presented in Table 2* and 28 poisoning autopsy series in Table 3*.

All three sets of studies reveal pesticides to be the most important poisons used for self-harm world-wide, with high incidence and fatality rate. Medicines and household products are also common and important causes of morbidity.

Pesticides

Agrochemical pesticides are a major public health problem throughout the developing world.[36–41] Many subsistence farming households have stocks of pesticides readily available for impulsive acts. Storage facilities (reference 42 and N. Abeysinghe, MSc thesis, University of Colombo, Sri Lanka) and knowledge of their toxicity are frequently poor.[9,28,41,43] However, where toxicity is well recognized, paradoxical increases in the rate of

poisoning have also occurred. For example, self-harm practices have grown up at various times around dimethoate in Zimbabwe (M. Eddleston, unpublished observations), paraquat in Trinidad[44] and Samoa,[45] malathion in Guyana,[46] and parathion in Thailand.[47]

Organophosphate (OP) pesticides were responsible for the majority of deaths in most series of self-poisoning cases, particularly those from rural areas (Table 1*). The reported fatality in hospital-based surveys was as high as 46%. Case series have also been reported from Brasil,[48] Chile,[49] China,[50–52] Costa Rica,[10] Ethiopia,[53] Guyana,[46] India,[54–60] Iran,[61] Israel,[62–64] Kenya,[43] South Africa,[65,66] Sri Lanka,[67] Taiwan,[68] Tunisia,[69] Turkey,[70] and Zimbabwe.[66,71]

Carbamates are less toxic than OP pesticides.[72,73] Series have been recorded in Israel,[74] Jordan,[75,76] and Brasil,[77] the majority occurring following ingestion of rodenticides. Dominicans living in the USA have been poisoned by aldicarb.[78] A series of seven deaths due to furathiocarb self-poisoning was reported from Korea.[79]

Poisoning with the organochlorines endosulfan and endrin has recently become an important cause of seizures in parts of South Asia.[80–83] They cause a status epilepticus that is normally unresponsive to standard treatment, requiring general anaesthesia. The pesticides are rapidly metabolized by the body and therefore, if the patient can be supported through the status epilepticus, prognosis is good with few residual complications.[84] Aldrin, dieldrin and lindane have been associated with few cases of self-harm.[85,86]

The dipyridyl pesticides paraquat and diquat are highly toxic, although safe after contact with soil. Paraquat has been reported to be a problem in many parts of the world, including Brasil,[87] the Caribbean,[44,88] Domenica,[89] Ecuador (Eddleston, Vargas; unpublished observations), Fiji,[90,91] Guadeloupe,[92,93] Korea,[94–96] Malaysia,[97–99] Mexico,[100] Nigeria,[101] Papua New Guinea,[102,103] Reunion,[104] Singapore,[105] Sri Lanka,[9] Surinam,[89,106,107] Taiwan,[34,108,109] Thailand,[110,111] and Western Samoa,[45,112–114] in addition to those studies listed in Tables 1–3*.

Aluminium phosphide is toxic after ingestion because contact with water in the stomach liberates phosphine gas.[115] It has recently become the commonest means of self-poisoning in northern India:[116] of 720 patients reported in four studies, 439 (61%) died.[117–120] A study from Chandigarh, India, showed that it is also a common means of self-harm amongst 11- to 15-year-old adolescents, with a mortality rate of 59%.[14] A small case series with zinc phosphide has been reported from Poona, India.[121] One of four symptomatic patients

Table 4 Summary table for patients reported in the hospital based poisoning surveys

Region/Poison	No. of studies	No. of patients	Percent of all poisonings	Death rate (range)
Sub-Saharan Africa	18	13 819	100	
Medicines		9970	72	0–14
Pesticides		1729	13	0–41
Chemicals		939	7	33–48
Traditional medicines		148	1	10–13
Plants		96	<1	NG
Others/Not detailed		937	7	NG
Middle Eastern Crescent	15	8614	100	
Medicines		5918	69	0–2
Pesticides		955	11	4–5
Chemicals		335	4	0–10
Others/Not detailed		1406	16	NG
India	6	3007	100	
Medicines		459	15	0
Pesticides		1777	59	36
Chemicals		413	14	0
Plants		51	<1	0
Others/Not detailed		307	10	NG
China	1	481	100	
Medicines		417	87	<1
Pesticides		42	9	7
Chemicals		18	4	0
Traditional medicines		4	<1	25
Others/Not detailed		0	NA	NA
Other Asia and islands	30	310 692	100	
Medicines		33 924	11	0–6
Pesticides		170 798	55	7–50
Chemicals		1271	<1	0–25
Traditional medicines		45	<1	NG
Plants		2222	<1	3–13
Others/Not detailed		102 432	33	NG
Latin America and Caribbean	6	2123	100	
Medicines		773	36	NG
Pesticides		575	27	NG
Chemicals		433	20	NG
Others/Not detailed		342	16	NG

Data from studies surveying poisoning admissions were grouped and analysed by region. Unfortunately, the large studies dominate these analyses. For example, chemicals are underrepresented in the Other Asia and Islands region since the two huge Sri Lankan studies of 295 000 patients only recorded cases of medicine and pesticide poisoning, listing chemical poisonings as 'other poisons'. Greater detail of the individual studies can be found in Table 1 with the on-line version of the journal at the Oxford University Press website.

died from myocarditis; the other three showed marked hepatic toxicity but recovered.

Thallium-containing rodenticides were banned in the USA during the 1960s after many reports of accidental poisoning. However, they are still used in some tropical countries and accidental poisonings are common.[122,123] Poisoning results in abdominal pain, vomiting and diarrhoea, severe limb pain due to neuropathy, mental lethargy, ataxia and alopecia;[124,125] severe intoxication results in convulsions and coma. Deliberate self-poisoning with thallium has been reported from Mexico[126] and Thailand.[127] The Mexican series was of 50 patients seen over 9 years in one hospital; 21 were deliberate. All but two of the 50 made a complete recovery; one elderly woman died from

pneumonia while a 46-year-old man was left with bilateral optical atrophy.

Propanil is an aromatic anilide herbicide used for rice farming that produces methaemoglobinaemia if ingested.[128] High levels are fatal unless treated with methylene blue. Self-poisoning cases have been reported from Sri Lanka[128]; it is currently a significant problem in Kurunegala and Anuradhapura Districts.

Two case series from Taiwan have described 181 patients with glyphosate-surfactant herbicide concentrate ('Round-up') poisoning, more than 90% due to self-poisoning.[129,130] The commonest effect was gastrointestinal tract irritation; severe cases showed cardiogenic shock, respiratory and renal failure, and metabolic acidosis. Eighteen patients died.

As for other pesticides, the compounds abamectin and ivermectin (both avermectins) are used for the control of parasite infections in crops and cattle. Out of 19 patients reported to a Taiwanese poison control centre between 1993–97,[131] seven showed marked toxicity with coma, respiratory failure, and hypotension. One patient died. Fourteen cases (six severe) were due to self-poisoning. Pyrethrins are less toxic than other pesticides; a few cases of self-poisoning have been reported from Sri Lanka (Table 1*) and India.[132] Five cases of intentional poisoning with imazapyr have been reported from Taiwan.[133] Long-acting 'superwarfarin' compounds such as brodifacoum cause long-term coagulopathies and have been used for self-poisoning in Hong Kong.[134,135]

Medicines

Medicines are used throughout the developing world's cities for self-harm; outside of the cities they are relatively uncommon, their prominence being displaced by pesticides. In general, they cause few deaths, particularly when compared to pesticides. However, chloroquine is an important and common exception to this rule.

CNS-acting drugs are the commonest medicines used for self-harm throughout the developing world's cities. While there are few case series of antiepileptics, benzodiazepines or antidepressants,[136,137] barbiturates were an extremely common means of self-poisoning during the 1970s, and large series exist from this time.[48,138–141]

Of the analgesic drugs, paracetamol (acetaminophen) is a common poison in some regions of the developing world. Cases have been reported from Bahrain,[142] Chile,[143] Hong Kong,[144–147] Kuwait,[148] Israel,[149,150] Malaysia,[151] Singapore,[152,153] South Africa,[154,155] and Taiwan.[156] Only rarely, however, did its incidence approximate the situation in the

UK. Salicylates have been reported as common causes of childhood poisoning (e.g. references 157 and 158) but in many of the urban series were less common means of self-harm than either barbiturates or benzodiazepines.

Chloroquine causes vasodilatation and myocardial depression that may present with convulsions and respiratory or cardiac arrest.[159] It is a common and dangerous toxin[160–162] used for self-poisoning in parts of Africa,[163–171] Asia,[172] and Pacific.[173–177] Its popularity blossomed in Cote d'Ivoire during the 1970s, with the 36 cases reported in Abidjan and Cocody during 1970 increasing to 241 in 1974.

Quinine is an antimalarial drug that causes cinchonism (tinnitus, deafness, nausea and vomiting) in overdose. Severe poisoning results in cardiac arrhythmias, myocardial depression, and/or blindness.[178,179] It is a well-recognized self-harm poison in Europe.[178,179] Reports from the tropics have been few but include cases in Casablanca during the 1960s[180] and Thailand in the 1970s (D.A. Warrell, personal communication).

Dapsone is used throughout the tropics for the treatment of leprosy. Acute poisoning causes deep cyanosis due to the formation of methaemoglobinaemia, and neurological complications such as reduced consciousness and convulsions. There have been no large case series reporting its use for self-harm, although it is a common cause of accidental poisoning in children in India.[181] One review reported 32 adult cases published world-wide between 1950 and 1993,[182] mostly published as single case reports. A few cases were of deliberate self-poisoning.

As regards other medicines, there have been several reports of self-poisoning with the anti-TB drug isoniazid,[183,184] although it does not appear to be a major problem in any region. Anticonvulsants were reported from many urban areas but were of less importance than other medicines.

Herbal or traditional medicines

African traditional medicines are mostly of plant origin but may incorporate mineral or animal products.[13] Examples include extract of the cantharadin beetle (which can be gastrotoxic and nephrotoxic) and the *Jatropha curcas* plant which produces watery diarrhoea and dehydration.[185] Traditional medicines are a common cause of accidental poisoning[186] but a rare cause of intentional self-poisoning. In northern South Africa, a study of 1306 poisoning cases found that traditional medicines accounted for 16% of admissions but 52% of deaths, with a mortality rate of 15%.[13] None were due to deliberate self-harm; however, 50% of cases and deaths in this study were in children <10

years. A study of several hundred admissions in Zimbabwe demonstrated a 13% mortality rate.[187]

Chinese medications of various forms have been reported to be commonly used for self-poisoning in Hong Kong and Taiwan.[188–191]

Margosa oil is an extract of the neem tree (*Azadirachta indica*) that is widely used by Indians as a traditional medicine. Small amounts are often given orally to children, sometimes producing a toxic encephalopathy similar to Reye's syndrome.[192] Intentional poisoning has been reported from Tamil Nadu, India.[193]

Bird lime thistle is reported to be used for suicide in north Africa.[194] An extract of this plant (*Atractylis gummifera*) is sold in local markets as a medicine for blanching the teeth and inducing abortion.

Household products

There have been few series looking at domestic chemicals, but within some African and Asian communities they are a major problem (see Table 1). Household products include kerosene oil used for lighting, cleaning agents such as Dettol (chloroxylenol) and bleach, and strong acids such as sulphuric acid used for drain clearing.

One study reported 1192 cases from six major Zimbabwe hospitals over 10 years.[195] The majority (61%) were accidents in children under the age of 6 years; self-harm accounted for only 19%. Kerosene oil was by far the most common agent (68%), followed by rodenticides, bleach and NaOH-containing oven cleaner. There were at least 138 deaths from self-harm using these products.

A different picture has been reported from Hong Kong. A study of 187 adult patients presenting to hospital in the New Territories showed that 95% of patients took these products (mostly 'Dettol' or cleaning products) with the intention of harming themselves.[196] Deaths were associated with aspiration of Dettol or detergent in two patients, and the ingestion of sulphuric acid in another. Severe poisoning with Savlon (cetrimide) was also associated with aspiration.[197] Another study from Hong Kong showed that nearly 50% of adolescents used dettol, detergent or shampoo.[198]

In large quantities, dettol may cause coma and cardiorespiratory depression;[199,200] renal impairment and GI tract damage are uncommon complications.[201,202] The commonest serious complication is pneumonia due to aspiration of dettol directly or following gastric lavage without adequate protection of the airway,[200,203,204] Delayed upper-airway obstruction requiring nasotracheal intubation has also been reported.[205]

'Rubigne' is a domestic cleaning agent that contains hydrofluoric acid and ammonium difluoride.[206] It is a common household agent in Cayenne and Guyana; 23 cases of self-poisoning presented to hospital in Cayenne between 1979 and 1981, with a 21% mortality rate.[206]

Kerosene and paraffin oils are common household energy sources throughout the developing world. Often kept in unsafe non-child-proof containers, these oils are a major problem with accidental poisoning among young children (e.g. references 207 and 208) and to a lesser extent, self-poisoning by adults. Complications and deaths result from their aspiration; management is symptomatic with preservation of the airway in unconscious patients.

Cosmetics were rarely reported. However, case series from Khartoum[209,210] and Casablanca[211] have reported 46 cases of hair dye (paraphenylenediamine) poisoning. The majority were deliberate and resulted in 12 deaths. The immediate results were marked facial and neck oedema and decreased consciousness; the high risk of asphyxia had to be managed by tracheotomy. Renal and liver failure occurred in severe cases. Paraphenylenediamine poisoning was the number one cause of poisoning in Morocco during the 1990s;[212] a single case of intentional poisoning has been reported from India.[213]

Traditional hair remover (*darou* or *nezafat*) containing arsenic sulphide and calcium oxide has recently become a popular and dangerous method of self-poisoning in Tehran after a well publicized suicide (M. Balali-Mood, personal communication). Barium sulphide is another chemical used for removing hair in India that has been used for self-harm.[214]

Of other substances, potassium permanganate is a common household disinfectant that has been used for self-harm in Hong Kong[215,216] with fatal hepatorenal complications. Yellow phosphorus is used in Ecuador for the manufacture of cheap fireworks; at the time of street celebrations, such as Easter, self-poisoning with this chemical becomes common (reference 217 and M. Brito, personal communication). Self-poisoning with cresol has been reported from Taiwan.[218]

Corrosives

Corrosive chemicals are used widely in industry and the home. They cause intense damage to the pharynx, oesophagus and stomach, often producing perforations. As a result, gastric lavage and activated charcoal are contraindicated. Patients die from peritonitis or mediastinitis, or from pulmonary

complications such as fistula formation and pneumonia.

This type of poisoning is quite unlike other forms of acute poisoning. Pesticides and medicines present with an acute crisis—if survived, the patients will have few complications. In contrast, survivors of acute corrosive poisoning often require extensive surgical follow-up for their GI complications.[219,220] In a series of 110 cases from Sri Lanka,[221] 14% of patients required complicated bowel replacement surgery; all other patients required regular bouginage, initially at weekly, then at longer intervals over many months. Four patients died during the acute poisoning episode, four as a result of complications of bouginage, and three at surgery.[221]

Self-poisoning with hydrochloric and sulphuric acids is a major problem in Taiwan. 274 patients (>75% self-poisoning; >50% HCl) presenting to two hospitals between 1983 and 1993 had a 12% fatality rate.[222,223] Fourteen patients, severely ill on admission, were treated conservatively and died; of the 27 who went to theatre, 19 died. Three hundred and twenty-five patients presented to a third hospital between 1976 and 1991 with five operative deaths out of 28.[224] However, this paper did not make clear how many patients were too ill to go to theatre and were treated with conservative therapy.

A fourth Taiwanese group has reported their results with 75 patients treated for caustic oesophageal strictures or post-caustic resection over 15 years.[225] Most (52 patients) had taken HCl; all adults (62 patients) had taken the corrosive intentionally. 87% of operations were done as an elective procedure; there were no deaths and the outcome after these complicated procedures was described as 'good' in 90% of cases.

A large series of 163 patients with mostly intentional HCl poisoning has been reported from Morocco.[226] Two died on arrival while three of four taken to theatre died. Two other papers have reported smaller series from Tunisia and Morocco.[227,228]

'Rubber acids' are the two acids used in rubber manufacture—formic and acetic acids. Self-poisoning is a problem in regions surrounding rubber plantations. Case series have been reported from India[229] and Sri Lanka.[221] Of the 53 cases of formic acid poisoning presenting to Trivandrum hospital between 1980 and 1982, 98% were intentional and 15 patients died.[229]

Vinegar is made from concentrated acetic acid. Before sale of the concentrated acid was banned by the government in 1980, it was an important and dangerous means of self-poisoning in Surinam.[89,230] Acetic acid poisoning was also common in Curacao during the 1970s—one group reported 112 cases in four years.[231]

Car battery acid poisoning was reported in a case series from Cape Town with 27 adults presenting to hospital over 3 years;[232] 25 cases were intentional. The acid spared the oropharynx but burnt the oesophagus, stomach, and duodenum, necessitating surgical repair in four cases.[233] The majority of patients stated that they used car battery acid because it was readily available in car batteries used as a power source in their unelectrified houses, and also because they were aware of its destructive effects.[232] Fatal cases have also been reported from Nigeria[234] and Trinidad.[235]

A large series of domestic chemical patients has been reported from Malaysia of whom the majority had taken NaOH.[236] Again complicated bowel replacement procedures were required after patient resuscitation. Ten died acutely, 11 required replacement surgery; all other patients received regular bouginage. Sodium hydroxide was the commonest means of suicide in South Korea during the 1930s and 60s;[237] however, it has now been almost completely replaced by other means, in particular potassium cyanide.[238]

Industrial chemicals

Copper sulphate has long been used for self-harm in South Asia,[140,239–243] although its popularity has fallen since the 1960s and 70s (references 244, 245 and S. Perera, personal communication) and it is now seen rarely in much of South Asia. Unfortunately, it has recently became popular again in the Rajshahi region of southern Bangladesh, where 123 cases were seen over six years.[246] Thirty-one patients died from hepatorenal failure, haemolysis, and GI haemorrhage.

An autopsy case series from Seoul covering 1980–84 reported 121 cases of suicidal potassium cyanide ingestion, 62% of all suicides from poisoning.[238] This was reported to be a recent phenomenon, since no cases were reported in either the 1930s or 1960s, the majority of cases in those years being due to sodium hydroxide ingestion.[237] Further reports of cyanide self-poisoning have been reported from Taiwan[247] and India.[248]

Other chemicals that have been used for self-poisoning include turpentine,[249] chromic acid,[250] and ethylene bromide[251–253] in India, sodium chlorite,[254] ferric chloride[255] and methylene chloride[256] in Taiwan, and xylene in Jordan.[257] A paper from Zimbabwe reported a series of 40 patients with acute heavy metal poisoning, mostly via industrial exposure.[258] There were nine cases of deliberate self-poisoning, with arsenic and cyanide, and six deaths (four arsenic, two cyanide).

Plants

Poisonous plants have been used for centuries for homicide, suicide and inducing abortion.[259–264] However, they appear to be used in few localities for self-poisoning now. Some have become locally popular methods for self-harm, but none compare with the remarkable epidemic of yellow oleander seed poisoning currently occurring in Sri Lanka.[265]

The sap of the yellow oleander (*Thevetia peruviana*) contains multiple cardiac glycosides. Although widespread in the tropics, it is only a major self-harm problem in South Asia. Medico-legal texts indicate that its seeds and leaves have been used in India, particularly the south, for abortions, homicide, and suicide throughout the 20th century.[259,260] However, the practice of intentionally ingesting its seeds has recently appeared in Sri Lanka with thousands of cases now occurring each year.[265] Severe intoxications result in cardiac arrhythmias and fatal cardiac shock; anti-digoxin antibodies are effective in treating intoxication.[266,267]

Although used for self-harm in the USA, no cases of poisoning have been reported from the tropics with the related common or pink oleander (*Nerium oleander*). *Digitalis purpurea* is used for self-harm in Zaire (J. Dinsmore, personal communication).

Ingestion of oduvan (*Clistanthus collinus*) leaf preparations is a common self-harm practice in Tamil Nadu, India.[268,269] Over 500 cases were recorded at the Forensic Sciences Dept, Tamil Nadu, between 1976 and 1984.[270] The plant contains the glycosides cleistanthin A and B[271] which produce marked hypokalaemia and cardiac arrhythmias;[268,272] deaths result from sudden cardiac arrest, and in a series of 32 patients, nine died.[268] In this case series, ingesting the extract of boiled leaves was associated with significantly higher mortality compared to ingesting fresh leaves.

Both intentional and accidental poisoning with the Superb lily (*Gloriosa superba*) have been reported from South Asia and Africa.[273–276] Its tubers contain multiple alkaloids, including colchicine, which cause persistent diarrhoea and vomiting, dehydration, and shock with profound hypotension. In a Sri Lankan series of six patients, all died.[277] There is no specific antidote in use; however, anti-colchicine antibodies[278] will probably be effective if they become affordable. A few cases of colchicine medicine self-poisoning have been reported from the tropics.[279,280]

Accidental and homicidal poisoning with alkaloid-containing thorn apple fruits (*Datura stramonium*)[281] have been reported from the tropics.[180,282,283] It appears to be a very rare means of self-poisoning (one case report from the West[284]).

World-wide, a number of cultures use plant preparations to stun or kill fish so that they can easily be picked out of the river. These preparations are also used for self-poisoning. Examples include the rotenone-containing derris root of Papua New Guinea[285] and Thailand,[47] and an unidentified plant used by the Achuar of the Ecuadorean Amazon (D. Holmes, personal communication).

Discussion

Poisoning is a common form of deliberate self-harm in the developing world. While suicidal intent is often far lower than for self-immolation and hanging, the mortality rate is high due to the toxicity of the poisons used and poor medical care.

Limitations to this study

The data presented above are very patchy. I have been unable to find studies for many countries, in particular those of South America and Africa. Few countries have more than one study, resulting in a picture of the situation in only one place at one time. Since trends in self-poisoning change over time and differ between regions, these snapshots may not be representative of the current problems.

Some papers presented few details of the patients, making it difficult to extract data on mortality and the percentage of admissions where poisoning was intentional. There is great scope for further epidemiological studies of self-poisoning from across the developing world to identify poisons that are of local importance.

There have been many large case series of poisoning with various pesticides, probably reflecting their importance. We do not have the same amount of information for the majority of other poisons. For example, although many plants are said to be used for self-harm, very little has been published and large case series have only been reported for yellow oleander.

Common poisons

Bearing these caveats in mind, the data presented above indicate that organophosphate pesticides are the predominant problem world-wide, being responsible for many cases of self-poisoning and the majority of deaths. Other pesticides such as aluminium phosphide, paraquat and organochlorines are important in specific localities. Pesticides, as would be expected, are particular problems in rural areas where they are freely available.

The mortality rate in urban areas, where pesticides are relatively uncommon, tends to be lower.

Here medications are the most commonly used. Fortunately, the majority of these poisons are less toxic than pesticides, although deaths still occur with barbiturates and benzodiazepines. Paracetamol is a significant problem in relatively few regions of the developing world. Traditional medicines appear to be an important cause of accidental but not intentional poisoning.

The most dangerous medicine in the developing world is chloroquine. It is highly toxic and a problem in many parts of Africa and the Pacific. Recent studies from France and West Africa suggest that diazepam and adrenaline may be effective antidotes, however, it is not clear whether they are used in clinical practice world-wide. The importance of chloroquine in a post-mortem case series from Mutare, Zimbabwe, compared with its low toxicity in a series of hospital cases (see Tables 1 and 3*; M. Eddleston, unpublished) suggests that it may kill quickly, before the patient gets to hospital.

There have been relatively few studies looking at the use of household and industrial chemicals; most have been surgical case series. Deaths appear to be rare with the majority of household chemicals and often due to ill-advised gastric lavage without protection of the airway. However, caustic acids and alkalis cause severe damage to the GI tract, requiring complex surgery and causing death in around 10% of cases. The frequency of potassium cyanide in a suicide autopsy series from Seoul, and its absence from a self-poisoning series appears to confirm this compound's extreme lethality.

In some regions, plants parts are consumed in acts of self-harm. Antidotes are rarely available, although polyclonal antibodies raised against cardiac glycosides and colchicine, if available, would probably be effective for many types.

Possible interventions

Reducing deaths from self-poisoning will require multiple approaches.

Banning common poisons, such as particular pesticides,[7,286,287] may be effective in particular regions. However, it is difficult to predict the long-term outcome, since the picture is never constant and new poisons become popular, replacing others.[8,245,265,288] Long-term improvements will come from reducing the incidence of harmful behaviour and improving medical management. In addition, adoption of the integrated pest management scheme with its reduced use of agrochemicals and long term environmental damage[289,290] can only be beneficial and should be encouraged. Similarly, improved storage of pesticides and medicines[291] together with the requirement for a 'prescription' for both medicines and pesticides may reduce the incidence of poisoning.

Hospital-based interventions after admission for self-harm have become popular in an attempt to reduce repetition. However, two recent meta-analyses and a review of these interventions concluded that there was insufficient evidence to recommend a specific intervention with which to reduce further harmful behaviour.[292–294] Improved mental health care, particularly at the community level, must be an important part of any strategy to reduce self-harm.[17,286,295]

Approaches to primary prevention may include increasing peoples' skill in coping with problems—perhaps offering coping skill classes at school and counselling in the community.[296] An attempt in Sri Lanka during 1997 to study the effects of a community based intervention did reduce the incidence of harmful behaviour, but this was felt to be due simply to increased attention and likely not to be sustained if the workers left (J. Marecek, personal communication).

Lastly, a sustained attempt to improve management and reduce the appallingly high death rates associated with self-poisoning should have both immediate and long term benefits.[297] The WHO's IPCS/INTOX project has successfully promoted the development of high-quality poison information services in the developing world. However, in parts of Asia, it is not poisons information in the Western sense that is required. Physicians in rural areas see hundreds of cases of OP or aluminium phosphide poisoning and are extremely familiar with the problem. It is the lack of evidence-based guidelines to aid management that is important, together with a lack of resources—drugs, ITU, and staff.

The management of the forms of poisoning seen in the tropics is not well developed, with few specific antidotes and few evidence-based protocols. For example, the efficacy of immunosuppression in paraquat-induced lung fibrosis has never been properly assessed. In addition, the recent recommendations for OP poisoning are based on theoretical studies, not on clinical trials. Since the developing world has little money to waste, the efficacy of interventions has to be proven to their satisfaction before they can be incorporated into clinical practice. It is, for example, this lack of evidence that prevents the more widespread use of pralidoxime in Asia.

Attitudes amongst physicians faced with severely poisoned patients are often of hopelessness, and sometimes simple delusion—one consultant physician in Zimbabwe confidently told me that no patients had died from OP poisoning during his 15 years at the hospital. This contrasted strongly with a simple review of case notes which revealed

9 deaths in the previous 16 months and a case mortality of around 50%.

Hardly any of the poisons listed in the tables have specific antidotes. This emphasizes the importance of establishing whether cheap non-specific therapies such as multiple-dose activated charcoal regimens[298] save lives. The debate surrounding the efficacy of activated charcoal has raged for decades with little change[299–302]—we are still desperately short of high-quality clinical trials. Until they are designed and run, we will be forced to rely on the current European and American consensus that activated charcoal cannot be recommended due to a complete lack of evidence for its efficacy.[303]

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*The supporting tabular material is available with the on-line version of the Journal at the Oxford University Press website.

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