

# Accidental kerosene oil ingestion in under-five age children in Nigeria – The need for vigilance in primary care settings in low- and middle-income countries (LMICs)

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## ABSTRACT

Four children aged between 15 months and two years presented in several different out-patient emergency departments with a history of recent ingestion of kerosene. Majority of the patients lived in crowded domestic settings, and they all presented with varying degrees of respiratory distress, different presentations of respiratory clinical symptoms and signs, after being subjected to various potentially dangerous home remedies to counter the effect of the kerosene. Majority of the children presented late, but all recovered following appropriate management. The presented cases demonstrate the vital importance of prompt emergency management in primary care settings, family counseling on childcare and domestic safety, and community enlightenment on reducing the complications and frequency of childhood poisoning in increasingly overcrowded and less affluent communities.

**Keywords:** Accidental ingestion, childhood poisoning, kerosene, paraffin, respiratory distress, overcrowding, urbanization

## Introduction

The ingestion of harmful substances is a fairly frequent occurrence in primary care, which can cause poisoning leading to organ dysfunction, injury, or death.<sup>[1]</sup> Ingestion is the commonest route of poisoning, and commonly ingested substances include household items such as cosmetics, medication, detergents, and cooking fuel.<sup>[2,3]</sup>

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Received: 15-09-2022

Revised: 18-01-2023

Accepted: 31-01-2023

Published: 17-04-2023

### Access this article online

#### Quick Response Code:



Website:  
www.jfmpc.com

DOI:  
10.4103/jfmpc.jfmpc\_1840\_22

In low-income countries like Nigeria, the most common source of accidental poisoning which is responsible for up to 70% cases seen in pediatric emergency is a dangerous hydrocarbon known as kerosene (paraffin) commonly used as cooking fuel.<sup>[2-4]</sup> Kerosene ingestion is especially common during the hot, dry season, and risk factors include low socio-economic class, low parental education, poor supervision, overcrowded living situations, households with children under-five, male gender, and urban residence.<sup>[2-5]</sup>

We present four patients aged one to three years [Table 1], who accidentally ingested kerosene while playing unattended and

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**How to cite this article:** Ore AC, Uchemefuna I, Mmamelu N, Imagbenikaro EU, Nafiu MA, Moses LA. Accidental kerosene oil ingestion in under-five age children in Nigeria – The need for vigilance in primary care settings in low- and middle-income countries (LMICs). J Family Med Prim Care 2023;12:796-9.

**Table 1: Summary of characteristics of four pediatric cases of accidental kerosene ingestion**

Patient characteristics	Child 1	Child 2	Child 3	Child 4
Age	36 months	24 months	15 months	24 months
Gender	Male	Male	Female	Male
Cough	Yes	Yes	Yes	Yes
Vomiting	Yes	Yes	Yes	Yes
Shortness of breath	No	No	Yes	Yes
Axillary temperature	36.8°C	38.4°C	36.9°C	37.8°C
Wheezing	No	No	No	No
Respiratory distress	Flaring of ala nasi	RR 42 cpm	RR 40 cpm	RR 40 cpm
Crepitations	No	Fine	No	No
Oxygen saturation	99%	88%	97-98%	88%
Volume of kerosene ingested	5 mL	20 mL	20 mL	25 mL
Storage of kerosene	Plastic water bottle	Aluminum Cup with poorly fitted lid	Plastic water bottle	Plastic Coca Cola® bottle
Home “remedy” given	Milk	Milk Palm oil	Milk Palm oil Induce gagging/vomiting	Palm oil
Symptom-to-presentation interval	1 h	7 h	7 h	6 h
Chest radiography findings	Normal	Normal	Normal	Normal
Laboratory investigation findings	Normal	Normal	↑WBC	Normal
Duration of observation/admission	24 hours	72 hours	24 hours	72 hours
Maternal occupation/Educational level	Petty trader/Secondary	Petty trader/Primary	Petty trader/Primary	Petty trader/Primary
Paternal occupation/education	Office clerk/Secondary	Car wash/Primary	Motorcyclist/Primary	Teacher/Diploma
Monthly household income	55 USD	13 USD	14 USD	150 USD
Housing type	Two-bedroom apartment	One-bedroom apartment	One-bedroom apartment	Two-bedroom apartment
Household size	5	5	5	5
Sibling (s) below the age of five years	Yes	No	Yes	Yes

unsupervised. Despite variations in their presentations, all four patients were diagnosed with chemical pneumonitis secondary to kerosene ingestion following respiratory examination and radiological assessment. Ethical clearance was obtained from the Health Research Ethics Committees of Federal Capital Territory and Federal Medical Centre Keffi, respectively, to report these cases.

### Case 1

A three-year-old male presented at Garki Hospital emergency pediatric unit in Abuja with a history of cough and vomiting one hour after accidentally ingesting kerosene stored in a plastic water bottle under the kitchen sink. He had been playing on the kitchen floor while his mother attended to her domestic chores and her seven-month-old infant. The estimated amount of kerosene ingested was about 5 mL, and the vomitus comprised recently ingested feeds. Her immediate response was to feed him some milk to dilute the kerosene ingested. However, thirty minutes later he started coughing uncontrollably till he was brought to the emergency room, but there was no associated wheezing or difficulty in breathing. On examination, he was afebrile with an SPO<sub>2</sub> of 99% in room air. His respiratory rate (RR) was 28 cycles per minute (cpm) with associated flaring of the alae nasi but no sub-costal or inter-costal recession. Bilateral air entry was adequate, and breath sounds were vesicular with no added sounds. His weight was 18 kg (64% above expected for age). Laboratory and radiological investigations were normal. He was placed

on intravenous 4.3% dextrose 0.18% saline 700 mls over 24 hours (half maintenance volume) with close monitoring of his SPO<sub>2</sub> and vital signs, which remained normal. After a 24-hour observation, the frequency of cough had reduced. He was subsequently discharged after comprehensive parental counseling on prevention of accidental poisoning. Home visits were also carried out to ensure adequate safety measures were adhered to.

### Case 2

A two-year-old male presented at May Day Hospital in Nasarawa State following the ingestion of half a cup full of kerosene while his mother worked in her shop. He immediately started coughing in bouts, but there was no associated post-tussive vomiting nor whoop. As a home remedy to induce vomiting, his mother forcefully gave him palm oil and milk, inducing him to vomit twice. The vomitus though small in quantity consisted of a mixture of kerosene, palm oil, and milk. He was subsequently brought to the emergency unit. On examination, he was noticed to be restless and febrile with an axillary temperature of 38.4°C. His weight was normal at 11 kg (91.7% expected weight for age) and had a good hydration status. He had an oxygen saturation (SPO<sub>2</sub>) of 88% in room air, a respiratory rate of 42 cpm with fine crepitations heard in the middle and lower lung zones bilaterally. With informed parental consent, he was placed on intranasal oxygen at 2 L/min and intravenous 4.3% dextrose in 0.18% saline at 500 mls 12 hourly and a stat dose of paracetamol® 150 mg at 12.5 mg per kg. An urgent chest radiography, posterior–anterior

view revealed normal findings. Laboratory investigations such as full blood count, malaria parasite, random blood glucose (RBG), and urinalysis were all within normal limits. By the first day on admission, he had become afebrile, his cough had reduced, and oxygen saturation (SPO<sub>2</sub>) had increased to 96% in room air with few crepitations in the lower lung zones and liberal fluid intake and feeding were encouraged. Within days, he improved with supportive therapy and was discharged after family counseling on the need for adequate domestic safety and the prevention of future occurrences.

### Case 3

A 15-month-old female presented at Mararaba Medical Center in Nasarawa with a two-hour history of breathlessness, seven hours after the ingestion of about 20 ml of kerosene while playing unsupervised while her mother traded food items. The distinct smell of kerosene on her clothing and the empty kerosene container alerted her mother who immediately force-fed her with palm oil and milk while she inserted her fingers in her throat to induce vomiting. The patient subsequently had five episodes of non-projectile vomiting which were non-bilious, non-bloody, and contained recently ingested feeds on their way to the hospital. There was associated cough, breathlessness, and noisy breathing but no cyanosis, fever, or diarrhea. On examination, she was tachypneic with a respiratory rate of 40 cpm and flaring of the alae nasi but no sub-costal or inter-costal recession, although her oxygen saturation (SPO<sub>2</sub>) was 97–98% in room air. She had transmitted sounds on auscultation, but good bilateral air entry. Her contaminated clothes were removed, and she was given oxygen via facemask at 10 L/min. Urgent laboratory and radiological investigations were within normal limits except her white blood cells which were elevated at  $12 \times 10^9/l$ : elevated neutrophils 80%, lymphocytes 17%. She was immediately commenced on intravenous ceftriaxone 250 mg 12 hourly (at 50 mg/kg in two divided doses), IV metronidazole 100 mg 8 hourly (at 7.5 mg/kg in three divided doses), and 4.3%/0.18% pediatric saline 500 mls 12 hourly at the rate of 8 drops per minute. Subsequent review showed improvement from the respiratory distress, and she was discharged home on oral antibiotics. In-depth parental counseling on domestic safety was given with subsequent follow-up home visits to ensure safety measures were followed through.

### Case 4

A two-year-old male was brought into the Garki hospital emergency pediatric unit in Abuja with a five-hour history of rapid breathing, an hour after accidentally ingesting an unknown amount of kerosene stored in a coca cola bottle. Following the ingestion, he had an episode of vomiting which was non-bilious and comprised of recently ingested food. His mother subsequently administered two tablespoons of palm oil. He was subsequently observed to have rapid breaths but no wheeze with associated intermittent cough, excessive crying with low-grade continuous fever before she brought him to the hospital. On examination, he was tachypneic with a respiratory rate was 40 cpm, and his

oxygen saturation was 88% in room air with good air entry bilaterally without crepitation or rhonchi. His contaminated clothes were removed, and he was subsequently placed on 100% intranasal oxygen administered at 3 L/minute for about 3 hours which improve his SPO<sub>2</sub> to 98%. He was placed on intravenous 4.3% dextrose in 0.18% saline 500 ml 12 hourly, intravenous amoxicillin-clavulanic acid 288 mg (at 25 mg/kg) 12 hourly for 48 hours and a stat dose of intramuscular hydrocortisone 60 mg (at 5 mg/kg). His laboratory and radiological investigations were essentially normal. Subsequent review showed remarkable improvement with a respiratory rate of 28 cpm and SPO<sub>2</sub> 96% in room air. Parental counseling on the control and prevention of domestic accidents was given.

## Discussion

At the primary care level, as urbanization and overcrowding increase in low-resource settings, despite global shifts away from fossil fuels to renewable energy, hydrocarbons such as kerosene are likely to remain threats to the wellbeing of lower-income individuals and families. Over one-quarter of Africa's poor reside in Nigeria and Democratic Republic of Congo, and this is anticipated to double by the year 2030.<sup>[6]</sup> Economic hardship leads to overcrowded living with limited storage space for toxic substances away from the reach of young children. This is most frequent in male toddlers,<sup>[1-5]</sup> and poverty, parental ignorance, and poor supervision fuel the childhood ingestion of poisons,<sup>[7,8]</sup> as was evident in all four cases.

Previous reports indicate that induced emesis and substances such as palm oil, milk, and herbal concoctions are often used by caregivers to “neutralize” poisons, thereby increasing the risk of aspiration and pneumonitis and worsening the child's prognosis.<sup>[4,6,9-11]</sup> These were in keeping with our findings, as these home “remedies” contributed to late presentations in all but one of the patients, increasing the likelihood of severe outcomes.<sup>[4,11]</sup> Typically, kerosene has a bad taste, preventing children from consuming more than 30 mL. Though poorly absorbed after ingestion, it is rapidly absorbed when aspirated; and its high volatility, low viscosity, and low surface tension enhance its penetration and spread in lung tissue.<sup>[9]</sup> The risk of severe pneumonitis is associated with the ingestion of more than 30 mL of a hydrocarbon, but even less than 1 ml of kerosene has been linked to pulmonary complications.<sup>[9]</sup> According to parental accounts, none of the children ingested more than 25 mL, and in all four cases, common features such as cough, dyspnea, and tachypnea<sup>[12]</sup> were provoked following the ingestion of chemicals aimed at neutralizing the kerosene and induced vomiting, with two recording low oxygen saturation levels [Table 1].

Medical management includes removing the child from the source of poisoning, ensuring airway patency, removal of contaminated clothing and thorough cleansing of the skin with soap and water. It is vital that patients are kept on nil per oral, and administration of charcoal and gastric lavage is contraindicated due to the risk of inhalation and pneumonitis. To increase oxygen

saturation and hydration, oxygen administration, analgesics, intravenous fluid administration, and close monitoring are additional management options.<sup>[13]</sup> Antibiotics are not routinely prescribed unless secondary bacterial infection is suspected from contaminated kerosene or commensals in the respiratory tract.<sup>[14]</sup> Adequate diagnosis and management therefore requires quick access to comprehensive care at the primary level to prevent the occurrence of further complications, morbidity, and mortality.

Additionally, primary care physicians can address the health educational component of childhood poisoning. In all four cases, kerosene was stored in common drinking bottles/cups as is common in the literature.<sup>[2]</sup> Therefore, caregiver education on safe storage of domestic chemicals, immediate presentation and discouragement of home remedies in cases of accidental ingestion should be done during well-child clinics, immunization days, and home visits where feasible. Counseling on regular hydration of children during the hot, dry months to prevent thirst and limit their exposure to poisons is also an important preventive strategy.

These cases were reported to highlight the frequency of childhood poisoning in primary care and emphasize the need for awareness, prompt emergency care, family counseling on childcare and domestic safety, community enlightenment and advocacy. A multi-pronged approach to domestic childhood poisoning in the context of the patient, the family and the community would help limit morbidity and mortality from this malaise in poor-resource settings and strengthen primary healthcare delivery.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the forms, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published, and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

### Key message

The domestic ingestion of toxic domestic substances such as kerosene is anticipated to escalate with increasing urbanization and overcrowding, with adverse effects on child morbidity and mortality. This series of cases of under-five children who ingested kerosene in the presence of their guardians highlights the importance of prompt emergency management in primary care, and family and community education on childcare and domestic safety.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

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