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Investigation of the Prevailing Diagnostic and Management Practices of synthetic Pesticide Poisoning -related cases in Isoka District, Muchinga Province of Zambia

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Abstract

Synthetic Pesticides are chemical substances that are used to kill pests that reduce the quality and production of the agricultural crops. Due to increase in Population and demand for food, the use of synthetic pesticides has increased. Despite their use, they pose health challenges to both the environment and humans. Once human beings are exposed to pesticides, they cause both acute and chronic poisoning. The diagnosis and management of the cases arising from exposure to Synthetic pesticides is therefore very crucial. The purpose of this study was to Investigate the Prevailing Diagnostic and Management Practices of Synthetic Pesticide Poisoning -Related cases among Primary healthcare providers of Isoka District in Muchinga province of Zambia. Data were collected by means of a questionnaire and analysed using frequency and percentages of descriptive statistics. There were divergence views among primary healthcare providers on the Diagnostic and management practices of pesticide poisoning -related cases. While 18% conducted procedures such as Airway, Breathing, Circulation and identified the type of pesticides, 25% give IV fluids and activated charcoal and 13% assess the type of poisoning. Further, 2% were able to remove clothes from the patients and give IV fluids while 42% take history. This showed nonexistence of standard practice in the management of pesticide poisoning -related cases. This study recommends the need to provide training on the diagnostic and management practices of pesticide poisoning-related cases among primary healthcare providers. The study further recommend the need for institution collaboration between the ministry of health and the ministry of agriculture.

Keywords: Pesticides; Pesticide Poisoning; Diagnosis; Management Practices; Healthcare Providers

1. Introduction

The global agriculture consumption of Pesticides is focused to increase slightly over the next few years from around 4. 3 million metric tons in 2023 to a value of around 4. 41 million metric tons in 2027 (Statistica research department, 2024). This shows that Pesticides have now become an integral part of our modern life and are used to protect agricultural land, stored grain, flower gardens from the pests transmitting dangerous infectious diseases. Synthetic pesticides are chemical compounds that are used to kill pests including insects, rodents, fungi, and unwanted plants (ZEMA,2011). Over one thousand different pesticides are used around the world (WHO, 2020).

Despite the use of synthetic pesticides to improve the quality of the crops and increase production, they pose a public health concern. Approximately 740, 000 annual cases of Unintentional Acute Pesticide Poisoning (UAPP) occur in 141 countries including about 7446 fatalities (Boedeker et al, 2020). On this basis, it is estimated that about 385 million cases of UAPP occur annually world-wide including around 11, 000 fatalities. Based on a worldwide farming population of approximately 860 million, this means that about 44% of farmers are poisoned by pesticides every year. A report by

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Atreya found out that every one of the farmers in their investigation affirmed typical symptoms of insecticide poisoning after each spraying task. These indications involved extreme cerebral pain (66%), dizziness (58%), body weakness or being abnormally tired (55%), nausea (53%), restlessness (37%) and sweating (41.3%). Pesticide sprayers reported more noteworthy signs and symptoms such as skin disturbances, stomach poisoning and eye aggravations than other farm workers (Atreya, 2008).

Different classes of synthetic pesticides pose different health problems. Carbamate pesticides have been implicated in the increasing prevalence of diseases associated with alteration of the immune system such as hypersensitivity reactions, and some autoimmune diseases such as cancer (Dhouib et al. 2016). Exposure to Organophosphate pesticide bring about health problems including neurological damage , cancer, disruption of the endocrine system and even death (Taiwo, 2019). Moreover, in severe cases organophosphate toxicity in prototypical patients may exhibit unresponsiveness, pinpoint pupils, muscles fasciculation and diaphoresis. Additional symptoms include emesis, diarrhoea, excessive salivation, lacrimation and urinary incontinence (ncbi, 2023). The pyrethroids have have been implicated in toxic effects that include nephrotoxic, hepatotoxic, cardiotoxic, immunotoxic, neurotoxic and behavioural effects in humans (Chrustek et al. 2018). The neonicotinoids have been implicated in mutagenicity, endocrine disruption, Teratogenecity, Neurotoxic and Carcinogenicity activities.

According to WHO (2008), the management of pesticide poisoned patients at various levels of health care include a number of stages. The airway, breathing, and circulation (ABC) of supportive care is crucial. It is not possible to over-emphasize the need to apply the basic treatment correctly in order to tailor treatment to the patient and evaluate the need for gastric decontamination and also to give antidotes early (WHO,2008). In emergency medical treatment the initial management is pivotal despite a great variation. The basic principles of initial resuscitation and assessment are often applied only after gastric decontamination for which there is currently no evidence of benefit (American Academy of Clinical Toxicology and European Association of Poison Centers and Clinical Toxicologists, 2004). Overall, if a patient is presented within one hour to a healthcare facility, the administration of activated charcoal should be considered if the patient is conscious and gives consent. Forced emesis is not recommended and Oral fluids should not be given. Moreover, some antidotes are used in the management of pesticide poisoning and atropine is one of the most important antidotes for pesticide poisoning that is effective to Organophosphates and carbamate poisoning (Eddleston et al, 2008). However, the dosing recommendations given in different sources vary markedly and there is much variation in how it is given in practice (Eddleston et al, 2004). Current recommendations are to give oximes to all Organophosphate poisoned patients requiring atropine although many patients do not seem to benefit (Eddleston et al, 2005). According to Schuman, et al (2015) Additional Interventions is required and while skin and gastrointestinal decontamination are progressing, investigation into the background of the exposure should be ongoing. Family members, co-workers, and emergency response personnel should be interviewed to determine how the exposure occurred by inhalation, ingestion, skin contact, or combination.

WHO -UNEP report of 2016 outlined that carbamate poisoning is diagnosed and managed based on history of exposure and the characteristic presentation of muscarinic, nicotinic and central nervous system effects of an excess of acetylcholine. The diagnosis is confirmed by measuring Acetylcholinesterase in red blood cells or plasma and chemical analysis of body fluids (gastric larvage, blood, urine) should be performed for identification. WHO, 2006).

WHO-UNEP report further indicates that for organochlorines, management should be done by carrying out laboratory tests for confirmation of diagnosis. Poisoning by organochlorines have no specific antidote like Organophosphorus that are managed by giving antidote such as atropine, Oximes such as pralidoxime or Obidoxime and Diazepam (WHO, 2006).

Moreover, Emergency management of patients presenting with acute pesticide poisoning should include both clinical assessment of the toxidrome and an attempt to identify the specific compound from history, the bottle or photographs. Identification of the specific compound ingested from self-poisoning is possible in most patients and is key to predicting and reducing complications, administering appropriate and timely management and reducing the length of hospital stay and cost from unnecessary medical interventions (Lamb et al., 2024)

In conference report by Eddleston (2008). it is reported that early management is similar to that of any other ill patient, requiring assessment of Airway, Breathing, and Circulation, and resuscitation with oxygen and fluids. Positioning of the patient in the 'Left Lateral Position' is important because vomiting is common and aspiration of the pesticide may cause fatal aspiration pneumonitis and pneumonia.

According to Roberts and Reigart (2013), When you suspect a pesticide poisoning, try to get as much information about the pesticide(s) as possible, including: the name of the pesticide used, the EPA pesticide registration number, and the pesticide label and/or the Material Safety Data Sheet (MSDS) for the pesticide(s). Moreover. Roberts and Reigart (2013)

adds that it it is important to Obtain an unlaundered sample of clothing that the patient was wearing at the time of the incident, if available. Put it in a plastic bag to prevent further exposure and to preserve the specimens for subsequent analysis; freezing is optimal. It can be difficult to find appropriate clothing to sample if the worker has been instructed to go home and thoroughly wash his/her clothing. If most clothing has been washed or is not available, it is likely the patient's hat or shoes would still be contaminated and could be analyzed

In zambia pesticides use in agriculture is increasing with nearly 43% of the farmers using them every season (CABI, 2025). Moreover, inadequate enforcement of existing laws and continued use of highly hazardous pesticides (HHPs) affect the health of the children. the elderly. pregnant mothers and the general public-which is being discussed as a human right issue. (IPEN, 2019)This means that the farmers are at risk of the health effects that these pesticides cause. It is against this background that this study investigated the prevailing diagnosis and management practices of synthetic pesticides poisoning related cases in isoka District of Muchinga province in zambia.

This study sought to investigate the prevailing diagnosis and management practices of synthetic pesticide poisoning -related cases in Isoka District, Muchinga province of zambia.

2. Materials and Methods

2.1. Study Location

Isoka District (10°2'4''S, 32°6'1''E) is located in the North Eastern part of Zambia in the recently created Muchinga Province. It is bordered by Nakonde District to the North, Chinsali District to the West, Chama District to the South and Malawi to the East.

2.2. Study Design

This study employed a cross-sectional survey and explanatory research design. The adopted research design involved the collection of primary data at a particular point in time that is useful in obtaining facts and perceptions of the respondents. This was combined with explorative approaches through in-depth interviews that revealed more about the Management practices of pesticide poisoning -related cases in Isoka District.

2.3. Target Population

This study targeted the primary healthcare providers working in the health facilities of Isoka District.

2.4. Inclusion and Exclusion criteria

Those who were included in this study were the nurses, clinical officers, medical Doctors, Environmental health personnel and laboratory technologists who were found working at the district health hospital and Kasoka health facility on the day data collection took place and they filled in the consent forms. The cleaners and those who were found working at the registry were excluded from this study.

2.5. Sample Size of primary healthcare workers.

The minimum sample size was calculated using Cochran's formula in its modification state.

$$n= N/1+(N/1000)$$ where n = sample size, N=population size.

$$n = 50/1+(50/1000)$$

$$n=33$$

Thus, the sample size for this study was 33 primary healthcare workers.

While the targeted sample size was 33. five (5) participants did not bring the questionnaires back reducing this number to twenty eight (28)

2.6. Data collection and Analysis

Data were collected using a semi-structured questionnaire. In the first part, the questions had optional answers such as 'Agree. Disagree. Uncertain'. In the next part the questions were open for the participants to express themselves freely

when answering. Data analysis were performed through SPSS version 20 and Excel statistical packages of 2013. The Descriptive statistics were the useful parameters of interest proposed under this study. The frequency and percentages were calculated.

2.7. Ethical Considerations

Before respective government Departments such as the ministry of agriculture and Ministry of health were informed of the research undertaking. Ethical clearance was obtained from excellence in research ethics and Sciences (ERES) Ref. no. 2022-Aug-017. All participants were informed about the survey before participating and had the right to withdraw at any point in time during the survey. For data that were collected from primary healthcare workers, they were made to sign an informed consent before being enrolled in the survey.

3. Result and Discussion

Table 1. The table provides responses to the questions in the questionnaire by the primary healthcare providers about the management and practices of pesticide poisoning related cases in Isoka District.

Table 1 Management Practices of Pesticide poisoning related cases in Isoka District

SN	Description of statement	Frequency	Percentage (%)
1	We easily recognise pesticide poisoning from the presentation of signs and symptoms by the clients exposed to pesticides		
	Agree	20	71
	Disagree	7	4
	Uncertain	1	25
2	Following pesticide exposure, we request for a copy of pesticide label from our our clients		
	Agree	6	21. 5
	Disagree	16	57
	Uncetatin	6	21. 5
3	Clients suspected of pesticide poisoning are asked to produce material safety data sheet		
	Agree	7	25
	Disagree	10	36
	Uncertain	11	39
4	We are able to collect whole blood, plasma or fresh urine from pesticide poisoned patients for analysis and possible diagnosis		
	Agree	3	11
	Disagree	15	53
	Uncetatin	10	36
5	We are able to collect any contaminated clothing. hats, foliage from the site and take them in clear sealable plastic bags		
	Agree	7	25
	Disagree	9	32
	Uncertain	12	43

6	Medication for managing pesticides poisoning are readily available at our our facility.		
	Agree	10	35. 7
	Disagree	12	42. 9
	Uncetatin	6	21. 4
7	Pesticide poisoning are further reported to the District office, Provincial office. Ministry of health. Local government public health department and zambia Environmental management Agency.		
	Agree	8	28. 6
	Disagree	12	42. 8
	Uncertain	8	28. 6
8	After treatment clients usually receive counselling and health education on pesticides		
	Agree	23	82
	Disagree	3	11
	Uncertain	2	7

About 71% of the primary healthcare providers were able to recognise pesticide poisoning from the presentation of signs and symptoms by the clients exposed to pesticides while 4% were not able to recognise the poisoning cases and 25% were uncertain. with regard to the copy of pesticide label, 21. 5% were able to request for a copy while 57% did not request for a copy and 21. 5% were uncertain about requesting for a copy of pesticide label. A copy of pesticide label provides important information on the active ingredient in the pesticides container. Some labels contain information on how to carry out first aid that could be very relevant in terms of helping the primary healthcare provider make correct decision on management of the cases. About 25% of primary healthcare providers ask clients suspected of pesticide poisoning to produce material safety data sheet while 36% did not and a further 39% were uncertain. Moreover, 11% were able to collect whole blood. plasma or fresh urine from the clients exposed to pesticides for analysis and possible diagnosis while 53% were not able to collect any sample and a further 36% were uncertain. Analysis of the samples is crucial because the type of pesticide will be identified and correct medication will be provided. This is because different types of pesticides have different ways of treatment. The way organophosphates are treated is different from the way Organochlorines, Carbamates and neonicotinoids may be treated.

In this study, 25% were able to collect contaminated clothing, hats, foliage from the site and take them in a clear sealable plastic bag while 32% did not and 43% were uncertain. When contaminated clothing are collected, they could be used for sample extraction in the laboratory so that the type of pesticide is identified. The results of this study showed that most of the primary healthcare provider were not able to collect contaminated clothing there by making diagnosis difficult for them. Further, 35. 7% confirmed the availability of medicines for the treatment of pesticide poisoning cases while 42. 9% expressed non availability of these medicines while 21. 4 % were uncertain. With regard to reporting of the cases to high authority the results of this study showed that 28. 6% reported the cases while 42% did not and 28. 6% were uncertain. About 82% of the primary healthcare providers provide counselling and health education on pesticides while 11% did not and a further 7% were uncertain. It is very important that pesticide poisoning -related cases are reported to relevant authorities such as the ministry of health so that they plan on the purchase of the medication as they are the ones charged with the responsibility of providing medical supplies. The results of the present study contradict those of Robert and Reigart who emphasized the need to collect as much information as possible from the labels and material safety data sheet in order for correct diagnosis to be made.

Table 2. This table is about the steps that primary healthcare providers take when managing chemical pesticides poisoning related cases in Isoka District.

Table 2 Explanation of some few steps taken in managing chemical pesticide poisoning related cases

SN	CODE	PERCENTAGE
1	Code:Conduct ABCD and Identify. First you conduct ABCD, identify the type of chemical pesticide the patient has been exposed to and give medication to that chemical.	18%
2	Code:IV fluids and Activated Charcoal Administering activated charcoal and milk Administering activated charcoal. milk for neutralization and fluids	25%
3	Code: Assess Assess for the type of poisoning we assess for the clinical features, type of poisoning and level of poisoning then treatment.	13%
4	Code:Remove Clothes first by removing the clothes. give fluids remove clothes remove clothes Remove clothes. give them anti-inflammatory	2%
5	Code:Take History Take history. examine. expose the patient. resuscitate and educate the patient.	42%

About 18% said they conduct ABCD and identify the type of pesticides while 25% said they give IV fluids and activated charcoal and 13% said they just assess the type of poisoning. Further 2% said they remove clothes from the patient and give IV fluids and 42% said they take history. The results of our study reveals divergence views in terms of prevailing diagnostic and management of pesticide poisoning -related cases. This could be due to non availability of the protocol for handling cases related to pesticides. The results of our study underscore the importance of following correct steps when screening for pesticide poisoning- related cases in order to ensure accurate detection, minimize risks to human and environmental health and prevent potential misuse of the medications. ultimately leading to safer and more effective pest management strategies. The results of the present study are in line with those of WHO (2008) who emphasized on the important of performing necessary steps such as airway ,breathing and circulation .

4. Conclusion and recommendation

There were divergence views among primary healthcare providers in terms of the prevailing diagnostic and management practices indicating non existence of standard procedure in dealing with pesticide poisoning -related cases. Primary healthcare providers did not take adequate history when dealing with clients that are poisoned by pesticides.The primary healthcare providers did not conduct thorough assessment of the type of pesticides that caused the poisoning.The primary healthcare providers did not conduct adequate decontamination.This study recommends the need to sensitize the primary healthcare providers on the health effects of pesticides and provide training on the diagnostic and management practices. The clients were able to receive counselling and health education regarding the pesticides.The study recommend the need for primary healthcare providers to take adequate history,conduct assessment of the type of pesticide poisoning and carry out decontamination correctly .There is need for collaboration through multi-sectoral approach for control and prevention of synthetic pesticide poisoning -related cases especially the ministry of agriculture , Ministry of health and the Zambia environmental management agency.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

Ethical clearance was obtained from Excellence in Research Ethics and Sciences (ERES). Ref. no.2022-Aug-017.All participants were informed about the study before participating and had the right to withdraw at any point in time during the study period.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

Declaration of competing interests

The authors declare no conflicts of interest in the present study.

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