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Acute Pesticide Poisoning Case Registration in Uganda's Health Care Facilities

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Abstract

Background: Over the years, synthetic pesticides use in Uganda has been on the rise mainly in combating pests, disease pathogens, and disease vectors, both in agriculture and public health. Although there is an increased import and use, the limited user knowledge has resulted into exposure to the toxic products causing both intentional and non-intentional poisonings. This study evaluates a simple tool to register acute pesticide poisoning cases in selected community health facilities.

Method: In 2013, a total of 66 health care workers from 66 health facilities serving a population of 367,169 and 2.007 million in Pallisa and Wakiso districts respectively were trained on diagnosis, treatment, registration and reporting of acute pesticide poisoning. In addition over 250 members of Village Health Teams were trained to sensitise and refer any victims of pesticide poisoning to nearby health care facilities. Thereafter 1300 copies of case registration forms were distributed to trained health care workers in the 66 health facilities to capture attributes to pesticide poisonings including; patient demographic information, name of poisoning agent, type of poisoning exposure, observed signs and symptoms by patient, first aid/treatment administered, outcome of poisoning or referral to a higher facility. Partnering health facilities were visited on a monthly basis to collect filled forms and discuss any upcoming challenges. Also a feedback meeting with the health facility in charge were organised on a quarterly basis to rectify the data collection challenges. Collected data was entered, cleaned and analysed using Stata/SE14.0 Statistical package and graphs constructed with MS. Excel 13. A total of 393 acute pesticide poisoning cases were registered in 43/66 health facilities in a period of 5 years (2013-2017), with an annual average of 78.6 cases and 65.2% reporting. The mean age was 20.6 years (SD ± 17.4 years). Male cases were significantly older than females ($p<0.05$), with a mean age of 22 years and 17 years respectively and formed the majority of the cases 215/393 (55.2%). By Age group, children <12 years formed the majority of cases, 146/393 (37.2%), followed by >30 years, 127/393 (32.3%). A majority of 215/393 (54.7%) cases were non-intentional poisoning of which 37/215 (17.2%) were occupational poisoning cases and 178/215 (82.8%) accidental poisoning cases, while 82/393 (20.9%) were intentional poisonings and the rest 96/393 (24.4%) listed among others. The health workers faced a challenge of inability to obtain names of pesticides that caused majority 301/393 (76.6%). However, known registered poisonings 58/393 (14.8%) by chemical group included; majority being Organophosphates 29/58 (50.0%), followed by Rodenticides (Coumarin & metal phosphide) 11/58 (19.0%), Pyrethroids 7/58 (12.1%), Phosphonates 5/58 (8.6%), Acaricides 3/58 (5.2%), Carbamates 1/58 (1.7%), Thiocarbamate 1/58 (1.7%) and phenoxy acids 1/58 (1.7%).

Conclusion: Acute Pesticides Poisoning (APP) is an on-going health challenge that has not been prioritised yet by the country's health sector. Organophosphate poisoning is the major cause of the poisonings. A majority of the poisonings were accidental poisonings seen in young age groups, followed by self-harm and occupational poisonings. This pilot serves as a guide for the country to build a robust pesticide poisoning surveillance system and pesticide access control mechanisms from end user to treatment facilities.

Keywords: Acute pesticides; Poisoning; Environment; Toxicology

Introduction

Globally, due to the increasing population, the demand for food is proportionally increasing and land fragmentation equally [1]. To increase agricultural productivity, hundreds of active ingredients and tens of thousands of pesticides formulations are produced each year [2]. Pesticides poisoning is increasing globally with pesticide self-poisoning being one of the most commonly used methods of suicide [3]. Worldwide, on an annual basis, an average of 258,234 deaths (with a plausible range of 233,997 to 325,907) deaths from pesticide self-poisoning is seen accounting for 30% (ranging from 27% to 37%) of the global suicides [3]. However, the magnitude of the problem in terms of poisoning classification and the global distribution of these cases and deaths is essentially missing for developing countries [3]. This is partly due to insufficiently trained clinicians on pesticide toxicology and inappropriate pesticide poisoning case registration at Health unit level yet pesticide poisoning information and surveillance in prevention and improvement on management of patients of pesticide poisoning is important.

The Uganda agricultural sector is working towards a healthy population by growing food and rearing animals to serve a balanced diet while feeding the increasing population. Faced with challenges of pesticides and diseases made worse by the climate change which intensifies pest resistance [4-7], use of agrochemicals for pest control, ecto parasites, bacteria and fungi remains as the best option to improve agricultural productivity as well as vector control for public health through the Indoor Residual Spraying (IRS) interventions [8]. But as a challenge, in Uganda, lack of adequate knowledge on safe pesticide use by end user has intensified the incidence of pesticide poisoning, a study by Atuhaire et al. [9] indicates that 29.2% of farmers are spraying tomatoes after harvest which can lead to food poisoning or chronic exposures. Numbers of pesticide poisonings in Uganda are though lacking as the health centres from where treatment is obtained lack a robust data capturing mechanism with Acute Pesticides Poisoning (APP) aggregated with general poisoning in the Health Management Information System (HMIS) 105.

The UN- Food and Agricultural Organisation (FAO) in 1985 released a voluntary code of conduct for the pesticides industry with an intention of reducing harm due to pesticides poisoning in addition the World Health Organisation (WHO) set standards for restricting extremely and highly hazardous pesticides for access. But due to limited government resources in developing countries the impact of pesticides poisoning reduction has not yet been realised though positive changes are registered in countries which adhered to the WHO guidelines [10].

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Uganda is one of the countries with a gap in the pesticides regulation law implementation, in addition to porous borders where pesticides are easily smuggled, pesticide are almost accessible for sale from any dealer including hawkers who sell them along the streets [11]. Though the Uganda National Agro-input Dealers' Association (UNADA) has trained Agro dealers on safe pesticides handling, the district agricultural department (Productions and Marketing Department) lack facilitation for Agro-input dealers monitoring in the country on a regular basis creating a loophole in the professional distribution of agro-chemicals. This might have resulted into more cases of pesticides poisoning, a recent study in the Kampala hospitals show a prevalence of 28.8% of poisoning due to only pesticides with self-harm constituting the higher proportion of the intoxication standing at 63.3% for the urban and 25.8% in the rural setting [12]. It also indicates that the majority of the poisoning cases registered from the health facilities including the national referral hospital from 2013 to 2017 were pesticides poisoning concurring with results found in other countries [13,14].

However, data collection for APP in facilities away from Kampala district like Wakiso and Pallisa districts has not yet been documented, although the Ugandan Ministry of Health (MOH) employs the Health Management Information System (HMIS) to collect health information. This system only records general poisonings and thus limits the quantification of acute pesticide poisoning.

The Ugandan Health sector is designed with an intention of providing quality, affordable and equitable health services to the Ugandan population [15]. Surveillance is very important in detecting the abrupt rise in the number of cases of an injury or disease [16]. A good surveillance system should be sensitive for the cases, flexible to the user, have high predictive power and be consistent in reporting [17]. The aim of this article is to present the result of a more detailed five years surveillance system for the characteristics, a little of diagnosis and treatment of acute pesticide poisonings under implementation of the Pesticides, Health and Environment (PHE) project in health centres and at Hospital level in countryside areas of Uganda.

Methods

Study area

Data was collected from health facilities in Wakiso and Pallisa districts with a population of approximately 386,889 & 1,997,418 (for Pallisa and Wakiso districts respectively) [18,19]. Small scale farming being the outstanding and favourable occupation in both districts, and pesticides use with inadequate precautions is very rampant, increasing risks for self-harm, and non-intentional (occupational and accidental poisonings). Liberalisation of pesticides distribution is also contributing to this case since private organisations are in-charge of pesticides distribution and also training in pesticides safety, with little lazed regulation by the government.

Study design

In the year 2013, PHE-Project trained a total of 66 healthcare workers from 66 health facilities in Wakiso and Pallisa districts on diagnosis, treatment, registration of APP cases. This was done in a two-day session at the district headquarters followed by quarterly follow-up meetings with the health workers. One day Refresher trainings were also carried out at each health facility annually to emphasise on proper management and registration of cases. In addition, over 250 members of the Village Health Teams were trained to sensitize and refer any victims of pesticides poisoning to a nearby heath care facility using a data capturing tool designed by the Pesticides use, Health and Environment (PHE) Project. A total of 1300copies of the pesticides registration tools for capturing APP data were distributed to the 66 trained health care workers in the 66 trained facilities (42 from Wakiso and 24 from Pallisa districts).

Materials

The tool was meant to capture different attributes, including: Victim's demographic information, name of poisoning agent, type of poisoning exposure, signs and symptoms observed, first aid/treatment given, outcome of the patient, referrals to the higher facility and general comments by the clinician. (Annex APPF)

On a Monthly basis, follow-up calls were made to the 66 facilities through their trained health care worker inquiring about any new APP case registered as well as keeping in touch and focusing them on the project objective. Facilities with new case registries were visited by the PHE project officers on a quarterly basis, new registry case forms picked with a one copy submitted at the district Biostatician's office while the other copies sent to the project headquarters for entry. This was done for a period of five years in the 66 health facilities from the two districts.

In addition, quarterly meetings were held with the previously trained health care workers as a refresher and a follow-up training to serve as an evaluation for covering the gaps in the data collection process.

Data analysis

Data collected were consecutively entered using Epidata version 3.1 into a pesticides poisoning database. The database in excel was then exported to Stata/SE14.0 for cleaning and analysis using Stata/SE14.0 Statistical package. Results were tabulated in frequencies for graphical presentation in addition to realizing t-tests and chi-square tests.

Ethical considerations

PHE project activities including evaluations for health care facilities were all approved by Ministry of Health. The data collection tool was submitted for scrutiny by the Ministry of Health before the data collection process by the health care workers. This study did not encompass secondary data review and collection, no interphase nor was collection of biological samples from the human subject done. All questionnaires were anonymously filled with patient initials and no patient name was used in the data entry and or Analysis.

Results

A total of 393 Acute Pesticides Poisoning (APP) cases were registered (Table 1). Male cases were registered in higher proportions than females and the difference was statistically significant ($p<0.05$). The association between gender and all types of pesticides exposure was significant (<0.05); males formed majority of occupational and intentional exposures while female the accidental exposures (Table 1).The mean age of cases was 20.6 years (SD ± 17.4 years), ranging from 0.4 to 77 years, with a mean male age of 22.7 years (ranging 0.6 to 77 years) and female age of 18.1 years (ranging 0.4 to 75 years). Males were significantly older than females ($p<0.05$). By all poisonings, age group <12 years was registered with the highest number of poisoning cases followed by >30 years. Age group was significantly associated with exposure types of intentional, accidental and occupational exposures ($p<0.001$). Age group of >30 years formed majority of both intentional and occupational poisoning while that of <12 years dominated the accidental poisonings with 146 (67.8%) being children below 5 years. Using a test, intentional poisonings were significantly older than the non-intentional (occupational and accidental) victims 31.5 (SD ± 13.97) & 12.99 (SD ± 15.90) respectively, $p<0.001$ (Annex 02).

As shown in Table 1, the highest numbers of cases were due to accidental exposures followed by intentional poisonings exposures with 178 (45.3%) and 82 (20.9%) respectively. A significant association was found between the class of pesticide and the three types of pesticide poisoning exposures ($p<0.040$).

By pesticide class and group

Acute Pesticide poisoning cases were registered by pesticide target organism and active chemical group. Considering pesticide class by target organism, out of the total cases registered (393, majority of these victims

Table 1. Pesticide poisoning by gender, age group, class of pesticide and outcome verses type of pesticide exposure (Chi-square).

N	Variables	Total Number of cases	Intentional	Accidental	Occupational	Others	P-value
		N (%)	82 (20.9)	178 (45.3)	37 (9.4)	96 (24.4)	
Gender	Female	176 (44.8)	30	99	9	38	<0.001
N=393	Male	217 (55.2)	52	79	28	58	
Age group	<12 years	146 (37.2)	0	139	0	7	<0.001
N=393	12-19years	40 (10.2)	17	3	2	18	
	20- 30years	80 (20.4)	25	13	16	26	
	>30years	127 (32.3)	40	23	19	45	
Class of pesticide	Insecticide	89 (60.4)	34	34	12	9	<0.040
N=147	Herbicide	25 (17.0)	6	10	8	1	
	Acaricide	10 (6.8)	1	6	2	1	
	Rodenticide	19 (12.9)	10	7	2	0	
	Fungicide	4 (2.7)	0	1	3	0	
Outcome	Recovered normally	159 (40.5)	29	77	25	28	<0.001
	Recovered with complications	23 (5.9)	13	6	1	3	
	Death related to poisoning	8 (2.0)	7	0	0	1	
	Cases not followed-up	203 (51.7)	33	95	11	64	

*For unknown cases and those with missing data on class of pesticide exposed to, were not included in the table column; unknown cases (208) and missing data 4 cases).

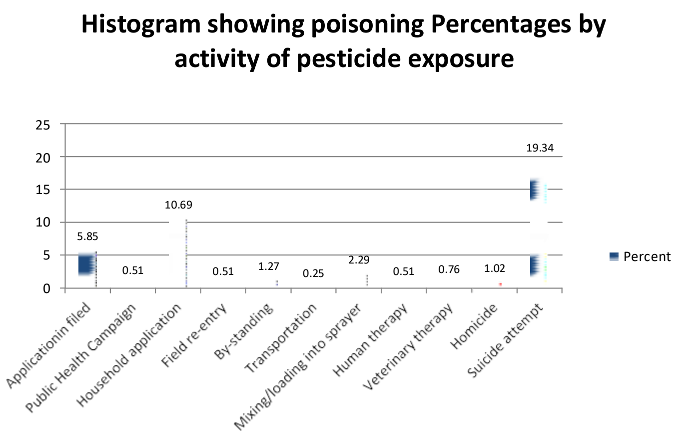
had unidentified class of pesticides 246 (62.6%) for poisoning while only 147 (40.9) were known and 4 (1%) had missing data (not included in the table). Among the known, Insecticides were the most frequent 89 (60.5%) followed by Herbicides 25 (17.0%), Acaricides 10 (6.8%), Rodenticides 19 (12.9% and Fungicides 4 (2.7%) respectively as indicated in Table 1.

A majority of 215/393 (54.7%) cases were non-intentional poisoning of which 37/215 (17.2%) were occupational poisoning cases and 178/215 (82.8%) accidental poisoning cases, while 82/393 (20.9%) were intentional poisonings and the rest 96/393 (24.4%) were of unknown exposures. The health workers faced a challenge of inability to obtain names of pesticides that caused majority 301/393 (76.6%) of the poisoning by active ingredient while 34/393 (8.7%) registered as non-pesticide poisonings and only 58/393 (14.8%) registered as cases with known pesticide names. These included by chemical group included; Organophosphates 29/58 (50.0%), Rodenticides (Coumarin & phosphide) 11/58 (19.0%), Pyrethroids 7/58 (12.1%), Phosphonates 5/58 (8.6%), Acaricides 3/58 (5.2%), Carbamates 1/58 (1.7%), Thiocarbamate 1/58 (1.7%) and Phenoxy acids 1/58 (1.7%) with the last three registered in equal proportions.

By route of entry and treatment outcomes

Pesticides route of entry into the body was mainly through oral 171 (43.6%), followed by dermal exposures 20 (5.1%), respiratory 18 (4.6%) and ocular exposures 9 (2.3%). However, majority of the cases 174 (44.4%) were registered with unknown routes of exposures. Although health workers were unable to register 203 (51.7%) of the patient outcomes, registered outcomes included 159 (40.5%) recovered normally, 23 (5.9%) recovered with complication and 8 (2.0%) died of APP. Out of 212 patients that received treatment with a combination of drugs, majority 58 (27.4%) were treated with atropine followed by hydrocortisone 47 (22.2%), charcoal tablets 39 (18.4%), normal saline 35 (16.5%), gastric lavage and charcoal tablets 18 (8.5%), other treatments given included 7 (3.3%) diazepam, 4 (1.9%) Dexamethasone and lastly equal proportions 2 (0.9%) receiving both artificial respiratory oxygen and Cetirizine.

From (Figure 1) below, majority of the cases 76 (19.3%) had suicide attempts at home, followed by 42 (10.7%) with household application and 23 (5.9%) field application, 9 (2.3%) exposed during mixing or loading the chemical into the pump. Public health campaigns and transportation were



*The above graph omits percentages of unknown activity of exposures which is about 224 (57%).

Figure 1. Frequencies of acute pesticides poisoning by activity of exposure.

among the exposures registered with the least cases of poisoning with 2 or less (≤0.5%) cases registered.

Majority of cases 169 (43%) were registered in 2016, followed by 122 (31%) in 2017. By month, August had the highest pesticides poisoning registration 56 (14.3%) followed by September 49 (12.5%). June and July both had 43 cases registered as indicated in Figure 2.

Discussion

Our intervention shows main findings as the magnitude of pesticides poisoning registered in 43/66 health facilities for a period of 5 years (2013-2017) in rural farming communities with 65.2% reporting and an annual average of 78.6 cases, mainly affecting the males and age groups of <12 years, of which the largest percentage being children below the age of 5 years, Implying that, APP in rural communities is mainly among the vulnerable population with a weak immune system and therefore needs more attention and protection by caretakers.

Surveillance under the Uganda ministry of Health uses the Health Management and Information System (HMIS) register 105 under the outpatient department for pesticide poisoning registration and a monthly tool for reporting.

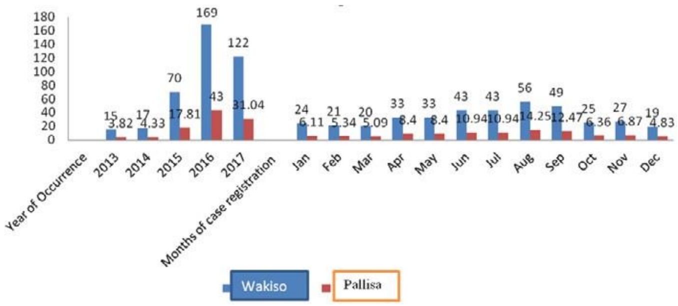


Figure 2. Acute pesticides poisoning distribution by year (counts) and month (percentages).

Pesticides poisoning is reported as an aggregated data together with other kinds of poisoning making it difficult to specify the actual magnitude of pesticide poisoning at district and national level as a whole, restricting accessibility and utilisation of pesticides poisoning data during planning for pesticides poisoning management needs and grass root outreach interventions to mitigate the causes of poisoning by the Uganda Ministry of Health.

Although in the Uganda rural settings women take it as an obligation to take care of the home and children and thus more engaged in agricultural work than men, agricultural tasks requiring enormous pesticide application are more performed by men. This explains why in our results males formed majority of the cases, they are more involved in pesticide application increasing the risk to acute pesticide poisoning by occupational exposures than women while women are accidentally exposed through drifts from gardens or when handling spray equipment after the activity of spraying. This is similar to a review by Sarwar and Azizpour [20,21] respectively which showed exposure to pesticides was higher among men and by Cha and Lee [22,23] respectively in south Korean where men formed majority of pesticides poisoning incidences and deaths but different from studies from the Middle-East [21,24] where women formed majority of the poisoning cases. Furthermore, as compared to the above studies in South Korea, our study also found out that being a male increased chances of intentional poisoning by 1.78 times. This concurs with a study from llama province, Iran [21] where males had a high tendency of committing complete suicides while female with a high tendency for incomplete suicides thus female do this as a way of attracting attention mainly to their spouses which is categorised more as being non –intentional than intentional poisonings.

This descriptive study shows <12 years age group as the most affected as this could be due to poor storage of pesticides bottles in areas accessible by children directly or through the contaminated dusts in the house which might be contaminated by pesticides residues after indoor residual spraying as found out [25,26]. These results are synonym to another study in china and Iran (Tehran) [27,28] respectively, where majority of the cases was children and majorly accidental in nature. The second affected in position, >30 years age group are adults and were significantly associated with intentional poisoning ($p<0.001$). These are majorly engaged in rigorous agricultural works of spraying but also face other risks of exposure which may not be farm related like stress, family overload, and domestic violence among other risks.

Across the 5 years, the number of cases increased with years, but rapidly increased in the second year to the fourth year (2014-2016) and reduced drastically in the fifth year. This trend can be due to the increased case diagnosis and registration at the facilities which was brought about probably by decentralising the mode of training from central place to health facility level as a way of increasing the number of healthcare workers trained, with an aim of bridging gaps in staff restructuring to facilities which had never received trainings before. Month of August-September was the period during which highest incidences were registered because this is the second season of the year coupled with garden preparation where pesticides users buy a lot of pesticides to spray their gardens for pest control. More than ½ of the cases were non-intentional poisoning (accidental and occupational poisonings) similar to findings from china [27] but different from findings in Iran and Sri Lanka where majority of cases were intentional poisoning [29,30] respectively.

Non-intentional (accidental and occupational poisonings) was the most registered type of poisoning registered as the interventional areas are mainly farming communities and the kinds of exposures are mainly accidental and occupational but also most of the intentional poisonings die before reaching the health facility for registration. Accidental, occupational and intentional poisonings were significantly associated with age group. Accidental poisoning happens mainly among (< 12 years and >30 years) mostly due to poor storage of these chemical and their availability in shops making them easily accessible for young and old respectively. Generally, lack of adequate safety knowledge and attitude to PPE use among occupational users also contribute to occupational exposures.

Insecticides of which Organophosphates and herbicides poisoning ranked highest among cases registered. Organophosphates which are mainly insecticides form the largest percentages of pesticides classes sold on the market for use in both agriculture and public health control. Rodenticides in the 3rd position of which majority are Rat poisons have been reported on several occasions by health care workers as the most class of poisoning used by children for both intentional and accidental poisoning. These are mainly accessed by children as rat baits (poison spread on bread or ground nuts). There is need for more training on safe application of rodenticides starting with agro-input dealers so that they can be able to pass on the information to the end-user on the safest way of putting up the baits. Comparing these results to other study findings [29] in Iran, organophosphates formed majority of all pesticides poisoning with a reason for its most sell and use as an insecticide.

The inability of health care workers to identify the type of pesticides poisoning is mainly due users buying pesticides in non-original containers thus finding it difficult to ascertain the cause of poisoning to a specific class of pesticide. Liberalisation of pesticide sale and use also largely contributes to these results. Those whose outcomes were registered unknown are mainly cases that were referred to higher level facilities and followed-up not registered their outcomes. Referrals are mainly due to lack of high level treatments which are required and not available at lower health centre like lack of some antidotes like atropine and oxime classes mainly available at hospital levels.

Findings of this study in context of type of exposures are similar to other findings [10] from developing countries which shows how misuse of agricultural pesticides are contributing to big proportions of intentional poisoning. In the developing countries like Uganda especially the rural areas pesticides are readily available from shops and markets which are liberalised and seldom monitored by the relevant agricultural officers for their fit to sell such chemicals. During management of cases, there are few antidotes for healthcare workers to choose from and use, however, Administration of Charcoal tablets alone for oral routes of entry is key in the management of Cases just like other studies have demonstrated [31] but no significant change in mortality thus charcoal has to be used with other drugs and antidotes in pesticides poisoning management [32].

Our findings indicate the relevance of continuous sensitisation among rural agricultural communities on the use and storage of pesticides in public health control, with emphasis on children protection as well as strengthening follow-up mechanisms by health workers on treated cases and capturing of health information on low priority health events like pesticides poisoning which are missed in the National Health Information Management System (HMIS).

This study has some limitations including the exclusion of the grass root health centres I (the Village Health team members who easily register these cases from the community). However, the health centres II, III and IV plus a few private clinics where data was collected have a higher turn up of patients. Generally there is limited awareness on pesticide health and safety; and yet the data collected was mostly based on the patients' or cares' ability to recall all the specific information about the poison. As a result there is a lot of missing/ unknown data although it was collected for a wide range of variables hence still informative. The study also took initiative to sensitize community members through drama on pesticide health and safety to increase awareness.

One of the strengths of this study is that it can be generalised with other districts in Uganda. This is because data was collected from all levels of health facilities right from health centre II to the central level of the districts involved (HCII to Hospital level) and from various categories and age groups of people and occupations.

Conclusions and Recommendations

Pesticides poisoning is an on-going health challenge that has not been prioritised yet by the country's health sector. Non intentional poisoning forms majority of the cases with Organophosphates as the major pesticide of exposure while children <12 years as the most affected age group. This study serves as a guide for the country to build a robust pesticide poisoning surveillance and poisoning management system and pesticide access control mechanisms. On top of making effective drugs like atropine, charcoal and normal saline readily available in the lower health facilities, the ministry of health should consider inclusion of APP case registration in the HMIS 105 register while ministry of education address the health care workers gap on APP diagnosis, treatment and management by including it in the clinical syllabi among medical students.

Data Availability

Data set used to yield the above results is available upon request from the author.

Conflicts of Interest

Authors of this article declare no conflict of interest for all issues concerned with data collection and reporting of results of this research. All methods have been strictly followed to ensure accurate data collection and analysis.

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