Malangu Afr J Tradit Complement Altern Med. (2014) 11(2):425-438
http://dx.doi.org/10.4314/ajtcam.v11i2.29

CONTRIBUTION OF PLANTS AND TRADITIONAL MEDICINES TO THE DISPARITIES AND SIMILARITIES IN ACUTE POISONING INCIDENTS IN BOTSWANA, SOUTH AFRICA AND UGANDA

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Abstract

Background: Acute poisoning incidents are one of the leading causes of morbidity and hospitalization in several countries. The purpose of this analysis was to compare the patterns of acute poisoning in three countries namely, Botswana, South Africa and Uganda; and examine the similarities and disparities in the patterns of occurrence of acute poisoning based on the sociodemographic factors of the victims, the toxic agents involved, the circumstances surrounding the incidents and their outcomes.
Materials and methods: This paper is based on the re-analysis of data that were collected from January to June 2005 by some Master of Public Health students using a similar data collection tool. A single dataset made of the original individual datasheets was constituted and analysed.
Results: Overall, it was found that the mean age of victims of acute poisoning was 20.9 ± 14.5 years; the youngest victim was a 3 months old boy from South Africa; and the oldest was a 75 years old man from Uganda. In descending order, the most common toxic agents involved in poisoning incidents were household products (46.1%), agrochemicals (18.8%), pharmaceuticals (14.0%), animal and insect bites (13.0%), food poisoning (4.5%), as well as plants and traditional medicines (3.6%). Across the three countries, acute poisoning occurred mainly by accident, but the contextual factors of each country led to a pattern of acute poisoning that showed some similarities with regard to the distribution of deliberate self-poisoning among females, teenagers, and young adult victims. There were disparities related to the differential access to toxic agents, based on the age and gender of the victims. Of the 17 deaths reported, 2 (11.7%) were due to traditional medicines; household products were implicated in fatal outcomes in all three countries, though the extent of their involvement varied from country to country.
Conclusion: Although plant and traditional medicines caused fewer cases of acute poisoning incidents, they contributed considerably to fatal outcomes.

Keywords: acute poisoning, disparity, similarity, Africa

Introduction

Acute poisoning incidents are one of the leading causes of morbidity and hospitalization in several countries. It is reported that these incidents may be accidental or deliberate. Accidental poisoning may result from error in judgment, carelessness, negligence, or an unexpected situation in the home, or at workplace as in the case of intoxication due to treatment, referred to as 'iatrogenic intoxication" (Hermanns-Clausen et al., 2009; Dart et al., 2009). In deliberate poisoning, the victim is intoxicated on purpose, either by their own doing, this is called "deliberate self-poisoning", it may be para-suicide or suicide; or at own request, as in euthanasia, or by being the unwitting victim of intoxication orchestrated with criminal intent (Uges, 2001; Trestrail, 2007).

With regard to acute poisoning due to plants and traditional medicines, they have been reported as major causes of hospital admissions in some African countries including Nigeria, South Africa, and Zimbabwe (Akang et al., 1994; Foukaridis et al., 1994; Kasilo and Nhachi, 1992; Eddleston, 2000). A retrospective study describing the pattern of hospital admissions due to poisoning in Zimbabwe reported that traditional medicines were responsible for 22.9% of cases of acute poisoning. Poisoning from plants is due to their toxic constituents, mainly alkaloids, but also taxanes, glucosides, saponins, flavonoids and other compounds. Historically plants containing alkaloids such as aconitine, strychnine and other toxic substances have been used in criminal poisoning (Trestrail, 2007). In Asia, cases of deliberate ingestion of yellow oleander seeds (*Thevetia peruviana*), known as "lucky nuts," had been reported in Sri Lanka, where this plant is frequently used for self-poisoning, with a case fatality rate of between 5% and 10% among untreated patients (Eddleston, 2000). In other settings, accidental plant poisoning incidents have been reported after people consumed teas brewed from plant parts or after consuming leaves, flowers, or seeds from toxic plants (Meda et al., 1999; Joskow et al., 2006).

Whether accidental or deliberate, acute poisoning elicits varied levels of severity. Multiple factors interact to influence the occurrence and severity of the resulting poisoning incidents. The purpose of this analysis was to compare the patterns of acute poisoning in three countries namely, Botswana, South Africa and Uganda; and examine the similarities and disparities in the patterns of occurrence of acute poisoning based on the sociodemographic factors of the victims, the toxic agents involved, the circumstances surrounding the incidents and their outcomes. By delineating the influence of plants and traditional medicines, it is hoped that a clearer understanding of contributing factors could be used for designing relevant interventions to minimize its prevalence and negative impacts.

Methods

This paper is based on the re-analysis of data that were collected from January to June 2005 by some Master of Public Health students using a similar data collection tool. A single dataset made of the original individual datasheets was constituted and analysed. Based on the pattern of acute poisoning, four pre-defined age groups were coded as follows: 0-12 years, 13-19 years, 20 to 30 years, and over 30 years. Similarly, toxic agents were coded in six groups: household products, pharmaceuticals, agrichemicals, plants and traditional medicines, food poisoning, animal and insect bites.

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The household products group included all unspecified toxic agents and diverse products likely to be found in the house such as paraffin, cleaning agents, soaps and other products. Pharmaceutical products included primarily identified medicines such as paracetamol, unspecified medicines overdoses and few cases of named drugs of abuse such as cocaine and marijuana. Plants and traditional medicines were grouped together since they were few cases of each group, and it is known that most traditional medicines are made of plants or herbs. Animal and insects bites constituted a group usually referred to as "natural toxins". It included snake, dog, and human bites for animals; as well as bee, spider and scorpion stings for insects. The gender of victims was dichotomised into "female" and" male"; while circumstances of the incidents were categorised as "accidental" or "deliberate"; and outcomes as 'died" or "survived".

Categorical data were analysed and summarised as percentages and proportions. For numerical data, descriptive statistics were calculated, namely, the mean, median and standard deviation. The case fatality was defined as the proportion of deaths over the number of people poisoned (Dean et al., 2010). The Pearson Chi-square test and the Fisher's Exact Test were used to estimate *P* values for differences between groups, based on whether the counts on any cell was more or less than 5. The *P* values of less than 0.05 were considered as statistically significant (Altman, 1999). Ethical approval for the conduct of the original studies was obtained from the Ethics Committee of the University of Limpopo (Medunsa-Campus).

Results

Age of victims of acute poisoning

Overall, the mean age of victims of acute poisoning was 20.9 ± 14.5years; the youngest victim was a 3 months old boy from South Africa; and the oldest was a 75 years old man from Uganda.

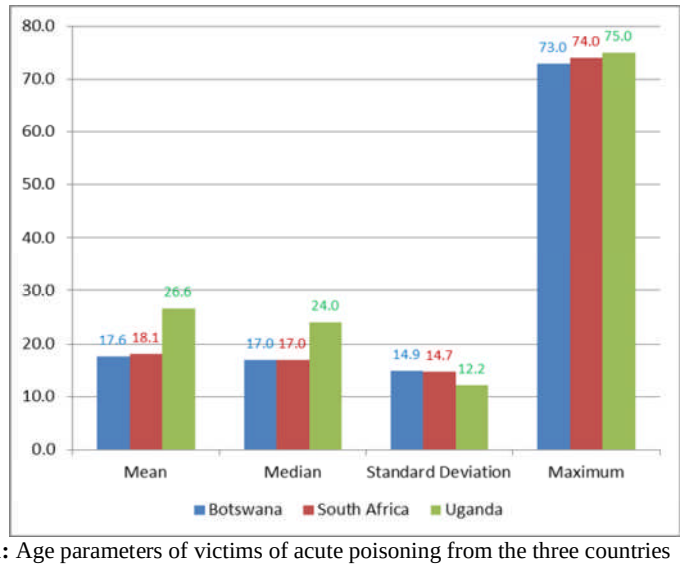

Figure 1: Age parameters of victims of acute poisoning from the three countries

While the maximum age of the victims was similar in the three countries, the mean and median ages were similar in Botswana and South Africa; the values of these parameters were much higher in Uganda (Figure 1). The frequencies of acute poisoning in relation to the age category of the victims are shown in Figure 2.

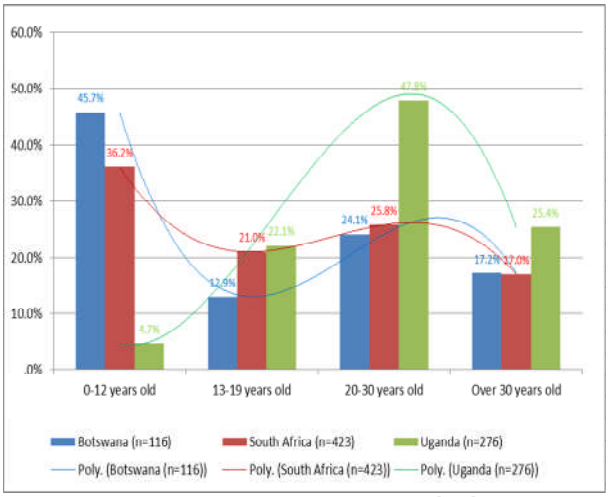

Figure 2: Acute poisoning per age category in the three countries

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In Botswana and South Africa, about 60% of acute poisoning incidents occurred patients younger than 20 years old, while in Uganda, over 70% of cases were among those older than 20 years old.

Distribution by gender

Acute poisoning was distributed differently across the three countries with regard to gender (Figure 3). In Botswana male and female victims were affected equally; in South Africa, female patients were significantly more affected than males; meanwhile in Uganda, males were significantly more affected than females (p=0.001).

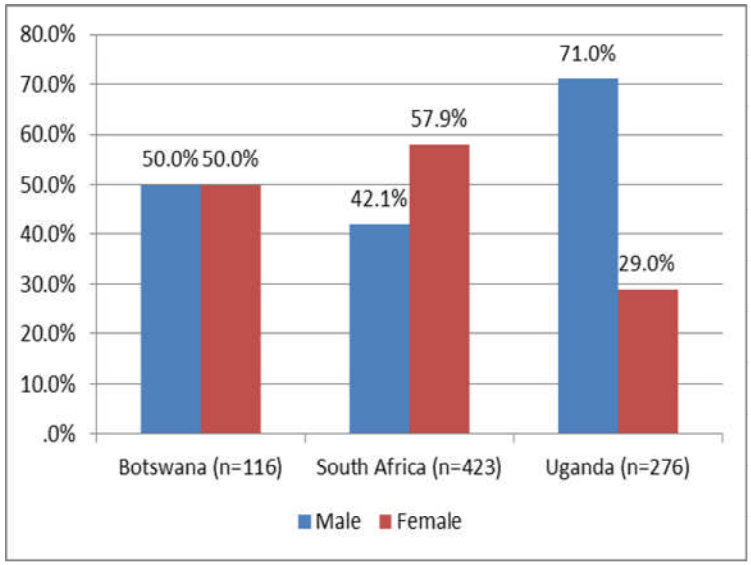

Figure 3: Acute poisoning per gender in the three countries

Age category and gender characteristics

Based on age category and gender of the victims, there were differences within each country and across the three countries as shown below (Table 1). In Uganda, male patients constituted the majority of victims in all age categories. In South Africa, female patients were the most affected from teenage period to adulthood; but, in children younger than 12 years old, South African boys were most affected than their female counterparts. In contrast, in Botswana, the proportions of acute poisoning shifted in each age category; there was similar distribution in boys and girls younger than 12 years, but females were significantly more victims than males during teenage period (p=0.01), while males were the most significantly affected in adults aged over 30 years (p=0.01).

Table 1: Acute poisoning per age category and gender

Country	Gender	Age category			
		0-12 years old	13-19 years old	20-30 years old	over 30 years old
Botswana (n=116)	Male	49.1%	20.0%	53.6%	**70.0%**
	Female	50.9%	**80.0%**	46.4%	30.0%
	Total	100.0%	100.0%	100.0%	100.0%
South Africa (n=423)	Male	55.6%	25.8%	38.5%	38.9%
	Female	44.4%	**74.2%**	**61.5%**	**61.1%**
	Total	100.0%	100.0%	100.0%	100.0%
Uganda (n=276)	Male	**61.5%**	**60.7%**	**75.0%**	**74.3%**
	Female	38.5%	39.3%	25.0%	25.7%
	Total	100.0%	100.0%	100.0%	100.0%

Racial characteristics of victims of acute poisoning

Although data from Botswana and Uganda did not report cases of acute poisoning in other racial groupings, data from South Africa showed that though the majority of victims were black Africans, 7.8% and 0.9% were respectively Caucasians and Asians. Of the 33 Caucasian victims, 57.5% were females.

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Circumstances of acute poisoning

Exposure to poisonous products occurred mainly through ingestion, but some occurred through dermal contact or transdermal route, and few through inhalation. Transdermal exposure occurred in cases of animals such as snake envenomation or insects bites; while inhalation occurred in case of carbon monoxide poisoning. Acute poisoning occurred either accidentally or deliberately as shown below (Figure 4).

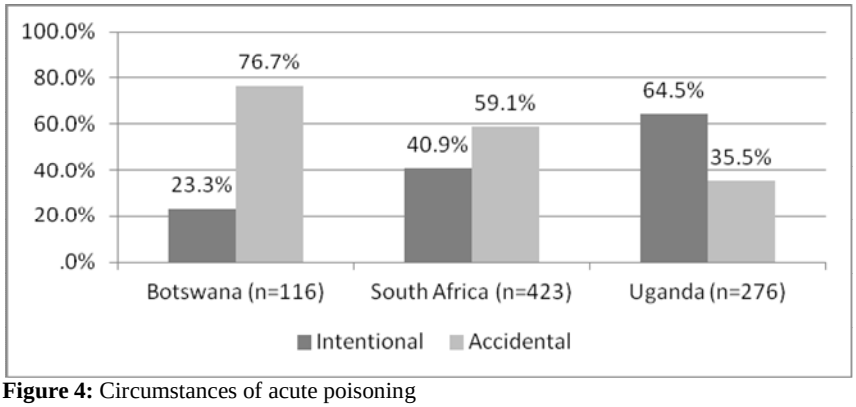

Figure 4: Circumstances of acute poisoning

In Botswana and South Africa, the majority of incidents occurred accidentally, being respectively 76.7% and 59.1%. In Uganda, 64.5% of poisoning cases were deliberate or deliberate self-poisoning (DSP). Nevertheless, the above distribution varied with age and gender.
With regard to age, as shown in Table 2, all incidents of acute poisoning in children younger than 12 years old in Botswana were accidental. In contrast, in South Africa and Uganda, lesser proportions of these incidents (5.9% and 7.7% respectively) were deliberate.

Table 2: Circumstances of acute poisoning per age category

Country	Circumstances	Age category			
		0-12 years old	13-19 years old	20-30 years old	over 30 years old
Botswana (n=116)	Intentional		46.7%	53.6%	25.0%
	Accidental	100.0%	53.3%	46.4%	**75.0%**
	Total	100.0%	100.0%	100.0%	100.0%
South Africa (n=423)	Intentional	5.9%	**62.9%**	**63.3%**	**54.2%**
	Accidental	94.1%	37.1%	36.7%	45.8%
	Total	100.0%	100.0%	100.0%	100.0%
Uganda (n=276)	Intentional	7.7%	**67.2%**	**71.2%**	**60.0%**
	Accidental	92.3%	32.8%	28.8%	40.0%
	Total	100.0%	100.0%	100.0%	100.0%

A similarity across the three countries about the circumstances of the poisoning incidents was that in young adults aged 20 to 30 years old, over 50% of incidents were significantly deliberate self-poisoning particularly in South Africa and Uganda ($P<0.05$). With regard to gender, deliberate self-poisoning was significantly higher in females than males in Botswana and South Africa ($p<0.05$), but in Uganda males were significantly more victims of intentional poisoning than females ($p<0.01$) as shown in Table 3.

Table 3: Circumstances of acute poisoning by gender

Country	Gender	Gender	
		Male	Female
Botswana (n=116)	Intentional	13.8%	**32.8%**
	Accidental	86.2%	67.2%
	Total	100.0%	100.0%
South Africa (n=423)	Intentional	30.9%	**48.2%**
	Accidental	69.1%	51.8%
	Total	100.0%	100.0%
Uganda (n=276)	Intentional	64.8%	63.8%
	Accidental	35.2%	36.3%
	Total	100.0%	100.0%

Across the three countries, female victims committed more deliberate self-poisoning than males among teenagers, particularly in South Africa and Uganda where the difference was statistically significant ($p<0.05$).
On the contrary, across the three countries, young adult male victims committed significantly more deliberate self-poisoning than their female counterparts ($p<0.05$). Yet, among adults over 30 years old, there was a disparity across the countries: in contrast to South Africa, female victims committed significantly more deliberate self-poisoning than males in Botswana; while in Uganda, the difference was not statistically significant although more males than females committed deliberate self-poisoning.

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Table 4: Deliberate self-poisoning per age category and gender

Age category	Botswana (n=27)		South Africa (n=173)		Uganda (n=178)	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*
0-12years old	0%	0%	3.6%	**5.9%**	.0%	**2.0%**
13-19years old	25.0%	**26.3%**	18.2%	**39.0%**	17.3%	**37.3%**
20-30years old	**62.5%**	52.6%	**45.5%**	37.3%	**58.3%**	39.2%
Over 30years old	12.5%	**21.1%**	**32.7%**	17.8%	**24.4%**	21.6%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Toxic agents involved in acute poisoning

The combined frequencies of toxic agents are shown in Table 4. Overall, in descending order, the most common toxic agents involved in acute poisoning incidents were household products, agrichemicals, pharmaceuticals, animal and insect bites, food poisoning, as well as plants and traditional medicines.

Table 5: Overall distribution of toxic agents

Toxic Agents	Percent
Household products (n=376)	46.1%
Agrichemicals (n=153)	18.8%
Pharmaceuticals (n=114)	14.0%
Animal and insect bites (n=106)	13.0%
Food poisoning (n=37)	4.5%
Plants and traditional medicines (n=29)	3.6%
Total (n=815)	100.0%

As shown in Figure 5, household products were involved in the majority of acute poisoning incidents in all three countries. The products most commonly involved were acetone, aluminium phosphate, creosote, paraffin, carbon monoxide, alcohol, acids, soaps, hydrogen peroxide, liquid engine cleaner, vinegar, methylated spirits, sodium hypochlorite, thinners, paints, glues, potassium permanganate, nitroglycol, and diverse unspecified chemicals. Of the above toxic agents, the most commonly involved household product was paraffin. It affected significantly children younger than 5 years old as compared to the older ones ($p<0.001$).

With regard to pharmaceutical products, the range of pharmaceuticals involved was similar between South Africa and Botswana. The following groups of drugs were reported in South Africa: narcotics such as cocaine and cannabis, non-steroidal anti-inflammatory drugs such paracetamol and aspirin, antibiotics such as cotrimoxazole and erythromycin, antimalarial drugs such as chloroquine, anti-epileptic drugs such as carbamazepine, and anti-scabies drugs such as ascabiol. In Botswana, narcotics such as cocaine, non-steroidal anti-inflammatory drugs such as paracetamol and ibuprofen, antibiotics such as amoxicillin, tricyclic antidepressants such as amitriptyline and imipramine, anti-psychotics such as chlorpromazine, and barbiturates such as phenobarbital, dopamine agonists such as bromocriptine, were reported. The most common pharmaceutical product involved in acute poisoning was paracetamol, both in Botswana and South Africa. It is worth noting that there were no cases of poisoning due to pharmaceuticals, plants and traditional medicines among cases reported in Uganda during the study period.

Although the composition of traditional medicines that were implicated in acute poisoning remains unknown, plant poisoning reported in this study was mainly about wild berries (*Vaccinium species*) and Elephant' ear (*Colocasia species*) in South Africa and Botswana. The pattern of involvement of various toxic agents differed from country to country. In Botswana, besides household chemicals, pharmaceuticals, plants and traditional medicines were the most involved agents; while in Uganda, agrichemicals were the most involved poisoning agents. The proportions of those affected by snake envenomation was almost similar between South Africa and Uganda (15.1% South Africa versus 14.1% Uganda); however, though bee stings, spider and scorpion bites were reported in South Africa, no such cases were reported in Uganda. In contrast, scorpion' stings were reported in Botswana among children under 12 years old.

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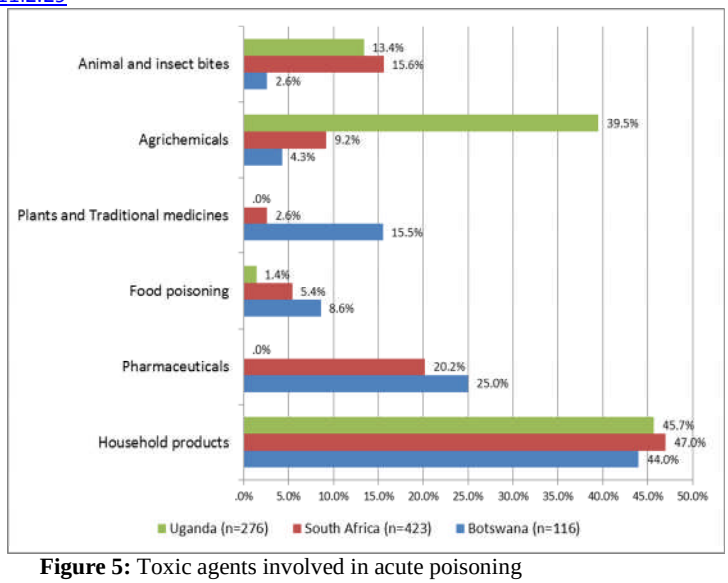

Figure 5: Toxic agents involved in acute poisoning

Toxic agents affected victims differently depending on their age and gender. With regard to age category, Table 6 shows that household products were the most implicated agents followed by plant poisoning and traditional medicines in children younger than 12 years of Botswana; but in Uganda, snakebites and household products predominated in this age group.

Table 6: Toxic agents involved in acute poisoning per age category

Country	Toxic agents	Age category			
		0-12 years old	13-19 years old	20-30 years old	over 30 years old
Botswana (n=116)	Household products	**58.5%**	33.3%	32.1%	30.0%
	Pharmaceuticals	9.4%	**53.3%**	35.7%	30.0%
	Food poisoning	9.4%	6.7%	7.1%	10.0%
	Plants and traditional medicines	20.8%	.0%	3.6%	30.0%
	Agrichemicals	1.9%	6.7%	**10.7%**	.0%
	Animal and insect bites	.0%	.0%	10.7%	.0%
	Total	100.0%	100.0%	100.0%	100.0%
South Africa (n=423)	Household products	**65.4%**	**34.8%**	**42.2%**	**30.6%**
	Pharmaceuticals	9.8%	**30.3%**	23.9%	23.6%
	Food poisoning	5.9%	4.5%	**7.3%**	2.8%
	Plants and traditional medicines	4.6%	2.2%	.0%	2.8%
	Agrichemicals	4.6%	10.1%	6.4%	**22.2%**
	Animal and insect bites	9.8%	18.0%	20.2%	18.1%
	Total	100.0%	100.0%	100.0%	100.0%
Uganda (n=276)	Household products	38.5%	**41.0%**	**47.0%**	**48.6%**
	Pharmaceuticals	.0%	.0%	.0%	.0%
	Food poisoning	.0%	1.6%	.8%	**2.9%**
	Plants and traditional medicines	.0%	.0%	.0%	.0%
	Agrichemicals	15.4%	**47.5%**	**40.9%**	**34.3%**
	Animal and insect bites	**46.2%**	9.8%	11.4%	14.3%
	Total	100.0%	100.0%	100.0%	100.0%

Moreover, in teenagers, pharmaceutical products were the most involved toxic agents followed by household products in Botswana. In South Africa, household products and pharmaceuticals were the most common in teenagers; while in Uganda, agrichemicals and household products predominated. Overall, these trends were fairly maintained in young adults and adults in each country.

With regard to gender, Table 7 shows that while no single case of poisoning by animal and insect bites was reported in females in Botswana, women were more bitten by animals than men in South Africa and Uganda. Furthermore, in Botswana and Uganda, household products were significantly more involved in males than in females ($p<0.05$); while in South Africa both males and females were affected almost equally.

In particular, of the twelve cases of alcohol intoxication in Botswana, ten were reported among males. In contrast, pharmaceuticals were more significantly ($p=0.013$) involved in acute incidents of poisoning of female than male victims. Similarly, fourteen of the sixteen cases of unspecified medicine-overdose affected female victims.

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Table 7: Toxic agents involved in acute poisoning per gender

Country	Toxic agents	Gender	
		Male	Female
Botswana (n=116)	Household products	**51.7%**	36.2%
	Pharmaceuticals	10.3%	**39.7%**
	Food poisoning	6.9%	**10.3%**
	Plants and traditional medicines	**20.7%**	10.3%
	Agrichemicals	**5.2%**	3.4%
	Animal and insect bites	**5.2%**	.0%
	Total	100.0%	100.0%
South Africa (n=423)	Household products	46.6%	**47.3%**
	Pharmaceuticals	**21.9%**	18.8%
	Food poisoning	5.1%	5.7%
	Plants and traditional medicines	2.8%	2.4%
	Agrichemicals	9.0%	9.4%
	Animal and insect bites	14.6%	16.3%
	Total	100.0%	100.0%
Uganda (n=276)	Household products	**51.5%**	31.3%
	Pharmaceuticals	.0%	.0%
	Food poisoning	1.0%	**2.5%**
	Plants and traditional medicines	.0%	.0%
	Agrichemicals	38.8%	**41.3%**
	Animal and insect bites	8.7%	**25.0%**
	Total	100.0%	100.0%

Table 8: Toxic agents involved in acute poisoning per circumstances

Country	Toxic agents	Circumstances	
		Intentional	Accidental
Botswana (n=116)	Household products	18.5%	**51.7%**
	Pharmaceuticals	**63.0%**	13.5%
	Food poisoning	.0%	11.2%
	Plants and traditional medicines	3.7%	19.1%
	Agrichemicals	14.8%	1.1%
	Animal and insect bites	.0%	3.4%
	Total	100.0%	100.0%
South Africa (n=423)	Household products	**52.6%**	43.2%
	Pharmaceuticals	28.3%	14.4%
	Food poisoning	1.2%	8.4%
	Plants and traditional medicines	.6%	4.0%
	Agrichemicals	17.3%	3.6%
	Animal and insect bites	.0%	26.4%
	Total	100.0%	100.0%
Uganda (n=276)	Household products	37.6%	**60.2%**
	Pharmaceuticals	.0%	.0%
	Food poisoning	.0%	4.1%
	Plants and traditional medicines	.0%	.0%
	Agrichemicals	**59.6%**	3.1%
	Animal and insect bites	.0%	32.7%
	Total	100.0%	100.0%

In comparison, in South Africa, pharmaceuticals were marginally more involved in the poisoning of males than females. Moreover, of the 12 cases of cocaine poisoning, eight occurred among Caucasians.

With regard to food poisoning, females were more significantly affected than men across the three countries, particularly in Botswana and Uganda. In contrast, poisoning by plants and traditional medicines affected more males than females in Botswana and South Africa. Similarly, six of the eight cases of poisoning by traditional medicines and all three cases of poisoning through drugs of abuse involved male victims. Furthermore, agrichemicals affected equally males and females in South Africa, but were more involved in poisoning incidents of females in Uganda, while affecting more males in Botswana.

With regard to the association between toxic agents and circumstances of poisoning, pharmaceuticals were involved in 63% of cases of deliberate self-poisoning in Botswana, but were second to household chemicals in South Africa as they were involved in 28.3% of deliberate self-

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poisoning incidents. As shown in Table 8, household products were involved in less than 40% of deliberate self-poisoning incidents in Botswana and Uganda, while in South Africa they accounted for 52.6% cases. Agrichemicals were more significantly involved in deliberate self-poisoning in each country ($p<0.001$); being found in 59.6%, 17.3%, and 14.8% of deliberate self-poisoning cases respectively in Uganda, South Africa, and Botswana. Plants and traditional medicines were involved more in accidental incidents than deliberate ones in Botswana and South Africa, but not in Uganda where no case was reported.

In Botswana, the toxic agents involved in deliberate self-poisoning were in descending order, pharmaceuticals, household products and agrichemicals; in South Africa, household products predominated but were followed by pharmaceuticals, then agrichemicals; while in Uganda, agrichemicals predominated.

Outcomes of acute poisoning
Length of stay in hospital

Victims of acute poisoning are often hospitalised. In South Africa, 70% of the victims of acute poisoning stayed for less than two days with the median duration of stay of 1.9 days. Based on gender, the majority of females as compared to males stayed for more than two days (70.1% versus 29.9%). Similarly, in Uganda, 79.7% of patients stayed for less than 2 days, and the mean length of stay was 2.1 days (Figure 6).

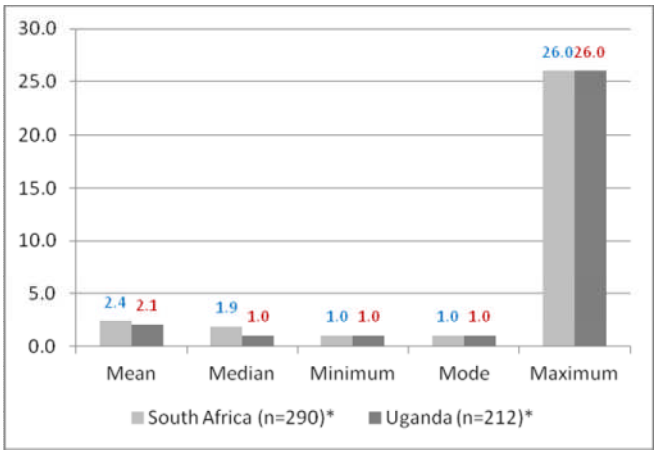

Figure 6: Parameters of the length of stay in hospital

Case fatality rate

Overall, the case fatality rate was 2.1%. The number of patients who died was respectively three, ten, and four, in Botswana, South Africa and Uganda.

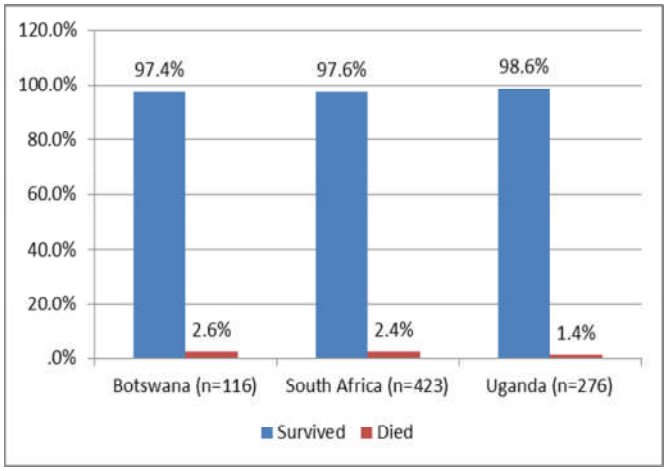

Figure 7: Acute poisoning case fatality rate in the three countries

Clearly, the majority of patients who were victims of acute poisoning survived; among those who died, the demographic profile, the types of toxic agents involved, as well as the circumstances of their poisoning incidents differed from country to country.

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Table 9: Case fatality per age category

Country	Survival status	Age category			
		0-12 years old	13-19 years old	20-30 years old	over 30 years old
Botswana (n=116)	Survived	96.2%	100.0%	96.4%	100.0%
	Died	**3.8%**	.0%	**3.6%**	.0%
	Total	100.0%	100.0%	100.0%	100.0%
South Africa (n=423)	Survived	100.0%	91.0%	99.1%	98.6%
	Died	.0%	**9.0%**	.9%	1.4%
	Total	100.0%	100.0%	100.0%	100.0%
Uganda (n=276)	Survived	100.0%	98.4%	99.2%	97.1%
	Died	.0%	1.6%	.8%	**2.9%**
	Total	100.0%	100.0%	100.0%	100.0%

With regard to age category, Table 9 shows a disparity in that, while the majority of deaths occurred among teenagers in South Africa; in Uganda it was among adults over 30 years; but in Botswana, the majority of deaths occurred almost in children younger than 12 years old. With regard to disparities between countries, there was no death among children younger than 12 years old in South Africa and Uganda, but in Botswana, 3.8% victims in this group died. Among teenagers, South African teenagers were the most affected as 9% of them died, while no death was reported in Botswana in this group. Amongst young adults, it was in Botswana where more youths died in comparison to South Africa and Uganda, where less than 1% of them died. Among adults, while no death was reported in Botswana in this category, a case fatality rate of 2.9% and 1.6% was reported respectively in Uganda and South Africa. With respect to gender, Table 10 shows that no male victims of poisoning died in Botswana, but there were slightly more deaths among males than females in Uganda. In South Africa, more female than male victims died from poisoning incidents.

Table 10: Case fatality rate per gender

Country	Survival status	Gender	
		Male	Female
Botswana (n=116)	Survived	100.0%	94.8%
	Died	0%	**5.2%**
	Total	100.0%	100.0%
South Africa (n=423)	Survived	97.2%	97.6%
	Died	2.2%	**2.4%**
	Total	100.0%	100.0%
Uganda (n=276)	Survived	98.5%	98.8%
	Died	**1.5%**	1.2%
	Total	100.0%	100.0%

Overall, the majority of deaths occurred in those who were poisoned accidentally; the case fatality was 2% in Uganda, 2.8% in South Africa and 3.4% in Botswana (Table 11).

Table 11: Case fatality rate per circumstances of acute poisoning

Country	Survival status	Circumstances	
		Intentional	Accidental
Botswana (n=116)	Survived	100.0%	96.6%
	Died	0%	**3.4%**
	Total	100.0%	100.0%
South Africa (n=423)	Survived	98.3%	97.2%
	Died	1.7%	**2.8%**
	Total	100.0%	100.0%
Uganda (n=276)	Survived	98.9%	98.0%
	Died	1.1%	**2.0%**
	Total	100.0%	100.0%

However, based on age categories, the distribution of deaths in relation to the circumstances of poisoning differed across the three countries. As shown in Table 12, in Uganda, 75% of deaths occurred among people over 30 years old and 50% of those had committed suicide. In South Africa, teenagers constituted 80% of those who died; of which 30% had committed deliberate self-poisoning; but in Botswana, all deaths were among those poisoned accidentally.

http://dx.doi.org/10.4314/ajtcam.v11i2.29

Table 12: Characteristics deaths per age category, gender, and circumstances

Country	Age Category	Intentional		Accidental		*Total*
		Male	*Female*	*Male*	*Female*	
Botswana (= 3)	0-12years old	0.0%	0.0%	0.0%	66.7%	**66.7%**
	13-19years old	0.0%	0.0%	0.0%	0.0%	0.0%
	20-30years old	0.0%	0.0%	0.0%	33.3%	33.3%
	Over 30years old	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	0.0%	0.0%	0.0%	**100.0%**	100.0%
South Africa (n= 10)	0-12years old	0.0%	0.0%	0.0%	0.0%	0.0%
	13-19years old	10.0%	20.0%	30.0%	20.0%	**80.0%**
	20-30years old	0.0%	0.0%	0.0%	10.0%	10.0%
	Over 30years old	0.0%	0.0%	0.0%	10.0%	10.0%
	Total	10.0%	**20.0%**	30.0%	**40.0%**	100.0%
Uganda (n=4)	0-12years old	0.0%	0.0%	0.0%	0.0%	0.0%
	13-19years old	0.0%	0.0%	0.0%	25.0%	25.0%
	20-30years old	25.0%	0.0%	0.0%	0.0%	25.0%
	Over 30years old	25.0%	0.0%	25.0%	0.0%	**50.0%**
	Total	**50.0%**	0.0%	**25.0%**	25.0%	100.0%

The toxic agents that led to the death of the victims differed from country to country. Even the extent of their involvement was dissimilar. Overall, of the 17 deaths reported, 2 (11.7%) were due to traditional medicines. Of the three deaths in Botswana, one was due to paraffin and two to traditional medicines. The four deaths in Uganda were as follows: alcohol intoxication was responsible of one death that affected a 75 years old man; while an organophosphate containing product caused the death of 42 years old man and an unspecified poison led to the death of a 29 years old man; finally, a female teenager died from carbon monoxide poisoning. Figure 8 shows that plants and traditional medicines were involved in fatal cases only in Botswana, where they were involved in two-thirds of the deaths; while drugs of abuse namely cocaine, were involved in 40% of fatal outcomes only in South Africa. On the contrary, household products were implicated in fatal outcomes in all three countries, though the extent of their involvement varied from country to country. They were involved in three-quarters of deaths in Uganda, half of deaths in South Africa, and in a third of deaths in Botswana. Moreover, agrichemicals were involved in the deaths of victims in Uganda and South Africa, but not in Botswana; they were involved in a quarter of deaths in Uganda and 10% of deaths in South Africa.

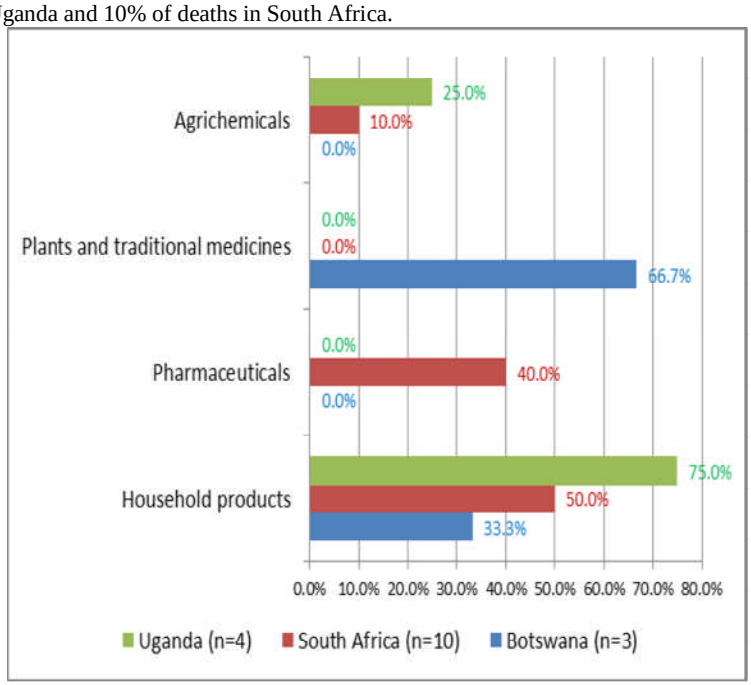

Figure 8: Toxic agents involved in the death of victims of acute poisoning

http://dx.doi.org/10.4314/ajtcam.v11i2.29

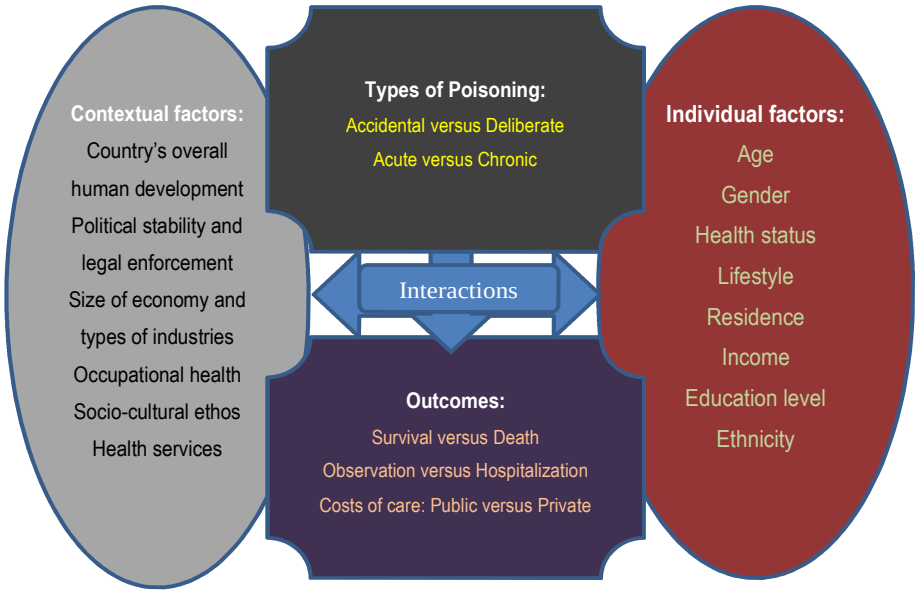

Figure 9: Interacting factors in a poisoning incident

Discussion

The results from this study show that there are several disparities and similarities in the pattern of acute poisoning incidents across the three countries. With regard to similarities, it is well established that the majority of acute poisoning incidents occur accidently as reported in this study. However, is interesting to note that with respect to socio-demographic factors and circumstances of poisoning, among teenagers, more females (over 60%) than males were victims of acute poisoning and that female victims committed more deliberate self-poisoning than males in this age group. Yet, overall, the majority of deliberate self-poisoning incidents occurred in male, young adults aged 20 to 30 years old. These findings concur with results found in other African countries such as Tanzania where adult males were three times more victims of suicide than females (Mgaya et al., 2008).

The findings of this study contrast with reports from some Asian and European countries where the majority of suicide cases were reported in females (Hawton and Harriss, 2008; Desalew et al., 2010; Sawalha et al., 2010). Although this study did not investigate the reasons associated with deliberate self-poisoning, data from the literature both from within Africa and elsewhere suggest that the immediate triggers include quarrels, family conflicts, break-ups of love relationships, failing exams, siblings' fights and sexual assaults (Mgaya et al., 2008; Hawton and Harriss, 2008; Desalew et al. 2010; Dzamalala et al., 2006). The above findings suggest that individual characteristics of victims must be taken into consideration when formulating intervention policies.

With respect to the types of toxic agents involved in the incidents and their outcomes, it is noteworthy that across the three countries, the majority of poisoning incidents involved household products that led to fatal outcomes and that agrichemicals were more involved in deliberate than accidental poisoning incidents. Furthermore, although plant and traditional medicines occurred in only 3.6% of incidents, they were responsible for 11.7% of deaths. These findings concur with several reports that show that household and agrichemicals as well as plant poisoning are involved in fatal outcomes in Africa (Joubert, 1990; Kasilo and Nhachi, 1992; Stewart et al., 1998; Tagwireyi and Ball, 2002).

Hence, the contextual and individual factors explain the disparities noted in the occurrence and outcomes of acute poisoning incidents reported in this study. As summarised in Figure 9, the political situation, the opportunities offered by the size of the country's economy, the cultural view on deliberate poisoning and other factors influence the occurrence of poisoning incidents (Nattrass and Seekings, 2001; Emsley, 2005). Historically, Whorton (2010) reported that in 19th century, arsenic was the poison of choice in Europe; it was implicated in a third of all cases involving the administering of a toxic substance for political gains. During Cameroun as well as Nigeria's instability periods, it is widely believed that poisoning was used to eliminate some of their leaders (Pyenson et al., 1998; Reza et al., 2001; Holt, 2005; Brittain, 2006; Eze et al., 2010).

With regard to the economic situation, Botswana and South Africa have heavy mining industries. The existence of these industries is associated with the presence of a wide range of chemicals used in these industries as well as the level of development and the lifestyles of their populations. This explains the diversity of household and industrial chemicals involved in acute poisoning incidents in these two countries (Mokoena et al., 2006).

With regard to cultural and other considerations, in many other countries, intentional poisoning is commonly practiced but because autopsies are often not carried out, their perpetrators get away with their criminal acts (Eze et al., 2010; Pyenson et al., 1998). In China, the Chinese government outlawed a rodenticide, tetramethylenedisulfonetetramine, whose human lethal dose is only 7–10 mg, following numerous reports of murders due to this substance. The law prohibited its manufacture, distribution, possession and sale. Nevertheless, in 2003, the Chinese police seized 92,282 kg of this product; an amount equivalent to at least 9.2 billion potential lethal doses (Trestrail, 2007). Because there was a demand, criminals ensured that there was supply. China accounts for 26% of suicides committed worldwide as it is culturally regarded as an act of honour and bravery (Weiyuan, 2009).

At individual level, mental health status, gender, occupation and other determinants of the socioeconomic status contribute to the disparity noted in acute poisoning incidents (Schlebusch, 2005). Studies elsewhere have reported links between the economic and unemployment situations in a country and the rates of suicide. A 'chain of adversity' has been described from job loss, for instance, to depression that leads to suicide ideation and finally to suicide attempts (Corcoran and Arensman, 2009).

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Moreover, although the mental health status of victims is a well-known factor in the onset of suicides (Nordentoft, 2007), it was not assessed in the series of patients in this study. Nonetheless, in South Africa, it is established that the lifetime prevalence of major depression is about 10%, and that mood disorders are associated with the female gender (Tomlimson et al, 2009). A study by Joe et al. (2008) reported that, though 7 .5% of attempts are unplanned; 50% of planned first attempts of suicide occur within one year of the onset of ideation.

The risk of suicide is highest among young adults, people of mixed race ethnicity, female and people with lower level of education. In Uganda, 82% of the labour force works in agriculture; while in South Africa, 65% of the labour force works in the service sector (CIA, 2010). The above data explain at least partially the differential access to agrichemicals and why in Uganda, agrichemicals were involved in about 60% of deliberate self-poisoning in comparison to 17% in South Africa. People in Uganda may have more easy access to agrichemicals from their workplaces than people in South Africa.

It is important to note that alcohol, agrichemicals, and pharmaceuticals are more amenable to legislative changes and indeed are subject to several regulations with regard to their availability and accessibility. However, their easy availability may be a particularly important factor in unplanned and impulsive attempts of self-poisoning. Of the 82 patients investigated in one study, all of whom had attempted suicide, almost 50% reported an interval of no more than 10 minutes between their first thought of suicide and their actual attempt (Deisenhammer et al., 2009).

Alcohol and its abuse and misuse are a major social problem across in the three countries. In South Africa, recent data show that the prevalence of risky, harmful, or heavy drinking, defined as drinking five or more standard drinks per day for men and three or more drinks per day for women, is between 21% to 39% in men; and 30.1% to 35% in women. The corresponding figures are 40.1 % for men and 20.3% for women in Uganda; while in Botswana, 31% of men and 17% of women met reportedly the criteria for heavy alcohol consumption.

Yet, in the three countries, despite the legal age for alcohol drinking being 18 years old, surveys' findings suggest that youths 16 years old and less have access to alcoholic drinks (Parry et al., 2005; Tumwesigye et al.,2009; Phorano et al, 2005; Peltzer and Ramlagan, 2009; Suliman et al., 2010). The above data suggest clearly that the laws and regulations restricting access to and availability of alcoholic drinks to minors are neither complied with, nor enforced.

Similarly, there are regulations about the sale, storage, and disposal of agrichemicals in the three countries. However, dangerous agrichemicals such as Aldicarb®, Temik®, and others can be bought from the streets of all major towns of the three countries (Rother, 2010).

In contrast, this study found that there was no poisoning due to pharmaceuticals reported among the cases analysed from Uganda. This suggests that access and availability of medicines within households is limited. Indeed, a major survey conducted by Kibira et al. (2008) reported that only about 1% of Ugandans have medical insurance; and that 64% of respondents stated that the costs of medicines were not affordable. This is consistent with the existence of widespread poverty in Uganda (Kiguli et al., 2009). This explains at least partly why households do not keep medicines that could possibly be implicated in poisoning incidents, whether accidentally or deliberately.

Nonetheless, just like agrichemicals, pharmaceutical products and drugs of abuse are easily available from the black market and can be bought on the streets in the three countries despite the existence of restricting regulations. In one survey, patrons of retail pharmacies in South Africa reported that they bought steroid creams from flea markets and cosmetic shops although these products should be obtained only on prescriptions through pharmacies (Malangu and Ogunbanjo, 2006).

The above discussion has highlighted the fact that the country's overall profile with regard to its political, socioeconomic, cultural, legal and judiciary systems determines how easily individuals will have access to potentially harmful products. It further highlights the individual factors that are associated with both accidental and intentional self-poisoning. Finally, it should be pointed out that clinical management of victims influences the outcomes of incidents.

Acute poisoning is one of the most common heath conditions that most healthcare providers encounter regularly in their practices. However, clinical guidelines that ought to assist them in the management of acute poisoning are incomplete, not up to date, or simply not available (Zungu et al., 2009). For instance, it is known that pre-hospital management, first aid assistance, or treatment offered by ambulance personnel, can save patients' lives. Yet, clinical guidelines do not provide any guidance on the pre-hospital measures that should be instituted for poisoned patients (MOH-RSA, 2008; Manoguerra et al., 2008).

Moreover, these guidelines do not provide clear instructions on which specialists should be contacted for referral purposes. Unfortunately, except in South Africa, there is no drug or poison information centres in Botswana or Uganda where at least a toxicologist might be available for consultation. As stated above, in the specific case of deliberate self-poisoning, the guidelines should have instructed that the cases must be referred to a psychiatrist or clinical psychologist for evaluation, but this is was not found in the guidelines reviewed (MoH-Uganda, 2010; MoH-RSA, 2008). Based on data from the literature reviewed, this should have been included so that clinical psychologists or psychiatrists should participate in the management the victims of acute poisoning incidents in order for them to help the victims to avoid or at least to decrease the risk of repetitions (Nordentoft, 2007).

While recognising the limitations of this study, namely that the data were from cross-sectional studies conducted at health facilities level, the findings provide valuable insights to derive some policy and practice recommendations. Firstly, there is a need for the establishment of regional poisoning surveillance systems, or toxicovigilance centres. These centers should be mandated with the responsibility to collect, aggregate, analyse, and report on acute poisoning with special emphasis on deliberate self-poisoning and traditional medicines. They should operate as independent research and educational institutions serving both clinicians and policy-makers. By providing epidemiological surveillance data, it will be possible to assess the magnitude of the burden of acute poisoning problem and its major risk factors, so that preventive measures can be taken and evidence-based interventions could be designed and implemented (Buckley and Gunnell, 2007).

Secondly, there is a need for a revision of clinical guidelines so that clear instructions are laid therein to assist clinicians in the management of acute poisoning and to collaborate with traditional health practitioners when traditional medicines are involved in poisoning incidents (Madiba et al., 2010). Because psychiatric and psychological states are underlying factors in deliberate self-poisoning, the guidelines should specifically state that the management of poisoning incidents should include an assessment by a clinical psychologist or psychiatrist. Where these specialists are not available, it should be mentioned that there are several assessment tools such as the Beck's Depression Inventory, the Hopelessness Scale, the Rosenberg Self-Esteem Scale and the CAGE-score that could be used by clinicians to assess the victims "psychological or psychiatric' status (De Leo and Kienhorst, 1995; Nordentoft, 2007).

Thirdly, given the need to treat patients effectively, the availability of antidotes and other required health commodities must be assured through effective management of the supply chain (Wium and Hoffman, 2009). Finally, besides surveillance data, prospective population-based studies are needed to collect data necessary to determine factors that are associated with higher mortality; and more studies are required to establish the reasons for the apparent non-enforcement of existing laws.

http://dx.doi.org/10.4314/ajtcam.v11i2.29

In conclusion, across the three countries, acute poisoning occurred mainly by accident, but the contextual factors of each country led to a pattern of acute poisoning that showed some similarities with regard to the distribution of deliberate self-poisoning among females, teenagers, and young adult victims. There were disparities related to the differential access to toxic agents, based on the age and gender of the victims. Although plant and traditional medicines caused fewer cases of acute poisoning incidents, they contributed considerably to fatal outcomes.

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