



## ABBREVIATED PAPER

## Predictors of mortality in emergency centre patients with acute pesticide poisoning in Uganda

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## ABSTRACT

**Introduction:** Although the global suicide deaths due to intentional pesticide poisoning disproportionately occur in low income countries (LIC) and lower to middle income Countries (LMIC), there is a scarcity of reports on emergency centre (EC) mortality and its predictors in these settings. Our goal was to determine the case fatality rate of Acute Pesticide Poisoning (APP) presenting to Mbarara Regional Referral Hospital (MRRH) EC and find out whether initial triage category predicted mortality in these patients.

**Methods:** This was a prospective observational longitudinal study. Patients presenting with APP were enrolled using data collection forms. Data collected included initial triage category, vital signs, demographics, initial assessment, and management. They were followed up for 1 week.

**Results:** Out of 66 patients admitted with suspected pesticide poisoning, 61 had complete follow up during the study period. However, only 58 patients had the pesticide ingested confirmed. These were predominantly males 48 (73%) and farmers 28(42%) with a median age of 23 years (IQR 18-31). Majority of patients 58 (88%) were suicide attempts and had ingested mostly organophosphates 23 (35%), amitraz 11 (17%), zinc phosphide 7 (10%), and aluminium phosphide 4(6%). The median time from ingestion to presentation was 4hours (IQR 2.5-8). More than half 41(62%) of the patients were in the red triage category (ESI-1). The overall case fatality rate of APP was 18%. Majority of patients who died were in the red triage category but the initial triage category was not significantly associated with mortality ( $p=0.381$ ). Male gender ( $p=0.018$ ), time of admission ( $p=0.037$ ), and triage vitals including hypothermia ( $p=0.020$ ), hypoxia ( $p=0.004$ ), hypotension ( $p=0.031$ ), and tachypnea ( $p=0.031$ ) were significantly associated with mortality.

**Discussion:** Although initial triage category was a poor predictor, triage vital signs, gender, and time of admission were significantly associated with mortality in patients with APP.

## Introduction

Pesticides are a major public health burden in developing countries. In 2019, WHO estimated that annually, 37% of deaths resulting from suicide worldwide were due to the deliberate ingestion of pesticides[1]. These deaths are disproportionately higher in low income countries (LIC) and lower middle income countries (LMIC), which lack rigorous pesticide regulatory and safety measures[2].

Patients with acute pesticide poisoning (APP) often require monitoring of airway, breathing, and circulation and critical care management[3]. These services are best provided in intensive care units which are few in Uganda[4]. Early identification of patients needing timely intervention and critical care may improve resource allocation and clinical outcomes. This is mostly important in situations of overt resource limitation as in LMICs[2], [5].

Emergency Centre triage assessments generally predict the likelihood of hospital admission, length of stay, mortality, and resource use[6]. However, this is not yet clear in patients with APP. The other tools used in risk stratification of patients with acute poisoning like the Poison Severity Score are complex and not practical for use in a busy emergency centre in a resource limited setting with no access to extensive investigations[7]. We therefore aimed to determine the case fatality rate of APP presenting to Mbarara Regional Referral Hospital (MRRH) Emergency Centre and find out whether initial triage category predicted mortality in these patients.

## Methods

This was a prospective observational longitudinal study carried out at MRRH Emergency Centre. MRRH is a government owned regional re-

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ferral hospital located in South Western Uganda, 286 km from Kampala. It serves 11 districts with a population of more than 2.5 million people.

Patient triage was recently introduced to the emergency centre using a tool that was adopted from the Emergency Severity Index (ESI)[8]. While the ESI has 5 categories from 1 Critical/dying, 2 Emergent, 3 Urgent, 4 Non urgent and 5 Routine), the MRRH Emergency Centre triage tool has four (Red = ESI-1, Yellow =ESI-2, Green= ESI 3 & 4, and Blue= ESI-5). The research assistants were nurses and emergency medicine residents who were trained on how to use the MRRH Emergency Centre triage tool. However, to ensure quality, the triage vital signs and presenting complaint were part of the data collected and used to determine the patient’s ultimate triage category.

A consecutive sampling method was used to enrol patients. Patients who presented to the emergency centre with a history of having ingested any pesticide (either witnessed or suspected) and those with an odour or clinical examination that revealed signs consistent with pesticide ingested were included in the study. Those with suspected poisoning but with no accompanying signs of toxicity and had an alternative most likely diagnosis that explained signs and symptoms were excluded. Also, those who did not consent to take part in the study were excluded.

We obtained ethical approval from Mbarara University of Science and Technology Research and Ethics Committee (Ref MUREC: 1/7). Data were collected from October 2019 to August 2020 using a data collection tool which captured patients’ demographics, initial patient assessment, and management parameters. Research assistants enrolled patients at triage after being notified by the triage team. They followed up the patients daily for a week, through observation of patients’ condition and changes in management on daily ward rounds. They recorded the four-hour vital signs, four-hour outcomes, and one-week outcomes. For patients who had been discharged before 1 week had elapsed, a follow up phone call was made at one week post admission. The research assistants asked about the patients general condition, whether they had recovered or gotten worse or died post discharge.

We entered data into Excel® sheet and exported to Stata®. We analysed using Stata/IC Version 12.0. Continuous variables were analysed by computing means and medians while discrete variables were analysed using Fisher’s exact. In the analysis, we only included patients with fully filled data collection forms and we excluded those who were lost to follow up at one week. The outcome variable of interest was mortality at one week. This was measured as the proportion of patients with APP who died within one week of admission to the emergency centre. The main predictor studied was the triage category. However, we also analysed triage vital signs and other variables that were found to affect mortality in other previous studies.

**Results**

Between October 2019 and August 2020, 6600 patients presented to the emergency centre. Although 80 of those had history suggestive of APP, only 66 patients met the inclusion criteria. Of the 14 patients who were excluded, 5 had alcohol intoxication, 2 were diagnosed with ischemic strokes, and 5 had ingested other compounds that were not pesticides including hair dye, paracetamol tablets, amitriptyline tablets, and lead batteries. Two patients who had ingested organophosphates

**Table. 1**  
Patients’ baseline characteristics

Characteristic N=66	n (%)
<b>Age</b>	
Median	23years IQR (18-31)
<b>Gender</b>	
Male	48 (73)
Female	18 (27)
<b>Occupation</b>	
Farmers	28 (42)
Students	18 (27)
Business owners	06 (9)
House wives	04 (6)
Boda Boda riders	03 (5)
Others	07 (11)
<b>Address</b>	
Mbarara	39 (59)
Isingiro	15 (23)
Kiruhura	05 (8)
Rwampara	03 (4)
Others	04 (6)
<b>Type of pesticides ingested</b>	
Organophosphates	23 (35)
Amitraz	11 (17)
Zinc Phosphide	07 (10)
Aluminium phosphide	04 (6)
Mixed poisoning	05 (8)
Rat poison (unknown class)	04 (6)
Unknown	04 (6)
Pyrethroid	02 (3)
Others	06 (9)
<b>Lag time</b>	IQR 4hours (2.5-8)
<b>Triage category</b>	
Red	41 (62)
Yellow	25 (38)
<b>Reason for poisoning</b>	
Suicide	58 (88)
Homicide	06 (9)
Accidental	02 (3)

The overall case fatality rate of APP at one week was 18% (11/61). Although 73% (8/11) of those who died were in the red category (ESI 1), initial triage category was not significantly associated with mortality (p=0.381) (Table 2).

and amitraz did not consent and were excluded. Five patients were lost to follow up at one week.

The patients were most often young adult males, worked as farmers, had suicidal intent, and resided in Mbarara district or the neighbouring Isingiro district. The pesticides ingested were mostly organophosphates, amitraz, zinc phosphide, and aluminium phosphide. (Table 1 ).

**Discussion**

In this prospective study, we found an overall case fatality rate of 18%. This rate was higher than 3.8% found in rural hospitals in Uganda[9]. This is possibly because the Pedersen study was retrospective and studied a population that had ingested majorly organophosphates (72%). In contrast, only 35% of our study population had ingested organophosphates with a big contribution from other less known,

**Table. 2**  
Triage as a predictor of one week mortality

Triage	Alive	Dead	Total	Fisher’s exact pvalue	1-sided Fisher’s exact pvalue
N=61					
Yellow	19	3	22		
Red	31	8	39	0.731	0.381
N=66 (including the lost to follow up and assuming that they died)					
Yellow	19	6	25		
Red	31	10	41	1.000	0.607

**Table. 3**  
Other predictors of mortality

Predictor: N=61	alive	Dead	Total	Fisher's exact pvalue	1-sided Fisher's exact p value
<b>Gender</b>					
Female	17	0	17		
Male	33	11	44	0.025	0.018
<b>Time of admission</b>					
Day	29	10	39		
Night	21	1	22	0.045	0.037
<b>Lag time</b>					
≤ 2	11	3	14		
>2	39	8	47	0.703	0.488
<b>Suicidal Attempt</b>					
No	6	2	8		
Yes	44	9	53	0.627	0.445
<b>Referred</b>					
No	32	5	37		
Yes	18	6	24	0.315	0.211
<b>Farmer</b>					
No	29	6	35		
Yes	21	5	26	1.000	0.546
<b>Antidote available</b>					
Yes	25	5	30		
No	25	6	31	1.000	0.524
<b>Comorbidities</b>					
No	31	9	40		
Yes	19	2	21	0.302	0.185
<b>Triage category</b>					
Yellow	19	3	22		
Red	31	8	39	0.731	0.381
<b>Triage vital signs</b>					
<b>Respiratory rate</b>					
Normal	11	6	17		
Abnormal	39	5	44	0.058	0.039
<b>Tachypnea</b>					
No	43	6	49		
Yes	7	5	12	0.031	0.031
<b>Oxygen Saturation</b>					
Normal	38	3	41		
Hypoxia	12	8	20	0.004	0.004
<b>Pulse rate</b>					
Normal	13	3	16		
Abnormal	37	8	45	1.000	0.599
<b>Blood pressure</b>					
Normal	10	5	15		
Abnormal	40	6	46	0.118	0.086
<b>Hypotension</b>					
No	43	6	49		
Yes	7	5	12	0.031	0.031
<b>Level of consciousness</b>					
Alert	13	3	16		
Responds to voice	12	1	13		
Responds to pain	9	4	13		
Unresponsive	16	3	19	0.511	
<b>Pupil size</b>					
Normal	18	6	24		
Abnormal	32	5	37	0.315	0.211
<b>Temperature</b>					
Normal	10	5	15		
Abnormal	40	6	46	0.118	0.086
<b>Hypothermia</b>					
No	44	6	50		
Yes	6	5	11	0.020	0.020
<b>Skin status</b>					
Dry	44	10	54		
Wet	6	1	7	1.000	0.630
<b>Intubation</b>					
Yes	9	1	10		
No	41	10	51	0.673	0.420
<b>Admission into ICU</b>					
Yes	10	3	13		
No	40	8	48	0.687	0.430
<b>Lavage</b>					
No	20	5	25		
Yes	30	6	36	0.747	0.497

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Table 3 (continued)

Predictor: N=61	alive	Dead	Total	Fisher's exact pvalue	1-sided Fisher's exact p value
<b>Activated Charcoal</b>					
No	20	3	23		
Yes	30	8	38	0.511	0.335

On the other hand, male gender ( $p=0.018$ ), daytime admission ( $p=0.037$ ), and initial triage vital signs including hypoxia ( $p=0.004$ ), tachypnoea ( $p=0.031$ ), hypotension ( $p=0.031$ ), and hypothermia ( $p=0.020$ ) were significantly associated with mortality at one week (Table 3).

more toxic pesticides with no available antidotes. Secondly, because we studied a cohort of mainly adult male farmers who have good knowledge of and easy access to pesticides coupled with the thoroughness with which men tend to attempt suicide, it is likely that higher doses were taken leading to high toxicity. Our case fatality rate was however related to 25.4% overall mortality found in a Taiwanese emergency centre [9]. Notably, the slightly higher mortality rate found in the Taiwanese ED was due to paraquat ingestion which was not ingested by any of our patients.

Although previous studies had showed that higher priority patients had a higher likelihood of dying [6], we found that ESI category was a poor predictor of mortality. It is plausible that this is because higher ESI categories likely led to earlier and more aggressive treatment which changed the course of the poisoning and overall outcome. In addition, the fact that pesticides have varying toxicokinetics and toxicodynamics may mean that the disease progress in these patients may not follow the same course as other conditions. It implies that stability at triage may not necessarily predict patients' outcomes and all of them require urgent and aggressive treatment nonetheless. The presence of antidotes may also alter the course of the disease despite the severity on admission and therefore would explain the poor association with mortality.

We also found that male gender, time of admission, and triage vital signs especially hypoxia, tachypnoea, hypotension, and hypothermia were good predictors of mortality in these patients. These findings are similar to those reported in previous studies. A study on emergency centre mortality in Taiwan found that suicide attempt, respiratory distress, and hypothermia were significant predictors of mortality in pesticide poisoning [10].

Although initial triage category was a poor predictor of mortality, initial triage vital signs, gender, and time of admission significantly predicted mortality in these patients. A multi-centre study should be done to assess a simple-to-use emergency centre tool that utilizes initial triage vital signs for the risk stratification of patients with APP. Patients with APP should be intensively monitored and managed irrespective of their initial triage category.

This was a small heterogeneous study sample that was composed of mostly dying or critical patients (ESI 1). Hence the other categories were not well represented. Another limitation was that 5 patients were lost to follow up. Of these, 3 had improved at the time of discharge while 2 were still sick but escaped from the ward and failed to pick up when called. So it is likely that these numbers would not significantly impact the results.

The enrolment depended on notification of research assistants by the triage team and therefore it is possible that we might have missed data from those patients that we were not notified about.

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## Dissemination of results

The results from this study were shared with Mbarara Regional Referral Hospital clinical team, and administration. A copy was given to the MUST Department of Emergency Medicine,

Internal medicine, Faculty of Medicine, and Library.

## Authors' contribution

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: JAO contributed 50%; DH 25%; and HC 25% each. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

## Declaration of Competing Interest

The authors declared no conflicts of interest.

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