A descriptive study of acutely poisoned patients presenting to the Western Cape Emergency Medical Services

by

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BEMC

MRRFAB001

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List of Abbreviations

AC	Activated charcoal
AEA	Ambulance Emergency Attendant
ALS	Advanced life support
ARV	Antiretroviral
BAA	Basic Ambulance Assistant
BLS	Basic life support
CO	Carbon monoxide
COVID-19	Coronavirus disease
CPR	Cardiopulmonary resuscitation
EC	Emergency centre
ECA	Emergency Care Assistant
ECG	Electrocardiogram
ECP	Emergency Care Practitioner
ECT	Emergency Care Technician
EMS	Emergency medical services
HIC	High income country
HPCSA	Health Professions Council of South Africa
ICU	Intensive care unit
ILS	Intermediate life support
IV	Intravenous
MAP	Mean arterial pressure
LMIC	Low-and middle-income country
NSAID	Non-steroidal anti-inflammatory drug
PSS	Poisoning Severity Score
SATS	South African Triage Scale
TB	Tuberculosis
UMIC	Upper-middle income country
WCGEMS	Western Cape Government Emergency Medical Service

Part A: Literature Review

Introduction:

Acute poisoning remains a common presentation to prehospital emergency care personnel, emergency centres (EC's) and hospitals worldwide. Acute poisoning refers to either the accidental or deliberate adverse health effect as a result of an acute exposure to a toxic substance (1). This can include exposure to medications, illicit substances, biological agents, chemicals, and occupational and environmental toxins, among other agents (1).

Approximately 385 million cases of acute poisoning occur worldwide annually (2). It's been reported that in the United States there was a 26% increase in suicide attempts by ingestion of toxins or medication overdoses between 2015 – 2019 (2). Adding to that is a notable increase in attempted suicides and suicides due to acute poisonings in people aged 10-19 years old during the COVID-19 pandemic (3). The primary cause of acute poisonings are reported to be drugs followed by carbon monoxide and alcohol; while rodenticides and paraquat, which previously were common, now reported to be a rare presentation to the emergency department in the global setting (2).

In the United States, the top toxins identified in acute poisonings include analgesics, cosmetics, household cleaning substances, sedatives/hypnotics/antipsychotics, and foreign bodies; while in Europe, the top toxins reported were illicit drugs, sedatives/hypnotics/antipsychotics, alcohol, and carbon monoxide (4).

In Africa, acute poisoning remains a significant public health concern (5). Unfortunately data in Africa is limited, and only 10 countries in Africa have poison information centres (5). Intentional poisonings largely predominated in studies done in Ethiopia and Tanzania of acute poisoning cases (4, 5). In Tanzania, the top toxins identified were alcohol, mixtures of different medications, sedatives/hypnotics and rodenticides, while in Ethiopia, organophosphates and household cleaning agents predominated (4, 5).

South Africa is a low to middle income country (LMIC) in sub-Saharan Africa with a population estimated at 62 000 000 as of 2022, plagued by a quadruple burden of disease, namely maternal,

newborn and child health; HIV/AIDS and tuberculosis (TB); non-communicable diseases; and violence and injury (6, 7). It has been said that the healthcare management of poisoning cases represents a preventable burden on constrained critical care resources in the country and is associated with a significant economic burden (8, 9). In one study, it was estimated that the cost of managing acute poisoning patients at one tertiary hospital in South Africa equated to around ZAR 50 000 per month (for data analysed between 2010 and 2011) (10). However, it should be noted that the estimated cost for the management of each case varied from ZAR 3 690 for a non-complicated case discharged from EC to ZAR 42 250 for a complicated case admitted to ICU for 5 days (10).

A large proportion of acute poisoning patients rely on emergency medical services for treatment and transport to a hospital for further management, with a study from the Free State province of South Africa reporting as many as 67.9% of all deliberate self-poisoning patients being brought to the tertiary hospital of the study by ambulance (10). In many studies, paracetamol was the most common ingested agent implicated in acute poisoning within South Africa (11, 12).

Deliberate self-poisoning is the primary cause of acute poisonings in the global setting (2). Accidental poisoning deaths were more prevalent in LMIC's at around 84% of all reported cases in 2012 by the World Health Organization (5). It has been reported that deliberate self-poisoning is the primary method of deliberate self-harm among adolescents in Western society (13). In China, females predominantly used acute poisoning as their method of suicide when compared to males (14). Deliberate-self poisonings were also more common among females in Qatar (15).

Individuals who practice in deliberate self-poisoning may have various intentions – of which communication, threatening and suicidal are key; however it has been stated that most persons attempting deliberate self-poisonings do not intend on killing themselves (16). Rather the action of deliberate self-poisoning may be due to feelings of depression, anger, jealousy, or desire for attention (16).

Literature Review Strategy:

Since this study is based on published papers, there is a need for a review of relevant and recent literature in order to contextualize the reported results and highlight the problem of acute poisoning. Electronic searches of PubMed (indexing MEDLINE), EBSCO Host (Indexing Africa-Wide Information and CINAHL, and SCOPUS were conducted, as well as searches of references from articles found from primary searches. Titles and abstracts of the results of the searches were reviewed for inclusion.

Searches included the use of several terms such as “overdose/s”, “toxins”, “acute poisoning/s”, “accidental poisonings” combining this with “prehospital” or “ambulance” or “emergency medical service”. Searches were limited to articles from the last 15 years; from 2009 to August 2024. A total of 38 articles were reviewed in full and 34 were included for analysis. An additional 11 articles were added following revision of the literature review.

Literature from hospital environment:

Several South African studies report on acute poisonings in the in-hospital environment (8, 9, 12, 17). These studies range from single centre studies examining the burden of acute poisonings at individual facilities to studies incorporating poison information centre data from provincial statistics.

Single Centre Studies

A study conducted at a tertiary hospital in KwaZulu-Natal examined acute poisoning patients that were admitted to an intensive care unit (ICU) (8). While patients admitted to an intensive care unit represent a particularly ill cohort of acute poisoning cases, findings must be interpreted with this in mind but are nonetheless still relevant. The majority of acute poisoning cases in this study were female and tricyclic antidepressants were the most common single agent identified as responsible for acute poisonings that were admitted to this ICU (16.5%), with antiepileptics (14.6%) and analgesics (9.7%) being the next most common agents (8). In this study, antihypertensive agents were implicated in 4.9% of all acute poisoning admissions (8). Of note, 17.6% of all acute poisoning cases admitted to this ICU in the study period had an unknown toxin responsible (which

is significant given the investigations likely to have been performed by the time a patient gets to ICU) (8).

A study conducted at an academic hospital in Johannesburg, South Africa, found that the most common agents responsible for acute poisoning (although, this was limited to intentional self-poisoning) were organophosphates/carbamates, responsible for 25.3% of EC visits, followed by Non-steroidal anti-inflammatory drugs (NSAIDs) (13.9%) and household chemicals (11.1 %) (9). Poisoning by multiple agents was recorded in 21.2% of all poisoning cases in this same study (9). Another Johannesburg hospital study reported that 8.5% of all admissions (not only poisoning cases) to the medical acute care unit at that facility were the result of non-accidental organophosphate poisoning (18). Both studies suggest a potential difference in patterns of acute poisoning by geographic region.

A study at a single centre, district level hospital in Cape Town, Western Cape, found that paracetamol was implicated in approximately one quarter of all intentional self-poisoning patients presenting to the resuscitation unit of that facility - paracetamol (25%) was the most ingested agent, followed by insecticides and pesticides (6.7%) and household products (5.8%) (12). Another Cape Town study from a tertiary hospital reported similar results, paracetamol ingestion had the highest number of occurrences of a known toxin (38.3%), followed by tricyclic antidepressants (12.7%), anti-hypertensives (12.7%), and antihistamines (12.0%) (17). Both studies reviewed acute poisoning patients with deliberate self-harm, and both used retrospective analysis of patient chart reviews as their primary means of data collection (12, 17). There was a significantly higher number of unknown toxins reported in the tertiary hospital study (23.5%) (17).

This contrasts with a study conducted in Uganda, which showed that the most common toxins in patients admitted to two large academic teaching hospitals in 2021 were alcohol (27.2%), followed closely by organophosphates (21.2%) (19). Data was collected by means of retrospective chart reviews and included all acute poisoning cases, regardless of intentionality and it recommended to raise community awareness, limit alcohol consumption, reduce the use of agricultural organophosphates, and provide training for healthcare workers to effectively manage these emergencies (19).

A common finding from local literature shows that most acute poisoning patients, whether intentional/deliberate self-harm or not, were shown to be female (8-10, 12, 17). Gender of acute poisoning cases would seem to vary geographically, with males higher in an Iranian ICU study (64%), and in Uganda (60%), while a study from Chile showed 68% female presentations (19-21). A South African cross-sectional study conducted in a tertiary hospital in Cape Town, reviewed all deliberate self-harm patients that presented to the EC in 2014-2015 and reported that males tend to employ more violent methods of self-harm, which may explain the higher prevalence of females in acute poisoning populations (17).

South Africa has a single national Poison Information Centre based in the Western Cape. A 2012 study examining the calls they received, revealed that accidental exposure was more common than intentional poisoning (22). As most of the local literature focuses on acute poisonings in the adult population, it should not be surprising that this study, which also includes the paediatric population revealed that 98.8% of all paediatric cases (aged <13 years old) were the result of accidental exposure, contrary to their adult counterparts (22). This Poison Information Centre study also found that although non-drug chemicals such as pesticides outweighed acute poisonings by pharmaceutical agents, of the pharmaceutical agents implicated across all age groups, paracetamol was the most common agent, followed by benzodiazepines and antihistamines (22). Of the non-drug chemicals that were responsible for acute poisonings in this study, pesticides (including organophosphates) were the most common agent, followed by irritants/corrosives and volatile hydrocarbons (22). Ingestion was the most common route of exposure in this study, and others across all age groups (22, 23).

The usefulness of a poison information helpline should not be underestimated and was apparent during the COVID-19 pandemic, where this service was used extensively, such as in the case of hand-sanitizer ingestion (24). Specifically, the usefulness of this service allowed trained personnel to advise on when it was safe to allow for monitoring at home, vs when transport to a hospital was necessary, thereby decreasing the burden on EMS, as well as local EC's (23, 24).

Paediatric-focused studies

Paraffin was the single most common agent responsible for poisoning admissions in a Cape Town paediatric hospital, while the most common pharmaceutical agents implicated were antipsychotics and antidepressants (28%), flu medications and antihistamines (8%), antihypertensives (7%), analgesics (7%), anticonvulsants (6%), and with vitamins and minerals accounting for 4% of all cases (23). This data was for the period of 2003-2008, and it remains unknown whether this is still the case today, however, paraffin ingestion among children in the Western Cape has been a problem for many years, with a 1987 study showing paraffin ingestion in 30% of all cases presenting to a local children's hospital (23, 25). There is evidence that paraffin ingestion remains a common occurrence today, with a recent study in Nigeria, another LMIC in sub-Saharan Africa, showing that it accounts for majority (48.6%) of childhood poisonings in the region (26).

Literature from the prehospital environment:

There remains limited literature on acute poisoning cases presenting to the prehospital provider in South Africa. EMS providers play a vital role in the acute management and transport of these patients, and it has been shown that early advanced life support measures decrease complications and mortality (27). Van Hoving et al. (12) found that 65.6% of all intentional self-poisoning patients in a Cape Town hospital arrived in the EC via ambulance, showing the importance of the role of local EMS in acute poisoning patients.

A study by Tilley et al. (28) examined cases of deliberate self-harm presenting to the Western Cape EMS in the Garden Route District between 2017 – 2019. They used a retrospective cross-sectional design and gathered data from EMS incident management records by categories where deliberate self-harm would be captured, including interfacility transfer cases, and found a total of 2976 cases that met inclusion criteria. This study found that deliberate self-poisoning accounted for 52% of all deliberate self-harm cases presenting to EMS in that district, with females being 3 times more likely to overdose then males (28). The study also suggested that the probability of overdose decreases with age (28). However, the study excluded poisoning that were believed to be accidental in nature, and also excluded poisonings that occurred in children under 8 years of age (28). The agent implicated in the vast majority of cases was an unspecified substance (28). Alcohol and illicit drug use was low and only accounted for 1.5% of cases. The study suggested that Western Cape EMS develop policies to ensure the quality of health care interactions,

preventing stigmatization and improving accountability in mental health care (28). This study was significant as it was the only South African prehospital study that reported on acute poisoning as one of its objectives.

One study conducted in Oslo, Norway, examined all acute poisoning patients over (and including) the age of 16, presenting to the ambulance service over the period of a year (2003 – 2004) (29). This study found a high rate of suspected opioid related acute poisonings, many of which were discharged from scene after treatment (78% of all opioid suspected acute poisonings) (29). This opioid related acute poisoning has been well documented as a problem of growing concern in high income countries (HICs) (29-31). They also reported a very high rate of alcohol poisoning among patients presenting to the ambulance service who were discharged from scene (29).

Another descriptive study from the Catalonia region in Spain examined the characteristics of paediatric patients (defined in this study as children below the age of 18 years) exposed to acute poisoning that presented to advanced life support (ALS) prehospital providers (32). They reported that the most common agent involved in acute poisoning in the region was carbon monoxide (CO) (33.8%), which was then followed by alcohol (26%) and psychotropic drugs (16.1%) (32). CO poisoning in this study was reported as the result of the incomplete combustion of household gas or from inhaling smoke from fires, and CO-related cases often involved multiple exposures, impacting entire families or groups of people (32). Another Spanish study reviewed acute poisoning cases presenting to EMS ALS providers in the adult population (27). This study found that median age of acute poisoning in this sample was 47 years, majority of cases were female patients, and the most common agents responsible for acute poisonings were psycho-pharmaceutical drugs, followed by drugs of abuse and toxic agents as a result of smoke inhalation (27). Paracetamol and NSAIDs were combined to represent 4.1% of all cases of acute poisoning patients presenting to these units (27).

A study done in the prehospital environment in Germany found that there was an increase in acute poisoning by alcohol and drugs when environmental temperatures were higher, suggesting seasonal variations of acute poisoning patients (33). One South African study at a single district level hospital in Khayelitsha, Cape Town, did not find this, reporting equal distribution across all

days of the week, but was not explicitly designed to find an association between environmental temperature and acute poisoning presentations (12). A South African study that reported trends in suicidality, found an increase in deaths by suicide in December and January, while there was a decrease in May to July (34). It remains unknown whether there is an association between environmental temperature, or seasonal variations and acute poisoning cases presenting to EMS in the local context.

Of all the prehospital studies reviewed, only one study was conducted in South Africa, despite many patients arriving to hospital by means of an ambulance. This study was limited as it only reviewed cases of deliberate self-harm in a small geographic region and therefore it remains unknown how this relates to the remainder of acute poisoning cases presenting to EMS. Other studies reviewed were all from high income settings, as there was a paucity of data on prehospital studies from LMIC's.

Validated tools used in acute poisoning patients:

Clinicians and researchers have identified the need for tools to predict the likelihood of serious consequences in acute poisoning presentations, since the agents are often unknown, as is the time and volume of ingestion. Two of the commonly used tools with applicability to prehospital care are discussed.

Poisoning Early Warning Score

Martín-Rodríguez et al (27) in Spain developed a tool to predict the risk of serious adverse events (defined in this study as the need for advanced airway management, or the need for vasoactive drug use, or the requirement for external pacemaker use) occurring in acute poisoning patients in the prehospital setting (27). The poisoning Early Warning Score (pEWS) utilizes 3 variables (age ≥65 years, SpO2/Fraction of inspired oxygen index (known as the Sp/Fi index) ≤300 and point of care lactate (known as the pLA) ≥4 mmol/L), providing a score of either yes (1 point) or no (0 points) to each (27). The score, out of 3, had a corresponding rate of serious adverse events of 15.9% for a 1-point total, 60.5% for a 2-point total and 80% for a 3-point total (27). As lactate is not routinely measured in the prehospital environment in South Africa, this would seem to be largely applicable to in-hospital management.

Poisoning Severity Score

The poisoning severity score (PSS) was designed primarily as a reflective evaluation tool for acute poisoning cases (22, 23, 32, 35). This is a grading system mainly reflecting clinical severity, with 5 different scoring levels based on signs and symptoms as a result of exposure to acute poisoning. The PSS is scored as follows: 0 – no symptoms; 1 – minor and mild signs or symptoms that are transient and spontaneously resolving in nature; 2 – moderate, pronounced or prolonged symptoms; 3 – severe or life-threatening symptoms; 4 – fatal (23, 35). The PSS has been used as a grading tool by many poison centres worldwide, as well as a research tool to report on acute poisoning patients by presentation, however it is time consuming to use, is unable to be broadly applied to all types of poisonings and therefore has very little clinical utility (36).

Treatment Capabilities of the prehospital provider in SA:

There are various levels and qualifications of prehospital providers within South Africa, all with their own respective scope of practice, governed by the regulatory body, the Health Professions Council of South Africa (HPCSA). There were 56 894 persons registered with the HPCSA as emergency care workers in 2019 (5377 registered in the Western Cape) (37). Of these, 75.66% were registered as Basic Ambulance Assistants, 18.53% as Ambulance Emergency Assistants, 2.59% as Paramedics, 1.97% as Emergency Care Technicians, and 1.24% as Emergency Care Practitioners (37). Emergency Care Assistants were not reported on. A table summarizing prehospital practitioners can be found below (38).

Table 1: Summary of prehospital practitioners in South Africa by HPCSA Register

HPCSA Register	Qualification Level	Commonly Called	Duration of Training	Discontinued or Ongoing?
BAA	Basic Ambulance Assistant *(also called Basic Life Support)*	Basic Life Support (BLS)	6-week vocational training	Discontinued
AEA	Ambulance Emergency Assistant *(also called Intermediate Life Support)*	Intermediate Life Support (ILS)	3-month vocational training (after completion of BAA)	Discontinued

ECT	Emergency Care Technician *(National Certificate)*	ECT	2-year	Discontinued
ECA	Emergency Care Assistant *(Higher Certificate)*	ECA	1-year	Ongoing
ANT	Critical Care Assistant	CCA / Advanced Life Support (ALS)	9-month vocational training (after completion of AEA)	Discontinued
	National Diploma	NDip / Advanced Life Support (ALS)	3-year	Discontinued
	Diploma	Advanced Life Support (ALS)	2-year	Ongoing
ECP	Bachelor of Technology in Emergency Medical Care (BTech EMC)	Advanced Life Support (ALS) / Emergency Care Practitioner (ECP)	1–2-year training (after completion of NDip)	Discontinued
	Bachelor of Emergency Medical Care (BEMC) / Bachelor of Health Sciences (BHSc) degree in Emergency Medical Care	Advanced Life Support (ALS) / Emergency Care Practitioner (ECP)	4-year training	Ongoing

Medications and procedures that are available for prehospital management of acute poisoning cases are summarized below, along with their availability to different scopes.

1) Activated Charcoal

Activated charcoal is one of the mainstays of treatment of managing an acute poisoning, if treatment is started within a timely manner. Activated charcoal adsorbs ingested toxins that are still in the digestive system, before these toxins enter systemic circulation (39) The administration of activated charcoal is in the scope of practice of all emergency care personnel registered with the HPCSA (40).

Activated charcoal is given orally, within 2 hours of ingestion, at 1g/kg, however the patient must be awake and able to protect their own airway, else it may be administered via a nasogastric or orogastric tube in an intubated patient (11). There is sufficient evidence to support the prehospital

use of single dose activated charcoal by ambulance services, and high-income setting studies have shown the administration of activated charcoal has not been associated with a marked delay in transport to hospital (41, 42). As EMS are frequently a patient's first point of access to the healthcare system, it can be said that they are more likely to encounter a patient in the therapeutic window for administration of activated charcoal.

2) ECG

A 12-lead electrocardiogram (ECG) may be used to assess for arrhythmias in the case of certain toxin ingestions, but this skill is limited to advanced life support practitioners, particularly only those registered as emergency care practitioners, as per the latest clinical practice guidelines (11, 40). The earlier mentioned Spanish study reported a poor rate of compliance (17.4%) in obtaining ECGs in paediatric patients who were exposed to cardiotoxic substances (32). It remains unknown whether this is also true for South African practitioners, and whether this effect extends to the adult population as well.

3) IV

Insertion of an intravenous catheter and administration of intravenous fluids is a skill taught and practised by many EMS providers in South Africa. All are capable of this skill, with the only exception being basic ambulance assistants (BAA's), however the BAA is a supervised practitioner and ideally should be paired with a higher-level practitioner (40). Aggressive fluid resuscitation may be needed in the management of shock due to certain poisonings, and maintaining adequate perfusion is vital in drug-induced hypotension allowing for clearance of the toxic metabolites (43). This highlights the need for fluid bolusing capabilities by EMS personnel.

4) Specific Antidotes

Certain drugs with widespread uses are also indicated for the management of some common overdoses, carried by some EMS practitioners including glucagon for the management of beta-blocker overdoses, which has been shown to be effective and evidence supports its use by paramedics, the drug is now carried by several South African EMS qualifications AEA's, ECA's, ECT's, ANT's and ECP's (40, 44). Calcium is another drug carried by ANT and ECP paramedics

in South Africa and is indicated for shock due to beta-blocker overdose that is refractory to other measures (40). Sodium bicarbonate is another agent that is carried by ANT and ECP paramedics that can be utilized to treat hemodynamic instability associated with tricyclic antidepressant overdoses (40).

In terms of specific antidotes, naloxone is an opioid antagonist and the reversal agent for acute opioid overdose, and is used by many EMS systems worldwide, and is also indicated for unresponsive persons with an unknown cause (29, 31). Naloxone is currently in the scope of practice of many EMS providers, including AEA's, ECA's, ECT's, ANT's and ECP's and can be given intranasally, intramuscularly or intravenously (40). Flumazenil has been recommended only for the reversal of iatrogenic induced benzodiazepine overdose. This drug is in the scope of practice of ECA's, ECT's, ANT's and ECP's (40). Atropine is a drug that is used in the management of organophosphate and carbamate poisonings (45). Atropine, for use in a toxidrome, is in the scope of practice of ECA's, ECT's, ANT's and ECP's (40). Adrenaline infusions have also been used as an adjunctive treatment in managing acute poisoning cases, such as organophosphate and carbamate poisonings responding poorly to atropine (45). Adrenaline is in the scope of practice of ECA's, ANT's and ECP's (40).

5) Airway Management and Oxygen Administration

Airway management and oxygen administration is a skill that is taught to all emergency care providers in South Africa. Specific airway management ranges from basic airway procedures to maintain and protect the airway, to definitive airway management, such as endotracheal intubation. Currently only ECP's have the ability to intubate via means of rapid sequence intubation, and intubation with other means is not currently recommended (40). All providers have the ability to place an oropharyngeal or nasopharyngeal airway and are skilled in bag valve mask ventilation (40). It remains largely unknown how many acute poisoning patients receive supplemental oxygen or any form of airway intervention in the local prehospital environment.

A Spanish study examined prehospital treatment provided to acute poisoning paediatric patients, reporting that oxygen therapy was administered to 32.3% of cases, intravenous fluid therapy was administered to 18.1% of cases, administration of specific antidotes occurred in 6.7% of cases,

the administration of activated charcoal only occurred in 6.3% of cases (and was only given in only 1/3 of eligible patients), and nebulized drugs were administered in 4.3% of cases (32). A complete set of vital signs were also highlighted in this study as being largely missing from this sample of patients and was a noticeable weakness in the quality-of-care indicators (32). This study holds value as many of the treatment modalities and quality of care indicators used can also be translated to the local South African prehospital context.

Activated charcoal administration, oxygen administration, and basic airway management are available to all local EMS providers, however certain skills like intravenous catheter placement, ECG use and interpretation, the administration of specific antidotes and advanced airway management are reserved for selected EMS providers with varying levels of qualifications.

Conclusion:

Acute poisoning remains a prevalent condition seen by local ECs and EMS in South Africa. There is a paucity of literature on acute poisoning patients presenting to the prehospital provider in South Africa and a need for further exploration is warranted, considering the burden that these patients place on the local EMS systems and healthcare system as a whole. Acute poisoning seems to predominate in the young adult population, internationally and locally. Capabilities of emergency care providers in South Africa vary across different EMS qualifications, however all are capable of basic airway procedures, vital signs monitoring, and administration of supplemental oxygen, with most qualifications also capable of gaining intravenous access.

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Part B: Manuscript in article format

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A descriptive study of acutely poisoned patients presenting to the Western Cape Emergency Medical Services

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Abstract:

Background: The scale and types of acute poisonings presenting to the prehospital provider in South Africa and other low or middle-income countries are largely unknown. Emergency medical service (EMS) personnel are often responsible for the on-scene management and transport of these patients and have a range of treatment options available depending on their scope of practice. The aim of this study was to describe acute poisoning patients presenting to the Western Cape Government Health and Wellness EMS.

Methods: A retrospective descriptive study was conducted utilizing electronic patient care data of acute poisoning cases extracted from EMS records for the calendar year 2022.

Results: Of the 2254 acute poisoning cases identified, 69.03% were female. The median age was 27 years, and the most common method of poisoning was ingestion (97.20%). A single toxin was involved in 46.85% of cases, while 32.03% of cases involved multiple toxins. In 34.38% of all cases, the type of toxin which the patient was exposed to was unknown. Paracetamol and alcohol were the most common toxins observed. The top 5 toxins by single toxin involvement were herbicides and pesticides; antiretrovirals; antiseptics and disinfectants; paracetamol; and hydrocarbons. There were a higher number of cases in the second half of the year, with a peak in November and December, as well as more cases during weekends. Most cases were triaged as moderate to severe acuity. Activated charcoal was administered in 3.46% of cases; oxygen was administered in 3.82% of cases; intravenous access was obtained in 17.7% of patients and 1.97% of cases had a documented airway intervention performed.

Conclusion: There is a necessity for better awareness, and improved training for EMS providers to enhance the care of acute poisoning patients. Further research is warranted to investigate the gaps in management and the implications for patient outcomes. This will ultimately contribute to the development of effective interventions and educational programs aimed at reducing the incidence and severity of acute poisoning.

African Relevance:

- Acute poisoning occurs worldwide with few prehospital studies conducted in Africa.
- With a better understanding of the acute poisoning presentations in South Africa, recommendations can be made for training and resources. Further research around the availability of some household chemicals may be indicated

Key words: acute poisoning, toxin, prehospital, South Africa, overdose

Background:

Acute poisonings present to emergency centres globally, but there is a lack of information regarding how these cases present to prehospital emergency medical services (EMS). These incidents are a major cause of illness and death worldwide (1). Acute poisonings can result from accidental exposure or intentional self-harm, with the latter often leading to higher mortality rates (2). To ensure the best outcomes, early intervention is crucial, including prehospital management and transport to hospital by ambulance (3).

Limited studies on acute poisonings in South Africa have been identified and there is a gap in understanding the specific burden and characteristics of acute poisonings in the prehospital setting in South Africa and Africa. This is crucial for determining the necessary resources, including equipment, medications, and training for prehospital care providers. Substance abuse is prevalent in South Africa, including the Western Cape, and contributes significantly to acute poisonings (3). Children are especially vulnerable to accidental poisonings due to their curiosity and because of their pharmacokinetic differences, decreased blood volume and small size, thus having a lower dose tolerance before reaching toxic levels, leading to serious clinical repercussions (4). It's been previously reported that non-drug chemicals, particularly irritants and corrosives, were responsible for most cases reported to the local poison information centre in Cape Town, Western Cape (5).

The Poison Information Centre in the Western Cape reports that the most common telephonic enquiries they received for moderate to severe acute poisonings were pharmaceuticals (approximately 50% of cases), pesticides (15% of cases), and household products (12% of cases) (2). Several local in-hospital studies reported common toxins implicated in acute poisoning among adults, with pharmaceuticals dominating, including paracetamol (and other analgesics), tricyclic antidepressants, benzodiazepines, antihistamines, anti-infectives (antiretrovirals, antibiotics, etc.), anti-epileptics. (6-9). Simultaneous alcohol use was found to be prevalent in one of the studies of deliberate self-poisoning (6).

Prehospital providers are variably limited in the scope of medications and procedures they can perform, but all are able to administer activated charcoal which remains a crucial treatment for acute poisonings if administered within the first hour post-ingestion (10). The frequency of its use in the South African prehospital setting is unknown. Other management strategies for acute poisoning include the use of antidotes in the case of certain poisonings, and the management of symptoms or sequelae of acute poisonings (11).

The South African Triage Scale (SATS) is used to prioritize patients into one of five groups based on patient physiology and presentation and is utilized by the Western Cape Government EMS (WCGEMS) and integrated into the electronic patient care report which is completed by prehospital providers for every patient managed (12).

All calls made to the WCGEMS, are logged by a call taker, and appropriate resources are then dispatched. Electronic patient care records are used by ambulance crews to capture patient and scene information as well as vital signs and treatment.

To date, there are no studies that describe or examine the burden of all acute poisoning patients to EMS in South Africa. Having more knowledge on this topic will give insight to policy makers with respect to resource allocation, education and training and raise public awareness in areas that need it most. This study describes acute poisoning presentations to the WCGEMS over a one-year period, reporting on patient demographics, patterns of presentations, toxins involved, and the prehospital management.

Methods:

A retrospective quantitative descriptive study was conducted in the WCGEMS, the public operated ambulance and rescue service of the Western Cape Province of South Africa. Ambulances are primarily responsible for transporting patients to hospitals, whether this is between hospital facilities (interfacility transfers) or from scenes to hospital. Within the Western Cape, hospital facilities have varying capabilities and services based on their designated level: primary health

care centres (such as clinics), district level hospitals, regional hospitals and tertiary (academic teaching) hospitals. Data was extracted from the EMS electronic database, cleaned, sorted and analysed using Microsoft® Excel® for Microsoft 365 (Microsoft Corp., USA).

Inclusion criteria were all patients transported by WCGEMS from the scene, where acute poisoning was documented whether accidental in nature or because of deliberate self-harm. The following categories were identified and extracted from the pre-existing EMS incident type categories: “Trauma, Self-Harm – Poisoning”, “Trauma, Self-Harm – Other”, “Trauma, Assault – Poisoning”. All cases in these categories, presenting to EMS from 1st January 2022 to 31st December 2022 were eligible for inclusion. The year 2022 was chosen as a convenient period after the COVID pandemic which may have had some impact on poisoning presentations.

Patients that refused transport and subsequently were not transported to a hospital, patients that were dead on arrival, and interfacility transfers of patients were excluded. This study did not include patients that experienced envenomation (such as spider bites, snake bite, etc.)

Data from electronic patient records were scanned to extract the toxin (or often multiple toxins) involved, if known, and were coded for each case. Data extracted included: South African triage score (SATS), time and day of the initial call to EMS, as well as age and sex of patients. Method of poisoning was captured, whether one or more toxins were involved, type of toxins involved, initial set of vital signs recorded (including heart rate, blood pressure, respiratory rate, level of consciousness), management provided (included the use of activated charcoal, oxygen administration, airway interventions, intravenous catheterization, and CPR), as well as the receiving facility type.

The median was used to express the variable of age. Relative risk was calculated to signify paediatric cases (≤12years old) where a single toxin was responsible for acute poisoning. Average time was calculated from incident times of calls made to EMS for acute poisonings.

Ethical approval was obtained from the University of Cape Town Human Research Ethics Committee (HREC ref: 163/2023). Facility Approval was provided by Western Cape Government: Department of Health (NHRD ref: WC_202303_037). Data was de-identified at source.

Results:

During the study period, 4139 patients with an EMS incident type identifying acute poisoning were transported by EMS from scene/ home (i.e. excluded interfacility transfers). Of these cases, 2254 cases met inclusion criteria, as the remainder of cases were either incorrectly assigned these case types, such as trauma cases with no acute poisonings or were part of the exclusion criteria.

The median age was 27 years (interquartile range,19). The method of poisoning was 2191 (97.20%) by ingestion, 12 (0.53%) by inhalation, eight (0.35%) by injection, four (0.17%) by multiple methods, one (0.04%) by exposure, and 38 (1.68%) were unknown (Table 1).

Table 1: Breakdown of results by age groups

		Adult >18	Teen 13-18	Child <13	Total
Number:		1713	387	154	2254
Gender:	Male	569 (33.22%)	56 (14.47%)	71 (46.10%)	696 (30.88%)
	Female	1143 (66.73%)	330 (85.27%)	83 (53.90%)	1556 (69.03%)
Disposition:	Clinic	114 (6.65%)	29 (7.49%)	14 (9.09%)	157 (6.97%)
	District	1217 (71.04%)	306 (79,07%)	105 (68.18%)	1628 (72.23%)
	Regional	222 (12.96%)	32 (8.27%)	28 (18.18%)	282 (12.51%)
	Tertiary	101 (5.90%)	13 (3.36%)	6 (3.90%)	120 (5.32%)
	Private Facility	56 (3.27%)	7 (1.81%)	1 (0.65%)	64 (2.84%)
Triage (SATS):	Red	123 (7.18%)	20 (5.17%)	7 (4.55%)	150 (6.65%)
	Orange	691 (40.34%)	117 (30.23%)	42 (27.27%)	850 (37.71%)
	Yellow	605 (35.32%)	163 (42.12%)	72 (46.75%)	840 (37.27%)
	Green	293 (17.10%)	87 (22.48%)	33 (21.43%)	413 (18.32%)
Toxin:	Single	732 (42.73%)	192 (49.61%)	132 (85.71%)	1056 (46.85%)
	Multiple	618 (36.08%)	97 (25.06%)	7 (4.55%)	722 (32.03%)
	Unknown	363 (21.19%)	98 (25.32%)	15 (9.74%)	476 (21.12%)
Method of Poisoning:					
	Exposure	0 (0%)	0 (0%)	1 (0.65%)	1 (0.04%)
	Ingestion	1668 (97.37%)	377 (97.42%)	146 (94.81%)	2191 (97.20%)
	Inhalation	9 (0.53%)	2 (0.52%)	1 (0.65%)	12 (0.53%)
	Injection	8 (0.47%)	0 (0%)	0 (0%)	8 (0.35%)
	Multiple	4 (0.23%)	0 (0%)	0 (0%)	4 (0.18%)
Location:	Urban	849 (49.56%)	158 (40.83%)	40 (25.97%)	1047 (46.45%)
	Rural/ peri-urban	864 (50.44%)	229 (59.17%)	114 (74.03%)	1207 (53.55%)

**Percentages are reflected as the proportion of each age group (i.e. row%)*
Unknown numbers were omitted from tallies where not mentioned.
Triage using SATS - South African Triage Score

The majority of patients were female (n = 1556; 69.03%), with 17.17% of cases in the teenager category (13–18-year-old), while 6.83% fell into the child category (<12 years old), with the remainder of cases being greater than 18 years old (76%). The lowest disparity between male and females occurred in the child age group (0-12 years old), with a split of 53.90% females and 46.10% males.

Some 1056 (46.85%) cases involved a single toxin, while 722 (32.03%) of cases were classified as multiple toxin involvement, and 476 (21.19%) cases were classified as unknown as to whether one or more toxins were involved. Of all the cases involving children and teenagers (≤18 years old), 104 (19.22%) cases were classified as being multiple toxin involvement, while 324 (59.89%) cases had a single toxin documented as being responsible, with 113 (20.89%) cases being unknown. The number of cases where a single toxin was identified was highest in the ≤12 years of age group (132 cases, 86% of all ≤12yr cases, relative risk 1.95).

Most cases (1690 cases, 74.98% of all cases) scored as moderate to severe acuity (SATS yellow – 840 cases and SATS orange – 850 cases) with 413 cases (18.32% of total cases) scored as low acuity (SATS green). A few cases (150 cases, 6.66% of all cases) were scored as life threatening acuity (SATS red). Cases triaged as orange and red (seriously ill) were higher in the adult group.

In 775 (34.38%) cases the toxin was undocumented and therefore designated as unknown. Paracetamol was most common documented drug ingested which was involved in 254 (11.27%) cases, and then alcohol, with 163 (7.23%) cases. Alcohol was most commonly found in combination with another toxin (multiple toxin involvement) – 93.87% of cases were listed as multiple toxin involvement when alcohol was involved. The top five known single toxins and the numbers of each were herbicides and pesticides (n = 92); antiretrovirals (ARVs) (n = 88); antiseptics and disinfectants (n = 75); paracetamol (n = 62); and hydrocarbons (n = 52). When there were multiple toxins involved, the most common were alcohol (n = 153); paracetamol (n = 152); antihistamines (n = 99); non-steroidal anti-inflammatories (n = 77); and opioids (n = 73). (Supplementary table 1) cyclic antidepressants were the toxin (other than unknown) with the

highest number of cases in the red colour category, although this was often reported as being a part of a multiple toxin ingestion.

There were a higher number of cases in the second half of the year, with a peak in November and December; average number of cases 187 cases/month minimum 124 cases (June), maximum 271 (December) (Figure 1). The average time from incident time (when a call was placed to EMS) to arrival time (when EMS arrived at the scene of the incident) was 38 minutes (range 1 minute - 7 hours 12 minutes).

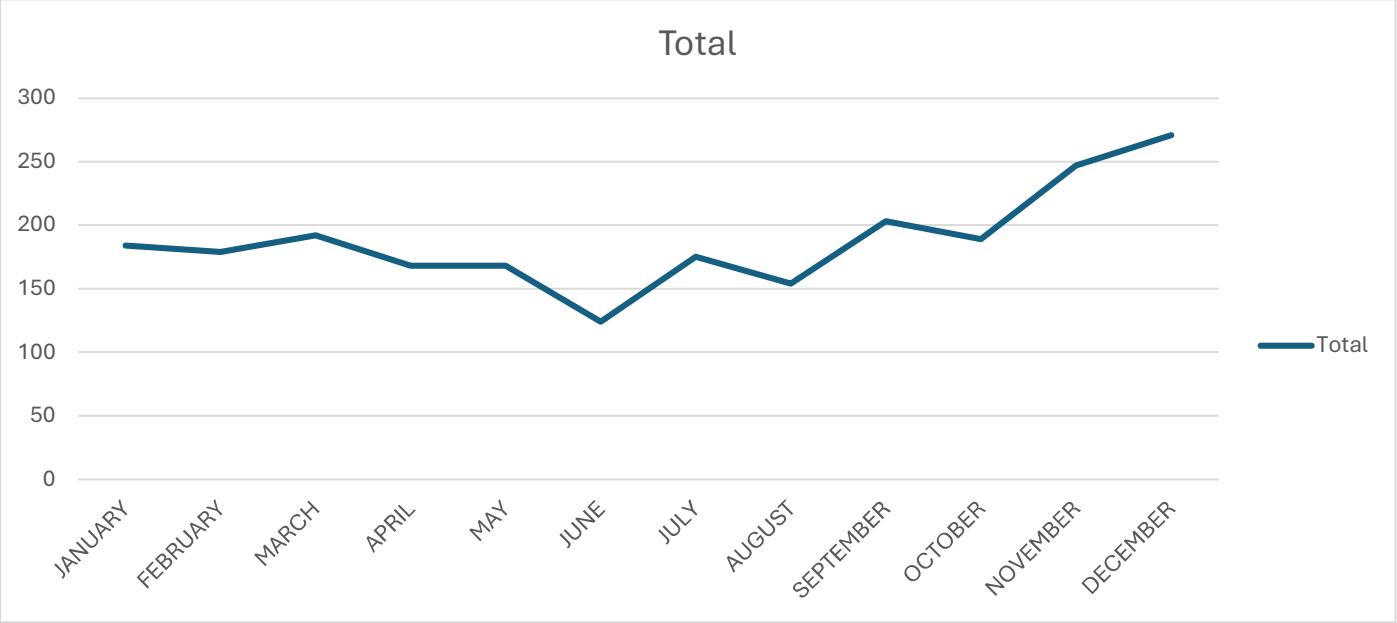

Figure 1: Acute poisoning cases managed by EMS for each Month of the Year

We found a peak in the number of yellow cases in the morning between 7AM and 9AM, peaking again in the late afternoon between 5PM and 6PM (Figure 2). Cases triaged as orange tend to peak between 8 AM and 12 PM. Green cases increased gradually through the day peaking at 8PM. Red cases presented throughout the day, with a small increase in cases around 4PM There was also an increase in the number of cases on Saturdays and Sundays when reviewing cases by days of the week (Figure 3).

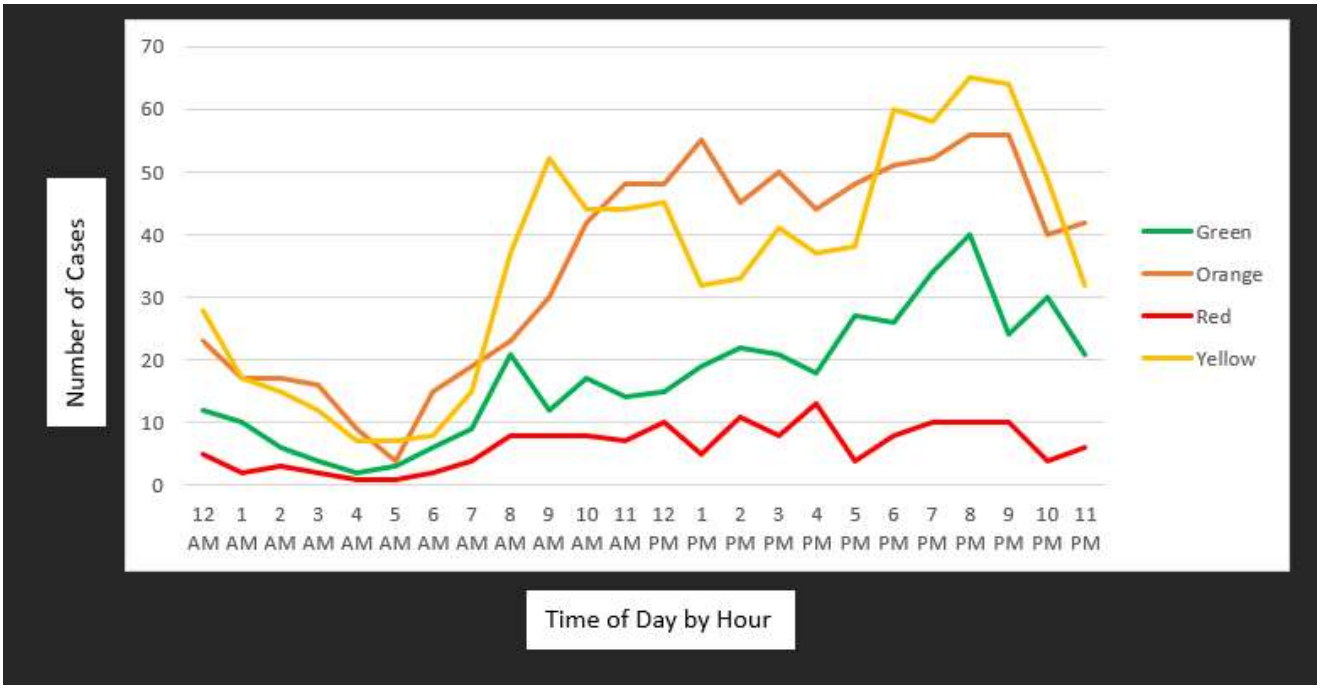

Figure 2: SATS Colour Code by Time of Day for acute poisoning cases managed by EMS.

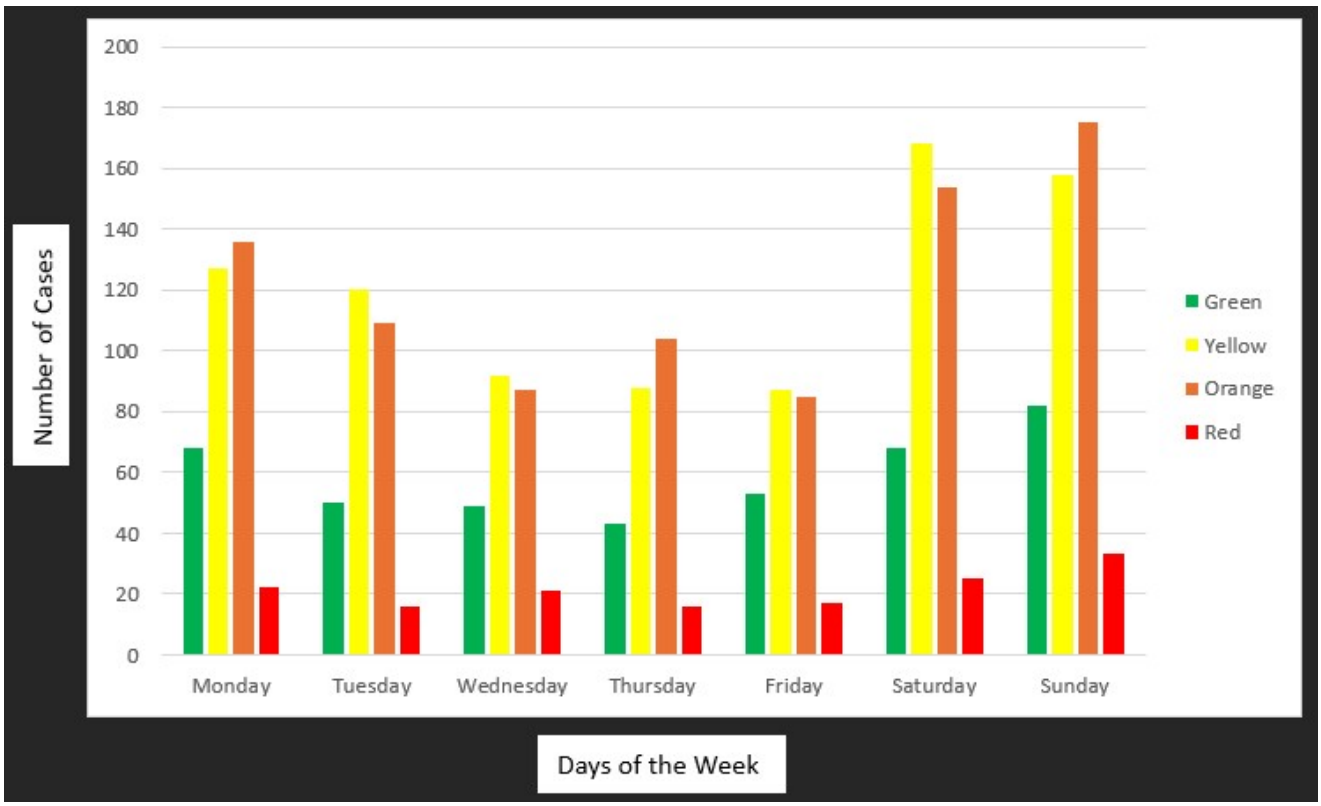

Figure 3: Patient Acuity (SATS) By Day of the Week

Management performed by WCEMS included intravenous access in 399 (17.7%) of patients. Activated charcoal was administered in 78 (3.46%) cases; oxygen was administered in 86 (3.82%) cases; and 45 (1.97%) cases had a documented airway intervention performed (Table 2).

Table 2: Management of patients poisoned by the five most common poisons.

	Single Toxin (Top 5 Most Common)					**Multiple Toxin Involvement (N=722)**
	Herbicides & Pesticides (N=92)	ARV's (N=88)	Antiseptics & Disinfectants (N=75)	Paracetamol (N=62)	Hydrocarbons (N=52)	
Activated Charcoal (Proportion of those given AC)	3/92 (3.26%)	4/88 (4.55%)	0/75 (0%)	1/62 (1.61%)	0/52 (0%)	32/722 (4.43%)
Oxygen Administered	2/92 (2.17%)	1/88 (1.14%)	2/75 (2.67%)	0/62 (0%)	0/52 (0%)	34/722 (4.71%)
Airway Intervention	0/92 (0%)	1/88 (1.14%)	1/75 (1.33%)	0/62 (0%)	0/52 (0%)	20/722 (2.77%)
IV Access Obtained	10/92 (10.87%)	7/88 (7.95%)	7/75 (9.33%)	8/62 (12.90%)	2/52 (3.85%)	193/722 (26.73%)

CPR while in the care of ambulance personnel occurred in only 3 (0.13%) cases and 171 (7.59%) patients had a presenting oxygen saturation of <94%. Of these, only 37 (21.64%) patients received oxygen by EMS providers.

Some 2129 (94.45%) patients had at least one blood pressure documented in the vital signs. Of these, 49 cases of patients aged ≥18 years old had a mean arterial pressure (MAP) of ≤65 mmHg. Just 26 (53.06%) of these 49 cases had intravenous access established by EMS providers. Some 19 (38.78%) of the 49 cases were exposed to multiple toxins, 22 (44.90%) were exposed to a single toxin, and in 8 (16.33%) cases this was unknown. The most common toxins that were implicated in patients with low MAPs among the adult population were unknown (n = 19), alcohol (n = 9), cyclic antidepressants (n = 5), calcium channel blockers (n = 3), and opioids (n = 3).

Discussion:

This is the first study, to our knowledge, which reviews all acute poisoning cases, irrespective of intentionality, presenting to an EMS system in a Low- or Middle-Income Country (LMIC). We found that most cases involved young adult females, the toxin involved was largely unknown to EMS providers, and ingestion was the most common method of poisoning. Two South African studies suggest that around two-thirds of acute poisoning patients are transported to hospital by ambulance, so it is a key opportunity to understand and influence the care of such patients (9, 13).

In children (≤12 years) the most common toxin was hydrocarbons, as seen in hospital studies (14, 15). Paraffin, a common fuel low-viscosity hydrocarbon, is often utilized as a fuel source for cooking, lighting, and heating in underprivileged communities; is frequently kept in unlabelled containers, and even small ingestions can cause a chemical pneumonitis (16). Education of parents around paraffin storage and safety, as well as phasing out this fuel source have been suggested. Long-term, the phasing out of paraffin as a domestic fuel should be considered (17). Launched in February 2021, the No Paraffin! Campaign advocates for a faster shift to safe, affordable, and modern energy sources that focus on the needs of economically disadvantaged communities, which aligns to the United Nations 2030 Sustainable Development Goal on universal access to safe and sustainable energy (17).

Predominance of acute poisoning in the young adult female population is supported by studies in local hospitals, with the proportion of females in other studies ranging from 55.3% to 68.8% (6-9). Males tend to employ more violent methods of self-harm, which may explain the higher prevalence of females in acute poisoning populations, however our study did not examine intention, which may have shed light on this (6).

Alcohol use was implicated in many cases (7.23% of total cases) of acute poisoning patients presenting to EMS in this study, also as seen elsewhere (18). This was a lot higher than the cases reported by a local poison information centre study which reported alcohol use as a co-ingestant in 2.5% of calls (19). Alcohol use, either as a co-ingestant or a single toxin was not shown to be

prevalent in several local in-hospital studies (6-9). In many cases, as found in other studies, the toxin involved in the acute poisoning was unknown or not reported by EMS (20). This could be due to EMS providers not documenting this information – which should be further researched, as EMS are key agents to decipher possible toxins at the scene to aid in-hospital care.

Several South African studies found paracetamol to be the most prevalent known toxin ingested, as we found, as well as being a common co-ingestant. (6, 9). Other pharmaceutical agents including antihistamines, antiretrovirals, cyclic antidepressants, opioids and NSAID's were also common toxins listed, while household products such as antiseptics and disinfectants; and pesticides and herbicides were also common. Opioid use is notably lower in LMICs and upper-middle income countries (UMICs) when compared to HICs, with the low numbers of prescription opioid use being attributed to income differences and lower population to physician densities when compared to HICs (21). In our study, the toxin implicated in the highest acuity patients was cyclic antidepressants. This was not a finding in one Cape Town study, however cyclic antidepressants were a common cause for ICU admissions seen elsewhere (8, 9).

Our findings seem to suggest seasonal variations with more acute poisonings presenting to EMS in the summer months. There are no local studies that comment on seasonal variations with acute poisoning however, a German study found an increase in acute poisoning cases when environmental temperatures were higher (22). A South African study reporting suicide trends over a 15-year period found an increase in suicide deaths in December and January with the lowest cases reported in Winter, between May and July (23). It is possible that there was an increase of cases during the festive season as this is associated with an increase in depressive episodes (24). However, as intentionality was not examined, this remains speculative. We found more presentations of acute poisonings on the weekends, compared to the rest of the days of the week. This contrasts with a local in-hospital study that found that presentations of acute poisoning were mostly equally distributed by days of the week (9). This could be attributed to less access to public transport on weekends, and therefore a reliance on ambulance transportation.

Alcohol misuse has been linked to increased risk of suicidal ideation, attempts and deaths (25). Heavy alcohol use in South Africa has been shown to be 5 times higher on weekends than on

weekdays (26). This correlation of increased alcohol use on weekends, and the depressant effect of alcohol on mood could potentially explain an increase in cases on the weekends, however the study was not designed to link causality.

EMS interventions appear to have been minimal for the majority of acute poisoning patients. Only half of adult patients that had a MAP ≤65 mmHg had IV access obtained. Although not all EMS providers have the capability to establish IV access, all EMS providers can administer oxygen, yet only 21.64% of patients who presented with an oxygen saturation of <94% receiving oxygen prehospitally. Activated charcoal was also uncommonly administered, with only 3.5% of cases receiving this intervention prehospitally, despite the high proportion of ingested agents. This study was not designed to report on the time since toxin ingestion or whether charcoal was indicated, and therefore no comment can be made on whether the use of activated charcoal was appropriate for these patients. Evans et al (27) found that there exists a significant prevalence of negative feelings by Cape Town EMS providers when treating suicidal patients, and this could potentially impact on quality of care provided to these patients, as our data may suggest. While no studies regarding attitudes of prehospital workers caring for acute poisonings in LMIC's exist, in-hospital studies from LMIC's have reported feelings of nervousness, frustration and discomfort (28, 29).

Study Limitations:

The study has several limitations, firstly the reliance on retrospective notes recorded for clinical purposes, of variable quality without any audit or review. However, these were reviewed by an experienced EMS provider (FM) to assess and extract data from them. The study utilized patient records from the public ambulance service only. This excluded patients that were transported by private EMS providers or non-profit entities. Although the public ambulance service transports by far the majority of cases, the inclusion of this cohort of patients may have been valuable. The data that was sent from EMS did not reflect hospital arrival times. This meant that EMS transport times from scene to hospital could not be calculated. The study design did not allow for the capture of all adverse incidents of acute poisoning cases, such as the development of new-onset seizures whilst in the care of EMS. The study was not designed to capture the use of antidotes such as Naloxone and Flumazenil, or specific management such as the use of atropine or adrenaline which may have added value. It is recommended that further studies should take this into account.

Conclusion:

This study provides valuable insights into the profile of acute poisoning cases presenting to an EMS system in LMIC. In most cases, the type of toxin which the patient was exposed to was unknown. Notably, hydrocarbons emerged as the leading toxin in paediatric cases, underscoring the urgent need for education campaigns to ensure safer storage and use of these substances, and a move towards more sustainable energy sources. The management of acute poisoning cases by EMS would seem to be minimal, highlighting a critical area for improvement. This study emphasizes the necessity for better awareness, and improved training for EMS providers to enhance the care of acute poisoning patients. Further research is warranted to investigate the gaps in management and the implications for patient outcomes, ultimately contributing to the development of effective interventions and educational programs aimed at reducing the incidence and severity of acute poisoning.

Declaration of Competing Interest:

The authors declared no conflicts of interest.

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Supplementary Table 1: Documented Toxins and Number of Occurrences across all age groups

Toxin	Number of Occurrences
Unknown	775
Paracetamol	214
Alcohol	163
Other	207
Antihistamines	137
Antiretrovirals	132
Antiseptics and Disinfectants	118
Pesticides and Herbicides	117
Cyclic Antidepressants	107
Opioids	106
Non-steroidal anti-inflammatories	100
Antibiotics	98
Homeopathic Agents, Vitamins and Minerals	86
Other Antidepressants	78
Anticonvulsants	75
Antipsychotics	72
Benzodiazepines	70
Antihypertensives (unspecified)	67
ACE Inhibitors	64
Thiazides and Related Diuretics	48
Calcium Channel Blockers	37
Hydrocarbons	63
Non-Benzodiazepine Hypnotics	62
Household Chemicals and Cleaning Agents	50
Hypoglycaemic Agents	50
Cardiac Drugs	31
Statins	24
Anticholinergic Agents	23
Organophosphates	20
Salicylates	19
Sympathomimetics	8
Hormonal Agents	6
Amphetamines	2

*Toxins may have occurred as part of a single or multiple or acute poisoning episode (or this may be unknown)

Supplementary Table 2: Top 5 Documented Toxins and Number of Occurrences for ages 13 - 17 years old

Toxin	Number of occurrences
Unknown	112
Paracetamol	25
Homeopathic Agents & Multivitamins	24
Other	23
ARV's	18

Supplementary Table 3: Top 5 Documented Toxins and Number of Occurrences for ages ≤12 years old

Toxin	Number of occurrences
Unknown	36
Hydrocarbons	26
Antiseptics & Disinfectants	18
Household Chemicals & Cleaning Agents	13
Other	9

Part C: Addenda

Research Proposal *(as approved prior to commencement of the study)*

A descriptive study of acutely poisoned patients presenting to the Western Cape Emergency Medical Services

by

Fabio Moreira

BEMC (CPUT)

MRRFAB001

This proposal is submitted in partial fulfilment of the requirements for the degree Master of Philosophy in Emergency Medicine in the Faculty of Health Sciences at the University of Cape Town

Supervisor(s): Ass. Prof. Peter Hodkinson, MBChB, PhD (UCT)

Dr. Candice Van Koningsbruggen, MBChB, MMed (Emergency Med)

March 2022

Declaration

I, Fabio Moreira, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university. I authorise the University to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever. I further declare the following:

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11. I have referenced all quotations and properly acknowledged other ideas borrowed from others.
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14. I am attaching the summary of the Turnitin match overview.

Signature: ……  **Date: …13 September 2021…**

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Background:

Acute poisonings are a common presentation to emergency centres worldwide, yet there is a paucity of data on the presentation of acute poisoning to prehospital emergency medical services. It is a cause of significant morbidity and mortality worldwide. Acute poisonings can be the result of an accidental poisoning, or deliberate self-harm, with the latter having a higher mortality rate (1). In order to maximize optimal outcomes, this group of conditions requires early management decisions, which may require urgent transfer to specialized healthcare facilities (2). Such facilities include those with intensive care units (ICU's) or high care units (HCU's), those with lab facilities, including toxicological screening capabilities, and potentially those with dialysis units, should this be required.

Data examining the incidence and spectrum of acute poisonings in South Africa are limited, with several studies aimed at assessing the burden of acute poisonings at a handful of hospitals (4-7). One study that reviewed calls to the National poison centre, found that adult females were the dominant group that presented with acute poisoning, and that analgesics were the most common toxin involved, with paracetamol being the most common (3). The findings of this study correlated with a more recent study performed at a local district hospital, which also found paracetamol to be the most common agent ingested in acute poisoning presentations among adults (4). This was in contrast to another study performed in an East London hospital, which found tricyclic antidepressants to be the most prominent toxin in acute poisonings; however, this study specifically used intensive care admissions, and deliberate self-harm as a sample (5). The majority of patients presenting with acute poisonings were around the 30-year age mark, and predominantly female (4-7).

Prior to arrival at healthcare facilities, acutely poisoned patients will often call for EMS and require on scene assessment and management and then ambulance transportation. We could find no studies reporting on the presentation of acute poisonings to EMS in South Africa, however, limited international studies do exist, with one study in Catalonia finding a high rate of carbon monoxide intentional poisoning among patients <18 years of age (8). It remains unknown what the burden and key features of acute poisoning are that present locally to the prehospital healthcare workers which would provide key evidence for the resources required, from equipment and drugs, to training and management practices needed by prehospital practitioners. For instance, the study

in Catalonia evaluated quality indicators to assess quality of care for poisoned patients; therefore, this study would look at similar indicators to measure quality of care provided (oxygen administration, administration of activated charcoal, etc.; described further in the study objectives).

It has been stated that further information is required to expand the understanding that toxicological presentations have on health services in South Africa (9). This study aims to add to that knowledge base.

In 2018, the Tygerberg Poison Information Centre (TPIC) reported that out of all telephone calls made to them for advice on poisonings, 51% of patients were female, while 47% were male and a further 2% were unclassified (10). The centre also reported that most exposures occurred in children between the ages of 0-6 years (46%) (10). When broken down by circumstances, accidental exposure far outweighed deliberate self-harm (7160 vs 3401 respectively) (10). As many young children are inquisitive and put things in their mouths, this explains the high percentage of exposures among this age group, combined with the fact that accidental exposure was predominant (10). This further supports the case that data for this study should analyze all age groups and not just adults.

Interestingly, the TPIC recorded that pharmaceuticals were the most common substances responsible for poisonings reported to them, followed by non-drug chemicals and then biological toxins (10). Of the pharmaceutical agents that were recorded, the most common was psychiatric and neurological medicines (1210 cases), followed by analgesics/anaesthetics and antipyretics (1024 cases) (10). Of the non-drug chemical agents recorded by the TPIC, insecticides/rodenticides predominated (1542 cases), followed by household chemicals (1420 cases) (10).

It is important to remember that this data only represents cases where either the healthcare provider or a member of the public phoned the poison control centre to seek advice. It can be argued that many healthcare workers are comfortable seeing most acute poisoning patients in their everyday day-to-day activities, and therefore have no desire to seek further treatment advice

via the poison centre. This would mean that a large amount of acute poisoning patients would be uncaptured by the Tygerberg Poison Information Centre.

In a study by van Hoving, only 5.7% of all intentional self-poisoning patients were intubated, while 42.7% of patients were given intravenous fluids (9). Many other studies lack this level of detailed reporting.

Rowe found their study that in their facility in East London, overdose admissions climbed in the summer months, and van Hoving found that most patients of self-poisoning presented to their Western Cape emergency centre outside of traditional office hours (9, 11).

A study conducted at Groote Schuur Hospital in Cape Town found that self-poisoning was the most common method of deliberate self-harm. This study found that prescription medication was the most common agent involved in deliberate self-harm, while when it came to non-prescription medication, paracetamol (an analgesic and antipyretic) was found to be the most common agent used (12).

Substance abuse is rampant throughout South Africa and the Western Cape. Illicit drugs as well as alcohol also contribute to the burden of acute poisoning seen in Cape Town hospitals, therefore it is thought that this burden will be similar to that presenting to EMS (12). Specifically, alcohol, methamphetamine, cocaine, cannabis, heroin, methylenedioxymethamphetamine, and opiates have all been reported as substances used in deliberate self-poisonings presenting to a Cape Town tertiary hospital (12).

Children are a vulnerable population, and as previously mentioned, certain age groups are naturally inquisitive and accidental ingestion resulting in acute poisoning is sadly a common reality. In a study by Marks and Van Hoving, non-drug chemicals were responsible for the most cases presenting to the TPIC, where specifically irritants and corrosives predominated (13). Of pharmaceutical agents ingested by infants, analgesics were the most common group of drugs

(13). It is unknown what the characteristics of the paediatric population are that present to the emergency medical services in the Western Cape.

The administration of activated charcoal remains a vital therapy option if given early enough in the management of acute poisonings (14). It is an adsorbent, a form of gastrointestinal decontamination. It is particularly beneficial if given in the first hour post ingestion of a toxin/poison (14). Emergency medical services are typically the first point of contact with patients in the health system after acute poisoning exposures, and this emphasizes the potential usefulness of activated charcoal administration prehospitally. The administration of activated charcoal in the conscious and compliant patient is currently in the scope of practice of all levels of emergency medical care personnel, yet it remains unknown how frequently it is used in the pre-hospital setting in South Africa (15). This study will report the usage of activated charcoal among acute poisoning patients presenting to the Western Cape EMS.

Motivation for the Study:

To date, there are no studies that describe or examine the burden of acute poisoning patients to emergency medical services in South Africa. A few studies report on this burden at local hospitals; however, this may differ from what presents to the emergency medical services prehospitally. Having more knowledge on this topic will give insight to policy makers with respect to resource allocation, education and training and raising public awareness in areas that need it most. This in turn, will hopefully lead to improved patient care, and potentially improved overall outcomes from acute poisonings. Improved documentation around acute poisoning cases is also a hopeful result after concluding the study.

Aims & Objectives:

The aim of this study is to describe acute poisonings presenting to the Western Cape EMS.

Research Question:

In patients that present to the Western Cape EMS from the scene of illness, what are the patient characteristics, substances involved, and prehospital management of acute poisonings over a 1-year period?

Objectives:

1. To calculate the proportion of patients with acute poisoning out of all prehospital presentations to Western Cape EMS.
2. To describe the patient demographics (age, sex, marital status, location) and clinical details of acute poisoning patients presenting to Western Cape EMS.
3. To describe the drugs/substances responsible for acute poisoning in patients presenting to Western Cape EMS.
4. To describe the management of acutely poisoned patients by EMS practitioners in the Western Cape, specifically looking at administration of activated charcoal, oxygen administration, use of airway procedures, and peripheral venous catheterization.

Methods:

The study will be a retrospective quantitative descriptive study. Data will be extracted from the EMS electronic database, cleaned, sorted and analyzed using Microsoft Excel. The study will use data for a 12-month period from January 2022 to December 2022.

Inclusion criteria will be all patients that were transported by Western Cape EMS from the scene, where acute poisoning was documented whether accidental in nature or because of deliberate self-harm. The following (existing) categories will be indexed from the EMS system categories: “Trauma, Self-Harm – Poisoning”, “Trauma, Self-Harm – Other”, “Trauma, Assault – Poisoning”. All cases in the categories mentioned, presenting to EMS between (and including) the 1st January 2022 and the 31st December 2022 will be eligible for inclusion.

Exclusion criteria will be patients not transported by Western Cape EMS, any patient that refused transport, patients that were dead on arrival (DOA), and interfacility transfers of patients. Dead on arrival patients will be excluded from the study as in the researcher’s anecdotal experience, most

patients that are DOA do not have an associated patient care report form completed, but rather a dead-on-arrival form, which is not available electronically. Therefore, to include the few DOA cases that do have a patient care record associated with them would underrepresent this population during analysis. Additional exclusions will include any patients that experienced envenomation (such as spider bites, snake bite, etc.), as this is beyond the scope of this small master's level study.

Data will be requested from the EMS database, and then cleaned and sorted using Microsoft Excel. South African triage score (SATS) colour codes will be reported. Time of the initial call to emergency services will be grouped into day/night and months will be grouped to reflect patterns of acute poisonings throughout the year, as well as age and gender of patients.

The following will be documented on included cases: substance/toxin/s that the patient was believed to be exposed to (including if nothing is documented), initial set of vital signs of the patient (defined as the first set of vital signs with at least 2 types of vital signs recorded), whether the patient received any form of medical interventions by EMS, such as whether activated charcoal was administered, whether oxygen was administered, whether any airway intervention took place, whether the patient received intravenous catheterization, and whether the patient received CPR at any point prehospitally – See appendix A for data collection tool. Substances/toxins will be later grouped as pharmaceuticals or non-drug chemicals with several sub-groups for each including analgesics and antipyretics, anticonvulsants, antipsychotics, cardiovascular medications, etc.

A data management plan has been created for the study and attached as annexure B. Statistical analysis will be performed with the use of a statistician which will be funded by the study. These findings will be reported.

Limitations:

The study has several limitations. Firstly, the study is descriptive in nature, and is not designed to answer more complex questions such as motives for exposure, history of psychiatric care, repeated exposures, morbidity and mortality rates, etc. The study also captures patients only in the EMS categories mentioned and will not capture acute poisoning patients that may have been

categorized as another EMS call type such as “patient unresponsive”, however the study has a limited timeframe, and the researcher believes that the EMS call type categories searched will reflect most acute poisoning patients presenting to EMS.

Another limitation is that the study is highly dependent on reliable and accurate by practitioners, and where a substance/toxin is not documented, it is recorded as such. The study also only indexes data captured on the electronic Patient Care Report (ePCR) system and does not account for any cases where the practitioner may be using a paper-based system, although majority of cases presenting to EMS are captured on the electronic system.

Ethical Considerations:

This study is retrospective and observational in nature. The risks to study participants are minimal. The researcher will apply for a waiver of informed consent from the UCT Human Research Ethics Committee, as it will not be possible to obtain consent from study participants. The researcher is aware of the fact that children are considered a vulnerable population, however due to the high incidence of acute poisonings in this population, it is believed that it would be beneficial to the research objectives to include this population into the study.

Data will be shared from EMS to the researcher via a secure transfer, and patient names and other identifiers will be de-identified. The researcher will access the electronic Patient Care Record system via a secure encrypted login to review patient care charts online, and this data will not be saved to the researcher’s local machine, unless it is specifically necessary for special circumstances to engage with the research supervisors for clarity. In such cases, the ePCR’s will have all identifying information redacted. Where data is captured, no personal and identifiable information will be collected for analysis. Furthermore, any data shared with, collected by, or stored by the researcher will be done on the researcher’s password protected device, in a protected folder.

Results will be presented to and shared with the Western Cape Government Emergency Medical Services stakeholders, as well as for presentation at conferences and to key stakeholders, and for publication in a peer reviewed journal.

Budget:

The study will be self-funded by the researcher. Expected costs include data costs for the use of internet, costs of a statistician, electricity usage, printing costs, and publication costs. The estimated overall sum of the budget is R 4000.00, broken down as follows:

Statistician Cost – R500 / session x 3 sessions = R1500.00

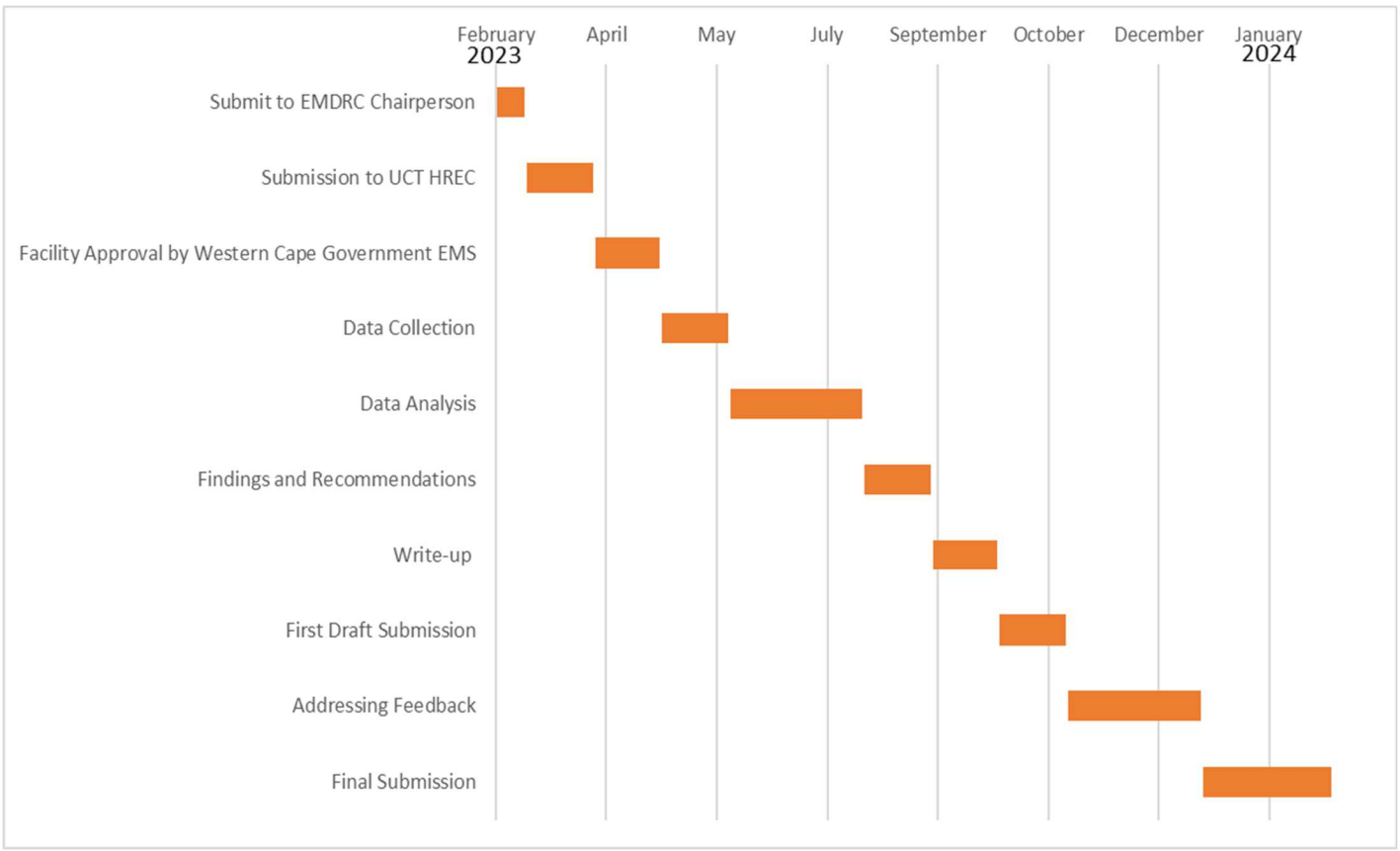
Data Costs – R1500.00

Electricity Usage – R500.00

Printing Costs – R500.00

The researcher will use his own personal computer, and the software used is provided by the University of Cape Town.

Timeframe:



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Appendix 1: Data variables to be requested (all routinely collected by EMS electronic database)

Date
Dispatch Priority
Incident Time
Ambulance Arrival Time
Ambulance Departure Time
Hospital Arrival Time
Total Time to Facility (HH:MM)
SATS Colour Code
TEWS Score
Method of Poisoning
Substance/s Documented
Age (in years)
Sex
District
Initial Respiratory Rate
Initial HR
Initial Systolic BP
Initial Diastolic BP
Initial SpO2
Initial GCS
Initial AVPU
Final respiratory rate
Final HR
Final Systolic BP
Final Diastolic BP
Final SpO2
Final GCS
Final AVPU
Activated charcoal administered?
Oxygen administered?
Airway Procedure?
Airway if yes - specify
IV placed?
CPR performed?
Destination Facility

HREC (Ethics) acceptance letter

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room 45 E-52-E-Floor- Old Main Building
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Website: www.health.uct.ac.za/home/human-research-ethics

22 March 2023

HREC REF: 163/2023

A/Prof P Hodkinson
Division of Emergency Medicine
F-51 OMB
Email: peter.hodkinson@uct.ac.za
Student: fabio.moreira9@gmail.com

Dear A/Prof Hodkinson

PROJECT TITLE: A DESCRIPTIVE STUDY OF ACUTELY POISONED PATIENTS PRESENTING TO THE WESTERN CAPE EMERGENCY MEDICAL SERVICES-
(MASTERS CANDIDATE-MR FABIO MOREIRA)

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee (HREC) for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 March 2024.

Please submit a progress form, using the standardised Annual Report Form (FHS016) if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

The HREC acknowledge that the student: Mr Fabio Moreira will also be involved in this study.

Please quote the HREC REF 163/2023 in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FACULTY OF HEALTH SCIENCES HUMAN RESEARCH ETHICS COMMITTEE

HREC/ref 163.2023

NHRD Acceptance Letter (Facility Approval)

Western Cape Government
Health

STRATEGY & HEALTH SUPPORT
Health.Research@westerncape.gov.za
tel: +27 21 483 0866; fax: +27 21 483 6058
9th Floor, Norton Rose House, 8 Riebeek Street, Cape Town, 8001
www.capegateway.gov.za

REFERENCE: WC_202303_037
ENQUIRIES: Dr Sabela Petros

University of Cape Town
Anzio Road
Observatory
Cape Town
7925

For attention: Prof Peter Hodkinson, Mr Fabio Moreira, Dr Candice Van Koningsbruggen

Re: A descriptive study of acutely poisoned patients presenting to the Western Cape Emergency Medical Services

Thank you for submitting your proposal to undertake the above-mentioned study. We are pleased to inform you that the department has granted you approval for your research.
Please contact the following people to assist you with any further enquiries in accessing the following sites:
Emergency Medical Services **Selwyn September** Selwyn.september@westerncape.gov.za

Kindly ensure that the following are adhered to:

1. Arrangements can be made with managers, providing that normal activities at requested facilities are not interrupted and the constraints caused by the Covid-19 epidemic above are respected and adhered to.
2. Researchers, in accessing provincial health facilities, are expressing consent to provide the department with an electronic copy of the final feedback (**Annexure 9**) within six months of completion of research. This can be submitted to the provincial Research Co-ordinator (Health.Research@westerncape.gov.za).
3. In the event where the research project goes beyond the *estimated completion* date which was submitted, researchers are expected to complete and submit a progress report (**Annexure 8**) and an updated ethics clearance letter to the provincial Research Co-ordinator (Health.Research@westerncape.gov.za).
4. The reference number above should be quoted in all future correspondence.

Yours sincerely

PROF. V ZWEIGENTHAL
DIRECTORATE: HEALTH INTELLIGENCE
DATE: 20 June 2023
CC