



Airborne Fungi in Hospitals

- Can the Ebola Zaire vaccine stop the Bundibugyo virus?
- Maternal and nutritional factors and childhood development
- Laparoscopic versus open cholecystectomy
- Stakeholders' perspectives on determinants of health financing
- Predictors of unsuccessful treatment outcomes of PTB
- Prostate cancer awareness and factors influencing screening
- And more . . .

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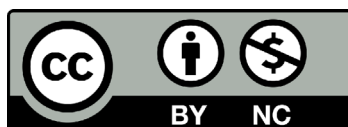
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Can the Ebola Zaire vaccine stop the Bundibugyo virus?

The current Ebola outbreak in the Democratic Republic of Congo (DRC) has officially become the fastest-growing, with the World Health Organization (WHO) reporting more than 5,200 confirmed cases and 2,600 deaths in the country as of August 12, 2026.^[1] Despite the valiant efforts of health workers, community mobilization, and international support, the Bundibugyo virus continues to wreak havoc in the DRC and poses a threat to neighbouring countries.

One public health tool for dealing with outbreaks is vaccination. Ebola vaccine candidates were developed over a long period by different companies, including the Wellcome Trust, Merck, and GlaxoSmithKline. These vaccines were mainly being developed against the dominant Ebola Zaire variant.

During the West Africa outbreak in 2014–2015, a vaccine was rapidly brought into clinical trials in the field and shown to be effective in protecting people against the Ebola Zaire virus. By March 2017, the WHO Strategic Advisory Group of Experts (SAGE) recommended deploying Merck's Ebola vaccine (VSV-ZEBOV) under the Expanded Access framework. This remained the only vaccine approved and licensed for use against the Ebola Zaire virus.^[2] There are no vaccines against the other virus strains.

When the Bundibugyo virus strain outbreak occurred in the DRC, the question was whether the Merck vaccine could be deployed against it. In May 2026, WHO's position on using the Ebola vaccine Ervebo® during the current Bundibugyo Ebola virus outbreak remained unchanged: there is not enough evidence to know whether the vaccine works against this virus, and it does not recommend using it to respond to the outbreak.^[3]

Things have changed quickly. Reports indicate that the WHO and Africa CDC approved the DRC government's request to release Ervebo vaccines for use against the Bundibugyo virus in August.^[4] As the only available vaccine, Ervebo is being deployed as part of a clinical trial to assess its impact on the Bundibugyo virus and provide evidence of its effectiveness.

Let us welcome this development. As the outbreak seems to continue unabated, every available effort and tool should be deployed to stop it. Maybe the vaccine can at least slow the outbreak and bring some relief to the community.

1. World Health Organization. Over 5200 cases recorded as Democratic Republic of the Congo crosses 100 days since Ebola outbreak declaration, News Release. WHO. 24 August 2026. <https://www.afro.who.int/countries/democratic-republic-of-congo/news/over-5200-cases-recorded-democratic-republic-congocrosses100-days-ebola-outbreak-declaration>
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4. World Health Organization. WHO and Africa CDC welcome the allocation of Ebola vaccines to the Democratic Republic of the Congo, News Release. WHO: Geneva/Addis Ababa. 20 August 2026. <https://www.who.int/news/item/20-08-2026-who-and-africa-cdc-welcome-the-allocation-of-ebola-vaccines-to-the-democratic-republic-of-the-congo#:~:text=Ervebo%20vaccine%20is%20licensed%20and,release%20of%2070%20000%20doses.>

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Assessment of airborne fungi in the emergency and traumatology departments of University Hospital Centre, Sidi Bel-Abbes, Algeria

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ABSTRACT

Introduction: Airborne fungi in hospital environments represent a significant risk, particularly in wards housing immunocompromised patients, where they may contribute to nosocomial infections, including hospital-acquired mold diseases. This study aimed to assess the presence of airborne fungi in operating theatres, waiting areas, and corridors within the emergency and traumatology departments of the University Hospital Centre in Sidi Bel-Abbes, Algeria, and to examine environmental and human-related determinants.

Method: Seventy-four samples were collected using passive air sampling. Temperature, relative humidity, and occupant density were recorded. Fungi were identified by macroscopic and microscopic characteristics.

Results: Operating theatres showed the lowest contamination 18 (28.10%), whereas corridors and waiting rooms each accounted for 23 (35.9%). Occupant density was significantly associated with fungal levels ($p = 0.05$). *Aspergillus* and *Penicillium* predominated.

Conclusion: The findings indicate that the operating theatres, waiting rooms, and corridors of the emergency and traumatology departments exhibited relatively low levels of fungal contamination. Airborne fungal concentrations, expressed as Colony Forming Units (CFU)/m³ based on agar plate exposure, were within limits; a few specific high-risk samples (12%) in operating theatres exceeded the threshold.

Keywords: indoor air quality; airborne fungi; fungal assessment; operating theatres.

Introduction

The World Health Organization (WHO) identifies air pollution as the world's largest single environmental health risk.^[1] The presence of airborne fungi in hospital air was first demonstrated by Noble and Clayton in 1963,^[2] and

later in a study by Lidwell and Nobe in 1975.^[3] This raises significant concerns, particularly in wards with immunocompromised patients, as a source of nosocomial infections or Hospital-Acquired Mold Infections (HAMI), which represent a major challenge and concern for hospitals, especially with the high costs they generate and the consequences for public health.^[3]

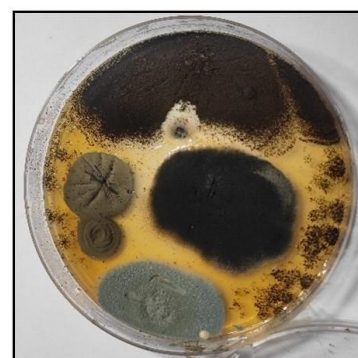
The operating theatre environment plays an important role in the causation of post-operative wound infections or surgical site infections (SSI), constituting a third of all nosocomial infections and 20% of all hospital-acquired infections. Several studies have shown that 80 to 90 % of contaminants found in the wound after surgery emanate from the air.^[4,5]



Penicillium sp



Aspergillus niger



Penicillium sp and Cladosporium



Rhizopus sp



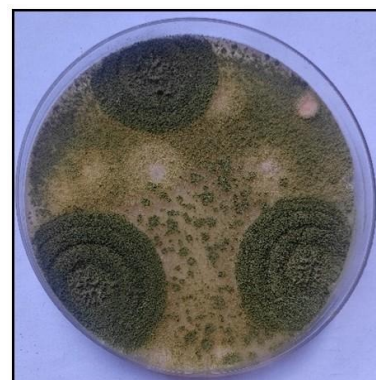
Aspergillus flavus and Alternaria sp



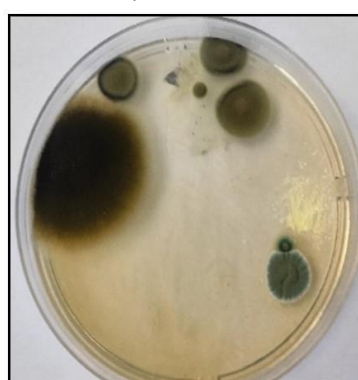
Penicillium sp colonies



Aspergillus flavus and Acremonium sp



Aspergillus flavus colonies



Cladosporium sp and Penicillium sp

Figure 1. Different types of samples collected on SDA media.

The objective of this study was to provide data on fungal concentrations in the indoor air of operating theatres, waiting rooms, and corridors within the traumatology and emergency departments of the University Hospital Centre of Sidi Bel-Abbès, Algeria.

Method

This case study was conducted over a 13-week period, from 1 September to 31 December 2023. The assessment was undertaken at the University Hospital Centre of Sidi Bel-Abbes, Algeria. Two departments were selected: emergency and traumatology

They were selected on the grounds that endo-orthopaedic procedures—i.e., those involving the implantation of prosthetic or artificial components—present a heightened susceptibility to contamination by airborne microorganisms. In addition, the emergency department hosts a diverse array of surgical procedures, each associated with distinct risk profiles and varying levels of sensitivity to microbial contamination.

Sampling was carried out in the following locations: waiting rooms, corridors, and operating theatres. The operating theatre within the emergency department was selected at random. The passive air sampling method was selected due to its practicality, as it utilizes readily available resources. This technique relies on the natural settling of airborne particles by gravity onto the surface of a culture medium. Petri dishes containing 4% Sabouraud dextrose agar supplemented with chloramphenicol were exposed, face upwards, to the ambient air for 15 to 20 minutes, and positioned on the floor at the centre of each sampling location.

Sabouraud dextrose agar is suitable for isolating airborne fungi due to its acidic pH and high dextrose content, which favour fungal growth while inhibiting many bacteria. The addition of chloramphenicol further suppresses bacterial contamination, preventing overgrowth on the culture medium. Together, they ensure selective, reliable detection and enumeration of fungal populations in air samples.

An observational checklist was completed concurrently during each sampling session to record indoor air temperature, relative humidity, the number of occupants present, and the presence or absence of a source of outdoor air.

After sampling, Petri dishes were promptly transported to the laboratory and incubated at 24 °C in an inverted position to prevent condensation, a condition suitable

Table 1. The characteristics of fungal contamination in operating theatres.

Characteristic		Proportion of contamination n (%)
Operating room	Emergency	10 (55.6)
	Traumatology	08 (44.4)
	Temp < 26 °C	10 (56.0)
Environmental conditions	Temp > 26 °C	08 (44.0)
	RH < 60 %	16 (88.9)
	RH > 60 %	02 (11.1)
Surgeries	During surgery	11 (61.0)
	Out of surgery	07 (39.0)
Number of individuals during sampling	≤ 5	12 (66.7)
	≥ 5	06 (33.3)
Type of surgery	Orthopaedic	06 (33.3)
	Digestive	05 (27.8)
	None	07 (38.9)
Mold presence	Presence	17 (94.4)
	Absence	01 (05.6)
Yeast presence	Presence	01 (05.6)
	Absence	17 (94.4)
Microbial contamination	Mono-microbial	15 (83.3)
	Multimicrobial	03 (16.7)
Isolated genera	<i>Candida</i>	01 (05.6)
	<i>Alternaria</i>	01 (05.6)
	<i>Cladosporium</i>	01 (05.6)
	<i>Penicillium</i>	02 (11.1)
	<i>Aspergillus</i>	13 (72.1)
CFU/m ³ in operating rooms	< 180 CFU/m ³	37 (88.0)
	>180 CFU/m ³	05 (12.0)

Table 2. The analytical section of the study

Characteristic		Contamination (-)	Contamination (+)	Prevalence n (%)	P-value
Sampling locations	Emergency	05	34	39 (87.2)	0.854
	Traumatology	05	30	35 (85.7)	
	Total	10	64	74 (86.5)	
Operating rooms	Outside	03	46	49 (93.9)	0.009
	Inside	07	18	25 (72.0)	
	Total	10	64	74 (86.5)	
Waiting rooms	Outside	08	41	49 (83.7)	0.322
	Inside	02	23	25 (92.0)	
	Total	10	64	74 (86.5)	
Corridors	Outside	09	41	50 (82.0)	0.103
	Inside	01	23	24 (95.8)	
	Total	10	64	74 (86.5)	
Ventilation conditions	Not ventilated	10	43	53 (81.1)	0.322
	Ventilated	00	21	21 (100.0)	
	Total	10	64	74 (86.5)	
Air temperature	< 26 °C	06	36	42 (85.7)	0.865
	> 26 °C	04	27	31 (87.1)	
	Total	10	63	73 (86.3)	
Air humidity level	< 60 %	10	60	70 (85.7)	0.416
	> 60 %	00	04	04 (100.0)	
	Total	10	64	74 (86.5)	
Number of individuals during sampling	≤ 5	07	24	31 (77.4)	0.05
	≥ 5	03	40	43 (93.0)	
	Total	10	64	74 (86.5)	
Surgeries	Absence	03	07	10 (70.0)	0.101
	Presence	07	57	64 (89.1)	
	Total	10	64	74 (86.5)	
CFU/m ³	<1000	07	38	45 (84.4)	0.206
	>1000	00	05	05 (100.0)	
	Total	07	43	50 (86.0)	
Mold contamination	Absence	10	02	12 (16.7)	0.0001
	Presence	00	62	62 (100.0)	
	Total	10	64	74 (86.5)	

Yeast contamination	Absence	10	61	71 (85.9)	0.485
	Presence	00	03	03 (100.0)	
	Total	10	64	74 (86.5)	
Multi-microbial contamination	Mono-microbial	10	33	43 (76.7)	0.004
	Multi-microbial	00	31	31 (100.0)	
	Total	10	64	74 (86.5)	

for the growth of most fungal species. The cultures were maintained for 7–10 days with daily observations.

The grown colonies were identified depending on morphological properties (shape, size, colour, elevation and edge shape), as well as microscopic examination (40X) to identify their proliferative parts, conidia shape, size, situation and mycelium segmentation (Figure 1).

Fungal isolates were subjected to microscopic examination using Lactophenol Cotton Blue (LPCB) staining following tape preparation/tease mount techniques. Identification was based on both macroscopic and microscopic characteristics, including colony texture and pigmentation, as well as the morphology of conidiophores, vesicles, phialides, and conidial arrangements observed under light microscopy.

Specifically, *Aspergillus* species were differentiated according to standard mycological criteria:

Aspergillus niger was identified by the presence of large globose vesicles with biseriate phialides and black radiate conidial heads.

Aspergillus flavus was characterized by rough conidiophores, predominantly uniseriate/biseriate phialides covering the vesicle, and yellow-green conidial heads. »

Following enumeration, airborne fungal concentrations were expressed as CFU/m³ using Omeliansky's equation.^[6]

$$N = \frac{5a \times 10^4}{bt}$$

N: microbial (CFU/m³) of indoor air.

a: number of colonies per Petri dish.

b: dish surface (cm²).

t: exposure time (minutes).

CFU/m³ (Colony-Forming Units per cubic meter) is a standard unit used to quantify the concentration of viable microorganisms in air. It represents the number of microbial colonies that can grow on a culture medium from a defined volume (1 m³) of air, providing an estimate of airborne microbial load.

To minimize misidentification, presumptive *Candida* isolates were further examined microscopically after Gram staining. The isolates showed oval to budding yeast cells consistent with *Candida* morphology. In addition, colony texture and creamy appearance on Sabouraud agar were considered during preliminary identification. No chromogenic media or germ tube testing was performed in the present study, and this limitation has been acknowledged in the revised manuscript.

Results

Characteristics of fungal contamination in operating theatres

Table 1 summarizes the characteristics of fungal contamination in operating theatres. The highest proportion of contamination, 10 (55.60%), was observed in the emergency operating theatre. Operating theatres with relative humidity below 60% exhibited the highest contamination rate at 16 (88.90%).

During surgical procedures, contamination was recorded in 11 (61%), representing the highest rate. The highest contamination rate was also observed in operating theatres with fewer than five occupants, at 12 (66.70%). Among contaminated samples in operating theatres, 17 (94.40%) contained mould.

Samples exhibiting single-species contamination (Mono-microbial) were predominant, accounting for 15 (83.30%). *Aspergillus* was the most frequently isolated

genus, present in 13 (72.10%). Notably, 5 samples (12%) in operating theatres exceeded 180 CFU/m³, indicating significant contamination.

Analytical section

Table 2 summarizes the analytical findings of the study.

Regarding sampling locations, the correlation between contamination and the department type (emergency versus traumatology) was not statistically significant ($p = 0.854$). In contrast, a significant correlation was observed between contamination and operating theatres ($p = 0.009$).

Concerning environmental conditions, no significant correlation was found between contamination and natural ventilation, temperature, or relative humidity (RH), with p -values of 0.322, 0.865, and 0.416, respectively.

However, significant correlations were identified between contamination and the number of occupants during sampling, the presence of mould, and the occurrence of multi- microbial contamination, with p -values of 0.05, 0.0001, and 0.004, respectively.

Discussion

The emergency department showed a slightly higher, though not statistically significant, contamination prevalence (39 [87.2%] vs 35 [85.7%] in traumatology; $p = 0.854$) (Table 2). Within operating theatres, contamination was greater in the emergency theatre (10 [55.6%] vs 8 [44.4%]) (Table 1), likely reflecting higher patient turnover and the variety of acute and contagious cases managed.

The incubation temperature of 24°C was selected because it is commonly recommended for the cultivation and enumeration of environmental airborne fungi, particularly filamentous molds, in indoor air quality studies. This temperature favours the growth and sporulation of a broad spectrum of environmental fungal species while limiting excessive bacterial proliferation. In addition, several previous studies investigating fungal air contamination in hospital environments have used incubation temperatures close to 25°C for environmental monitoring purposes.

Contamination prevalence was significantly higher outside operating theatres (49 [93.9%]; $p = 0.009$) (Table 2), while operating theatres showed the lowest levels, likely due to restricted access, strict hygiene protocols, and controlled locations. These results align with findings from Nigerian teaching hospitals, where operating theatres also exhibited the lowest fungal concentrations (10–15 CFU/m³).^[7]

Contamination was more prevalent in areas outside waiting rooms, affecting 41 (64.1%) of samples. Within waiting rooms, a higher, though not statistically significant, prevalence was observed (92% vs 83.7% outside; $p = 0.322$), consistent with findings from the Nigerian study.^[7]

The prevalence of contamination was higher inside corridors, with 24 (95.80%), compared to 50 (82%) outside corridors; however, this difference was not statistically significant ($p = 0.103$) (Table 2).

No significant association was observed between contamination and the presence of natural ventilation (Table 2). Nevertheless, ventilation—natural or mechanical—can influence indoor fungal levels by diluting, removing, and replacing air, as supported by previous studies.^[4,7]

In operating theatres, contamination was 10 (56%) at temperatures below 26 °C (Table 1), with a slight, non-significant increase in warmer areas ($p = 0.865$) (Table 2), indicating no clear temperature effect. While an Iranian study observed a similar non-significant rise in fungal growth at higher temperatures,^[8] other research has reported a strong correlation between indoor fungal load and ambient temperature.^[9]

Contamination in samples collected at ambient humidity below 60 % was 60 (93.8%), with 42 (85.7%) in operating rooms. This difference was not statistically significant ($p = 0.416$), consistent with a Portuguese maternity unit study,^[10] although other research, such as in Southern Thailand hospital wards, reported a significant correlation between relative humidity and fungal contamination.^[11]

Overall contamination at relative humidity below 60 % was 60 (93.8%) (Table 2), with 16 (88.9%) in operating theatres (Table 1). This difference was not statistically significant ($p = 0.416$), aligning with a Portuguese maternity unit study,^[10] although other research, such as in Southern Thailand,^[11] has reported a significant correlation between humidity and hospital fungal contamination.

In operating theatres, contamination increased with more than five individuals present during sampling, reaching 12 (66.7%) (Table 1). Overall, areas with over five occupants showed higher contamination (43 [93%] vs 31 [77.4%]) (Table 2) in areas with five or fewer, with a significant correlation between fungal levels and occupant density ($p = 0.05$), consistent with previous findings from a Saudi Arabian university hospital.^[12]

Contamination prevalence was higher in active operating theatres (64 [89.1%]) (Table 2) compared with idle

theatres (10 [70%]), possibly reflecting the impact of staff activity and patient-related exposure. However, this difference was not statistically significant ($p = 0.101$), in contrast to findings reported in other studies.^[13]

Mould was detected in 97% of positive samples, while yeasts were found in 5%, with 48% showing mixed growth; in operating theatres, mould predominated (94%), and contamination was strongly associated with mould ($p = 0.0001$) but not with yeasts ($p = 0.485$), likely reflecting the limited sensitivity of passive air sampling for yeasts (Table 2).

A significant correlation was observed between multi-species contamination and overall contamination ($p = 0.004$), with higher microbial loads in such environments, suggesting that these settings may favour microbial proliferation and reflect potential shortcomings in hygiene practices.

Aspergillus spp. was the most frequently detected genus 56 (33.7%), followed by *Aspergillus flavus* 47 (28.3%), *Penicillium spp.* 21 (12.7%), and *Aspergillus niger* 14 (8.4%). In operating theatres, *Aspergillus spp.* predominated 13 (72.2%), followed by *Penicillium spp.* 2 (11.1%), while *Cladosporium*, *Alternaria*, and *Candida* were each detected in a single case (5.6%).

Although direct comparisons are limited by methodological and environmental differences, numerous studies consistently report these genera as the most prevalent airborne fungi in hospital indoor environments.^[14]

Across multiple studies, the most frequently reported genera were *Aspergillus spp.* (24 studies), *Penicillium spp.* (23 studies), *Cladosporium spp.* (17 studies), and *Fusarium spp.* (10 studies), while *Candida spp.* was the most common unicellular fungus. Within *Aspergillus*, the most prevalent sections were Niger (18 of 24 studies), followed by *Fumigatus* (14 of 24) and *Flavus* (9 of 24).^[15]

A study conducted across five educational hospital wards in Iran reported that the highest fungal populations were *Penicillium spp.* (32.06%), *Cladosporium spp.* (20.5%), *Aspergillus fumigatus* (14.61%), and *A. niger*.^[13]

Similarly, a study carried out in the Paediatric Unit of Edirne Government Hospital in Turkey found that the most frequent genus was *Cladosporium*, with 462 colonies (33.58%), followed by *Alternaria* with 310 colonies (22.53%) and *Penicillium* with 280 colonies (20.35%).^[16]

A higher, though not statistically significant, prevalence was observed in samples with CFU/m³ exceeding 1000 5 (100%) compared with those below this threshold (p

$= 0.206$) (Table 2), consistent with the World Health Organization's recommended limits.

In operating theatres, 37 (88%) of CFU/m³ values were below 180 (Table 1), corresponding to levels associated with a lower risk of postoperative wound infections.^[5]

Although passive air sampling is practical and inexpensive for routine environmental surveillance, it is less sensitive and less quantitative than active volumetric sampling methods.

Future investigations should incorporate molecular identification methods, such as PCR and sequencing, to improve the accuracy of fungal identification at the species level. The inclusion of antifungal susceptibility testing would also be highly relevant, particularly for the detection of emerging antifungal-resistant strains, including azole-resistant *Aspergillus spp.*, which represent an increasing concern in hospital-associated infections and infection control programs.

Conclusion

Most fungal isolates were detected at levels below 180 CFU/m³ in operating theatres and below 1000 CFU/m³ in waiting rooms and corridors, remaining within internationally accepted limits and indicating effective infection control measures. However, the presence of *Aspergillus* underscores the need for improved cleaning and disinfection practices.

Overcrowding should be minimized, as occupant density is positively associated with airborne fungal levels; restricting visitors may therefore help reduce indoor microbial load in hospital settings.

Future studies should incorporate molecular identification techniques and antifungal susceptibility testing to better characterize airborne fungal species and detect emerging resistant strains, particularly azole-resistant *Aspergillus spp.* of clinical importance in hospital environments.

Conflict of interest: None

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Authors' contributions: DM and SM contributed to study conceptualization, methodology, data interpretation, and drafting of the original manuscript. ZB and AB contributed to the methodology. YM, MAB, and OG conducted sampling and contributed to data interpretation.

Ethics approval and consent to participate:

The study protocol was approved by the Ethics Committee of the Sidi Bel-Abbes University Hospital Centre (Ref: Opinion No. 34, 17 June 2023). Informed consent was obtained from all participants.

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Maternal and nutritional factors associated with early childhood development in rural Indonesia

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ABSTRACT

Introduction: Nutritional status during childhood and maternal knowledge are priority health issues. This study aimed to examine the predictive value of nutritional status and maternal knowledge on the mental and psychomotor development in toddlers.

Method: A cross-sectional study was carried out involving 106 mother-child pairs. Nutritional status was assessed using Z-scores, while maternal knowledge was categorized using a validated questionnaire. Child development data were measured using the Bayley Scales of Infant and Toddler Development, Third Edition. Data were analysed using binary logistic regression to determine the adjusted odds ratio (AOR).

Result: The findings indicated that both nutritional status and maternal knowledge were significant predictors of delays in child development. Children with stunting had increased odds of psychomotor developmental delay (AOR = 12.1) and mental developmental delay (AOR = 7.6). Moreover, mothers with poor knowledge were significantly associated with increased odds of child psychomotor delay (AOR = 5.3).

Conclusion: Both child nutritional status (stunting) and maternal knowledge were significant predictors of psychomotor delay. These findings suggest that addressing physical growth deficits and enhancing maternal awareness are equally critical to mitigating child developmental risks

Keywords: stunting; psychomotor; development; knowledge; Indonesia

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Introduction

The factors influencing child development are complex. One of the most important relationships is that between parents and children. Childhood is a crucial period, particularly the first 1,000 days of life. Adequate nutrition and environmental stimulation are vital during this period to prevent chronic malnutrition and stunting.^[1]

Stunting is associated with developmental delays in early childhood. Preventive initiatives need to be established and nutritional advice provided.^[2] Besides, child development is not only a biological process but also dependent on the household environment.^[3] Maternal knowledge is a key factor, as it will determine the quality of nutritional intake and the amount of developmental stimulation the child receives.^[4] Expanding access to health information for mothers and establishing educational programmes are imperative strategies towards reducing stunting among children below the age of two.^[5]

Healthy eating enhances brain performance and intelligence. Although the link between nutrition and growth has long been recognized,^[4] few studies have evaluated the effects of child nutritional status and maternal health literacy on child development simultaneously. This study aimed to assess the degree to which stunting and mother nutritional awareness raise the risk of mental and psychomotor impairments in children.

Method

A cross-sectional study of 106 mother-child pairs was conducted. The study population was children aged 6-22 months who had lived in the study area for at least six months. Inclusion criteria were that children lived with their biological mothers and had no history of serious illnesses that could cause developmental problems. The sample was the entire population of one village.

Toddler psychomotor and mental development were the dependent variables and were assessed using the Bayley Scales of Infant and Toddler Development, Third Edition (BSITD-III). Independent variables included child nutritional status and mothers' knowledge regarding stunting and child development (their understanding of its general meaning, causes, and prevention).

Descriptive statistics were used to summarize the data. Chi-squared tests were initially conducted to identify independent variables that were significantly associated with the dependent variable. Binary logistic regression was then employed to determine adjusted odds ratios (AORs) with 95% confidence intervals (CI). Statistical analyses were performed using SPSS Version 24.

This study received approval from the Health Research Ethics Committee of the National Research and Innovation Agency (No. 180/KE.03/SK/07/2025). All parents signed informed consent before participating.

Results

Nearly half the mothers had insufficient knowledge regarding stunting and child development. About a quarter (26.4%) had had only an elementary school education, and around a fifth of children experienced delays in psychomotor (21.7%) and mental development (19.8%) (Table 1).

There is a significant correlation between stunting and mental and psychomotor development, as well as between maternal knowledge and psychomotor development (Table 2).

As shown in Table 3, stunting significantly increased the odds of delayed mental (AOR = 7.6) and psychomotor development (AOR = 12.1) compared to the non-stunted group. Similarly, children of mothers with a lack of knowledge had increased odds of psychomotor delay compared to those with sufficient maternal knowledge (AOR=5.3).

Table 1. Sample characteristics (N=106)

Variable		n (%)
Sex	Boys	51 (48.1)
	Girls	55 (51.9)
Age (months)	< 12	58 (54.7)
	≥ 12	48 (45.3)
Mothers' knowledge of stunting and child development	Poor	46 (43.4)
	Sufficient	60 (56.6)
Mothers' education	Primary	28 (26.4)
	Secondary/higher	78 (73.6)
Nutritional status Length/Height-for-age (HAZ)	Stunted	5 (4.7)
	Normal	101 (95.3)
Nutritional status Weight-for-age (WAZ)	Underweight	13 (12.3)
	Normal	93 (87.7)
Nutritional status of Weight-for-Length/ Height) (WHZ)	Wasted	19 (17.9)
	Normal	87 (82.1)
Nutritional status BMI-for-age	Wasted	21 (19.8)
	Normal	85 (80.2)
Child mental development status	Delay	21 (19.8)
	Normal	85 (80.2)
Child psychomotor development status	Delay	23 (21.7)
	Normal	83 (78.3)

Table 2. Bivariate analysis of independent variables on mental and psychomotor development status

Variable	Child mental development status		p-value	Child psychomotor development status		p-value
	Delay	Normal		Delay	Normal	
Sex						
Boys	11 (52.4)	40 (47.1)	0.662	13 (56.5)	38 (45.8)	0.362
Girls	10 (47.6)	45 (52.9)		10 (43.5)	45 (54.2)	
Age (months)						
< 12	10 (47.6)	48 (56.5)	0.466	16 (69.6)	42 (50.6)	0.106
≥ 12	11 (52.4)	37 (43.5)		7 (30.4)	41 (49.4)	
Nutritional status Length/ Height-for-Age (HAZ)						
Stunted	3 (14.3)	2 (2.4)	0.022	3 (13.0)	2 (2.4)	0.034
Normal	18 (85.7)	83 (97.6)		20 (87.0)	81 (97.6)	
Nutritional status Weight-for-Age (WAZ)						
Underweight	5 (23.8)	8 (9.4)	0.072	4 (17.4)	9 (10.8)	0.397
Normal	16 (76.2)	77 (90.6)		19 (82.6)	74 (89.2)	
Nutritional status of Weight-for-Length/ Height) (WHZ)						
Wasted	6 (28.6)	13 (15.3)	0.155	5 (21.7)	14 (16.9)	0.590
Normal	15 (71.4)	72 (84.7)		18 (78.3)	69 (83.1)	
Nutritional status BMI-for-Age						
Wasted	6 (28.6)	15 (17.6)	0.261	4 (17.4)	17 (20.5)	0.742
Normal	15 (71.4)	70 (82.4)		19 (82.6)	66 (79.5)	
Mothers' education						
Primary	8 (38.1)	20 (23.5)	0.175	8 (34.8)	20 (24.1)	0.304
Secondary/Higher	13 (61.9)	65 (76.5)		15 (65.2)	63 (75.9)	
Mothers' knowledge of stunting and child development						
Poor	10 (47.6)	36 (42.4)	0.663	16 (69.6)	30 (36.1)	0.004
Sufficient	11 (52.4)	49 (57.6)		7 (30.4)	53 (63.9)	

p-values calculated using the chi-squared test

Discussion

Approximately 25% of mothers were elementary school-educated (Table 1). Lack of knowledge is linked to low maternal education. Previous studies have shown that maternal education is also linked to a child's cognitive development.^[6] Almost half of the mothers were not aware of the meaning of stunted children (Table 1). Knowledge about a child's growth and development can be useful for everyday communication, stimulation, and understanding dietary requirements.^[7] A mother's understanding of child growth and development can provide appropriate care.^[4]

Approximately 20% of children had delays in psychomotor

and mental development (Table 1). Delayed child development is a public health issue and is closely linked to stunting, low birth weight, low dietary diversity, and suboptimal infant and early childhood feeding practices.^[8]

Table 2 indicates that developmental delays were prevalent in both groups, regardless of whether the children had normal nutritional status or were stunted. In children of normal nutritional stature (not stunted), 17% were mentally delayed, and 19% were psychomotor delayed. This suggests that not only stunted toddlers have developmental delays. Even children with normal height (not stunted) are prone to developmental delays.

Table 3. Logistic regression analysis of stunting and maternal knowledge on delayed mental and psychomotor development status

Variable	Child mental development delayed		Child psychomotor development delayed	
	p-value	AOR (95%CI)	p-value	AOR (95%CI)
Nutritional status Length/ Height-for-Age (HAZ)				
Stunted	0.035	7.6 (1.15, 50.67)	0.016	12.1 (1.59, 92.22)
Normal	Ref	-	-	-
Mothers' knowledge of stunting and child development				
Poor	0.483	1.4 (0.527, 3.875)	0.003	5.3 (1.779, 15.99)
Sufficient	Ref	-	-	-

In this study, malnutrition (stunting) was associated with an increase in the odds of psychomotor delay compared to healthy nutritional status (AOR=12.1) (Table 3). These results are consistent with previous studies that have established a significant correlation between psychomotor development and stunting in children.^[9]

We also revealed that stunted children had significantly higher odds (AOR = 7.6) of experiencing mental delay than their non-stunted counterparts (Table 3). A similar study carried out in Bangladesh reported that malnourished children were less able to perform motor activities compared to non-malnourished ones.^[10]

Good knowledge of child development is necessary to parent them properly. Studies have found that good parenting in the first three years of children's lives is effective in promoting early childhood development.^[11]

Table 3 demonstrates that children raised by mothers with poor knowledge had higher odds of psychomotor developmental delays than those whose mothers possessed sufficient knowledge (AOR=5.3). This finding is consistent with other research on intervention programmes that improve maternal knowledge, as such programmes contribute to child growth and development.^[12]

The wide confidence intervals observed in our models indicate lower precision in some estimates, likely due to the limited sample size and high variability in mothers' backgrounds. Despite this limitation, the adjusted odds ratios still provide valuable directional insights into the factors influencing.

Finally, this study acknowledges some limitations

regarding unmeasured confounding factors. We did not evaluate socio-economic indicators, as socio-economic status can influence both maternal knowledge levels and a child's nutritional status. Future longitudinal studies incorporating socio-economic parameters are warranted to more precisely isolate the independent effects of growth deficits and mothers' cognitive factors on early childhood development.

Conclusion

This paper highlights the importance of improving nutrition for children under two years of age and mothers' education programmes. Therefore, to reduce the risk of long-term developmental delays in children, integrated interventions that improve both nutrition and mothers' education on child development are crucial.

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Declarations: Our database is available from the corresponding author.

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Observed outcomes and costs of laparoscopic versus open cholecystectomy in Juba, South Sudan

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ABSTRACT

Introduction: Cholecystectomy is the standard operative treatment for symptomatic gallstone disease and may be performed using either an open or laparoscopic approach. Laparoscopic cholecystectomy is now the preferred approach in many settings, although open cholecystectomy remains common in parts of sub-Saharan Africa. This study compared observed outcomes and admission costs for laparoscopic and open cholecystectomy in a low-resource clinical setting.

Methods: We conducted a retrospective comparative study of 100 adult patients who underwent open cholecystectomy (OC) or laparoscopic cholecystectomy (LC) between January 2023 and June 2024. OC was performed at South Sudan Modern Specialist Hospital, Juba Teaching Hospital, and Juba Military Hospital. LC was performed at Nile Kings Specialist Hospital in Juba. After application of the inclusion and exclusion criteria, 50 patients were included in each group. All the patients consented to surgery. Medical records were reviewed for the cost of the operative package, medication use, complications, and length of hospital stay. Ethical approval was sought and approved for the retrospective study of the notes.

Results: The mean age was 44.9 years, 46.3 years in the OC group and 43.6 years in the LC group. In the OC group, 11 patients (22%) were male, and 39 (78%) were female; in the LC group, 14 patients (28%) were male, and 36 (72%) were female. Mean hospital stay was 6.2 days after OC and 2.1 days after LC. Complications were recorded in 5 patients (10%) after OC and in 1 patient (2%) after LC. The mean total admission cost was USD 2,553.60 for OC and USD 2,179.82 for LC, a difference of USD 373.78 in favour of LC.

Conclusion: LC was associated with shorter hospital stay, fewer recorded complications and lower observed admission costs than OC. Further prospective evaluation is recommended to confirm these findings and to inform wider implementation of laparoscopic surgery in low-resource settings.

Keywords: gallstones; laparoscopic cholecystectomy; open cholecystectomy; cost; South Sudan

Introduction

Cholecystectomy is a common surgical procedure for the management of symptomatic gallstone disease. The operation may be performed by open cholecystectomy (OC) or laparoscopic cholecystectomy (LC). In many high-income settings, LC has become the standard approach since the early 1990s.^[1] However, OC remains commonly performed in many low-resource settings, including most parts of sub-Saharan Africa.^[2] In settings where LC is widely performed, OC is usually reserved for patients with a contraindication to laparoscopy or for intraoperative conversion when a laparoscopic procedure cannot be completed safely. Conversion may be more frequent during the early learning curve for laparoscopic surgery, when operating times and conversion rates are often higher.^[3] Published studies have reported several benefits of LC over OC, including shorter hospital stay, improved cosmesis and lower morbidity.^[4]

The objective of this study was to compare observed clinical outcomes and admission costs for LC and OC in the Republic of South Sudan, a low-resource clinical setting in sub-Saharan Africa.

Method

This retrospective comparative study included 100 adult patients who underwent cholecystectomy in South Sudan between January 2023 and June 2024. All the patients were selected consecutively. OC was performed at South Sudan Modern Specialist Hospital, Juba Teaching Hospital (JTH), and Juba Military Hospital (JMH). LC

was performed at Nile Kings Specialist Hospital in Juba. Eligible patients were adults with symptomatic gallstone disease who consented to OC or LC and had no clinical contraindication to surgery. Fifty patients who underwent OC and 50 patients who underwent LC.

Documented ethical approval and individual notes review consent were not necessary, as this was an audit review.

Medical records were reviewed for operation cost, length of hospital stay, postoperative medication use, conversion from LC to OC, and recorded perioperative and postoperative complications.

Results

Most procedures were performed in private hospitals. The mean age of the study population was 44.9 years: 46.3 years in the OC group and 43.6 years in the LC group. In the OC group, 11 patients (22%) were males and 39 (78%) were females. In the LC group, 14 patients (28%) were males, and 36 (72%) were females. The mean duration of postoperative analgesic use was 8.9 days after OC, at a mean cost of USD 26.70, compared with 3.6 days after LC, at a mean cost of USD 10.86. Postoperative antibiotics were given for a mean of 10.2 days after OC, at a mean cost of USD 76.80, compared with 6.4 days after LC, at a mean cost of USD 48.15.

There were no perioperative or postoperative deaths. The recorded complications occurred during the index admission, with none during the follow-up. The complication rate was 10% after OC and 2% after LC (Table 1). All included LC patients underwent surgery,

Table 1. Summary of patient characteristics, resource use and admission costs by procedure.

Variable	Open cholecystectomy (n=50)	Cost (USD)	Laparoscopic cholecystectomy (n=50)	Cost (USD)
Age, mean $\pm$ SD (years)	46.3 $\pm$ 13.24		43.64 $\pm$ 15.34	
Sex ratio, M/F	11/39		14/36	
Analgesic requirement, mean (days)	8.86	26.70	3.62	10.86
Antibiotic requirement, mean (days)	10.24	76.80	6.42	48.15
Time to oral intake, mean (days)	2.28	17.10	1.12	8.40
Recorded complications, %	10		2	
Hospital stay, mean (days)	6.22	933.00	2.08	312.41
Operation fee		1,500.00		1,800.00
Total cost		2,553.60		2,179.82

Table 2. Common and recorded complications by procedure perioperatively and post-operatively N=50

Complication	OC n (%)	LC n (%)
Bleeding	1 (2.0)	0 (0.0)
Wound infection	3 (6.0)	0 (0.0)
Jaundice	0 (0.0))	0(0.0)
Bile leak	0 (0.0)	1 (2.0)
Post-cholecystectomy syndrome	0 (0.0)	0 (0.0)
Chest Complications (Pneumonia)	1 (2.0)	0 (0.0)
Total	5 (5.0)	1 (2.0)

and no LC case was converted to OC in this series.

Mean time to resumption of normal oral intake was 2.3 days after OC and 1.1 days after LC. The mean postoperative intravenous fluid cost was USD 17.10 after OC and USD 8.40 after LC.

Mean hospital stay was 6.2 days after OC, with a mean stay-related cost of USD 933.00, compared with 2.1 days after LC, with a mean stay-related cost of USD 312.41. The recorded operation fee was USD 1,500.00 for OC and USD 1,800.00 for LC. When all admission-episode costs were included, the mean total cost was USD 2,553.60 for OC and USD 2,179.82 for LC, a difference of USD 373.78 in favour of LC. All costs were charged to the patients in the study.

Table 2 shows the common and recorded complications by procedure, perioperatively and post-operatively.

Statistically, the total costs for open cholecystectomy showed a 95% confidence interval (CI) of [2472.32, 2634.88], and the CI for the length of hospital stay was [5.68, 6.76]. For the laparoscopic arm, the mean total cost had a CI of [2167.71, 2191.11], and hospital stay showed a CI of [2.01, 2.15]. These statistical calculations, despite the sample size, show that OC costs more than LC.

Discussion

This study provides an early comparative description of LC and OC in the Republic of South Sudan. Published studies from sub-Saharan Africa indicate that OC remains the most frequently performed procedure for symptomatic gallstone disease in many settings.^[2] Although LC is available in some tertiary hospitals, its uptake has been

slower due to limitations in infrastructure, equipment, and trained surgical personnel.^[5] By contrast, LC has become the standard approach in many high-income countries over the past three decades.^[1]

Gallstone disease is a significant contributor to the surgical disease burden in Africa. Over recent decades, urbanisation and changing lifestyle patterns have been associated with an increasing incidence of gallstone disease.^[6]

In this series, 75 of 100 patients undergoing cholecystectomy for symptomatic gallstone disease were female. This is consistent with established epidemiological evidence that gallstone disease is more common in women than in men.^[6,7]

LC was associated with fewer recorded complications than OC in this series (2% versus 10%) and no conversions to OC were recorded (Table 2). These findings are encouraging, particularly in the context of an early laparoscopic programme in South Sudan. However, the small sample size and non-randomised design mean that these results should be interpreted as descriptive rather than definitive evidence of superior safety. The shorter hospital stay observed after LC is consistent with published reports from other settings and is one of the principal advantages of laparoscopic surgery.^[5,8,9,12]

The cost of OC varies across low-resource African hospitals and may differ between private and public facilities. In this study, the reported costs reflect practice in private specialist hospitals and in private-wing or public-private cost-sharing admissions in government hospitals (Table 1). The overall cost comparison is therefore best interpreted as an admission-cost comparison rather than a formal cost-effectiveness analysis. As laparoscopic surgery has become more established, costs have fallen in many settings and outcomes have improved with training, resulting in lower conversion rates and shorter hospital stays, equipment availability, and accumulated surgical experience.^[5,10,11] In sub-Saharan Africa, LC is increasingly performed in well-resourced private hospitals and large tertiary teaching hospitals, but access remains uneven.^[6,12] In the present study, total admission cost incorporated professional fees, hospital stay, medications, and costs associated with recorded complications (Tables 1 and 2).

Mean total admission cost was USD 2,554 for OC and USD 2,180 for LC, a difference of USD 373.78. This difference may be meaningful for patients with modest incomes. In this series, the higher total cost of OC appeared to be driven mainly by longer hospital stays, longer durations of postoperative analgesic and antibiotic

use, and management of recorded complications. These findings are consistent with reports that LC can reduce length of stay and postoperative resource use compared with OC.^[13-14] However, the present study did not include indirect costs, quality-of-life outcomes, or formal economic modeling; therefore, the term “cost-effective” should be used cautiously.

In South Sudan, the main government hospitals have no clearly defined pricing policy for cholecystectomy beyond basic administrative admission fees. This study also found that laparoscopic operating sets were not available in the main government hospitals. Consequently, patients who can afford private care may seek LC in a small number of private facilities in the capital, while others may travel to neighbouring countries or further afield for surgical treatment.

The findings also highlight the need for clearer regulation of private healthcare pricing and tariffs, particularly as the number of private specialist hospitals increases in parts of sub-Saharan Africa.

This study has several limitations. The sample size was small, the design was retrospective and non-randomised, and the two procedures were performed in different hospitals. These factors introduce potential selection bias and confounding. Prices were not standardised across hospitals, and there was wide variation in cost packages, particularly for OC, between government and private hospitals. Only a limited number of surgeons performed LC in the study sample. A longer-term audit over several years, including the learning curve for laparoscopic surgery, would provide a more reliable assessment of outcomes, complications, conversion rates, and costs.

Conclusion

LC is the standard surgical approach for symptomatic gallstone disease in many countries. This retrospective series suggests that LC can be delivered in South Sudan and may be associated with shorter hospital stay, fewer recorded complications and lower observed admission costs than OC. Wider adoption would require investment in equipment, training and governance, together with clearer regulation and standardisation of hospital tariffs.

Despite the limitations of small sample size and non-randomisation of this retrospective study, LC was associated with more favourable observed outcomes and lower admission costs than OC. Prospective studies with standardised costing, longer follow-up and adjustment for case mix are needed before definitive conclusions can be drawn.

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How South Sudan is staying ahead of drug resistance

23 June 2026 by Malaria Consortium South Sudan

Malaria remains a major public health issue in South Sudan, with the disease accounting for over 38 percent of outpatient visits and around 64 percent of inpatient deaths in 2025. As antimalarial drug resistance continues to emerge across East Africa, there is a growing concern that the malaria burden could increase if resistance spreads further and undermines the effectiveness of existing prevention and treatment drugs, including artemisinin-based combination therapies (ACTs).

ACTs act as the first-line treatment for uncomplicated malaria, made up of the powerful antimalarial compound artemisinin and a partner drug with complementary features. Resistance to artemisinin has been steadily spreading in parts of southeast Asia for more than 15 years and has more recently emerged in east Africa; a 2024 study documented cases of partial resistance among children hospitalised with complicated malaria in Uganda.

Molecular surveillance techniques can pinpoint specific genetic alterations linked with antimalarial drug resistance, playing a crucial role in detecting emerging resistance and ensuring that responses remain effective. As evidence evolves, the strategies we use to prevent, diagnose and treat malaria should evolve as well.

Malaria Consortium's South Sudan team has been working closely with government and partners to strengthen the use of evidence in decision-making, including through convening stakeholders to interpret new findings and translate them into action.

Read more here:

https://www.malariaconsortium.org/blog/south-sudan-drug-resistance?utm_source=Malaria+Consortium+Mailin+g+List+-+Master&utm_campaign=46c210c55d-EMAIL_CAMPAIGN_2024_06_28_03_37_COPY_02&utm_medium=email&utm_term=0_-61cb29d84b-22612365

Stakeholders' perspectives on determinants of health financing in South Sudan: a qualitative assessment

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ABSTRACT

Introduction: Health financing is a critical constraint to health system performance in fragile and post-conflict settings. Despite global and regional commitments such as the Abuja Declaration, South Sudan allocates less than 2% of its national budget to health, resulting in heavy dependence on donors and high out-of-pocket expenditure. Understanding the determinants of health financing from a stakeholder perspective is essential for informing sustainable reforms.

Method: This study employed a qualitative case design to explore stakeholder perspectives on the determinants of health financing in South Sudan. Primary data were collected through key informant interviews (n = 17) from selected stakeholders and were analysed using reflexive thematic analysis following the Braun and Clarke framework.

Results: Findings reveal a health financing system in South Sudan that is widely perceived as inadequate, unsustainable, and heavily donor-dependent. Key determinants identified include insufficient domestic budget allocation, weak public financial management, limited risk-pooling mechanisms, and low political prioritization of health. Socio-economic fragility, insecurity, and constraints on institutional capacity further undermine domestic resource mobilization.

Conclusion: Health financing in South Sudan remains dominated by short-term humanitarian funding rather than nationally anchored, sustainable public financing. Stakeholders emphasized the urgent need for increased government budget allocation, strengthened financial management systems, improved donor alignment, and a phased transition toward domestic financing mechanisms.

Keywords: domestic financing; donor funding; out-of-pocket expenditure; budget allocation; South Sudan.

Introduction

Health financing is one of the core building blocks of any health system, directly determining how resources are generated, pooled, and allocated to enable equitable access to health services.^[1] Globally, there are extreme disparities in health financing; i.e., those with the highest burden of disease have the least funding for health services.^[2] According to the Institute for Health Metrics and Evaluation, high-income countries spend nearly 300 times as much on health as low-income countries.^[3]

In Saharan Africa, health financing is fragile and inadequate. Although African leaders pledged in the Abuja Declaration (2001) to allocate at least 15% of national budgets to health, most countries remain far below this target.^[4] More than twenty years after signing the declaration, only three countries (Botswana, Cape Verde and Rwanda) have fulfilled this endeavour.^[5] Moreover, the region still struggles with fragmented insurance schemes and catastrophic household expenditure (spending that exceeds 10% of total household income).^[6]

South Sudan continues to grapple with weak financing structures, limited institutional capacity, and dependency on donors, hindering sustainable development of health systems.^[7] Over the years, South Sudan has invested less than 2% of its budget in health services, with the exception of the 2021-2022 budget, which allocated 9.6%,^[7,8] partly due to COVID. This low government expenditure forces households to cover healthcare costs directly, with Out-of-Pocket Payments (direct payments made by individuals to health providers at the point of service) accounting for over 54% of total health spending.^[9]

Despite these pressing challenges, literature exploring the underlying systemic and stakeholder-driven factors constraining health financing in South Sudan is sparse. This study aimed to fill this gap by assessing key stakeholders' perspectives on determinants of health financing in South Sudan and investigating the systemic challenges of current health financing mechanisms to inform sustainable and acceptable policy reforms.

Method

A qualitative descriptive case study design was used to explore the perspectives of key issues in the South Sudan Health Financing landscape.

An institutional mapping exercise was first conducted to guide the identification of key stakeholders in South Sudan's health financing landscape. Building on that,

the study adopted a purposive sampling design to recruit key informants. These participants were selected for their knowledge, technical expertise, and decision-making authority within their organizations. The final sample included 17 key informants (n=17) representing different sectors within the health system.

Data collection

Data for this study were collected between November 2025 and April 2026. The primary method involved face-to-face interviews. However, a small number of participants provided their responses via email. The data collection instrument was a semi-structured Key Informant Interview (KII) guide designed to facilitate dialogue on three core areas: perceived barriers to domestic resource mobilization, the implications of donor dependency, and the effectiveness of the current funding mechanisms. Each interview was recorded, transcribed, and stored in a password-protected drive.

Data analysis

Data analysis was conducted using reflexive thematic analysis, following the six-phase framework established by Braun and Clarke (19). This process was managed using NVivo (Version 10) to ensure systematic data organization and retrieval.

Ethical Considerations

Ethical clearance for this study was obtained from the Ministry of Health/ Institutional Review Board. Prior to data collection, all participants provided informed consent, having been briefed on the study's purpose and the measures taken to ensure anonymity and confidentiality.

Results

Governance for health financing

The Ministry of Health sees itself as the primary actor in planning health financing strategies. A senior official emphasised that their role goes beyond setting strategic policies to coordinating donor funding.

"In the Ministry of Health, we are the visionaries and the advocates for health financing. But beyond the budget, we negotiate on behalf of the South Sudanese."

At the macro-fiscal level, officials from the Ministry of Finance and Planning (MoFP) underscored their role in budget system control and expenditure oversight.

“Budget execution requires a dialogue: they provide their needs (Ministry of Health), and we provide the fiscal framework to make it happen.”

From the perspective of international donors, engagement in health financing is fundamentally strategic rather than operational. A high-level executive in a donor agency described their organization as a catalytic investor, seeking to align global health funding with South Sudan's national priorities.

“Our role emphasizes catalytic funding, reform incentives, and governance safeguards.”

Adequacy and Sustainability

Participants agreed that per capita public spending on health remains among the lowest globally and far below WHO benchmarks for universal health coverage.

“Health financing is severely inadequate. Per-capita public spending is among the lowest in the world, far below what is required for basic services. Almost everything depends on donors.”

Participants from international NGOs emphasized that South Sudan's health system is not anchored in sustainable public financing but instead functions as an externally financed humanitarian platform.

“The system is not sustainable. Humanitarian funding is short-term and volatile. When donor projects end, services often stop.”

South Sudan lacks health insurance mechanisms that could reduce out-of-pocket spending. While recognizing that donor support remains essential, stakeholders consistently advocated for a gradual shift toward a mixed and more sustainable financing model.

“Pooled donor funding aligned with national plans should be strengthened in the short term, while pooled insurance programmes should be introduced gradually.”

Perceived barriers to health financing

Political stability emerged as a critical determinant as it often disrupts economic activities, weakens governance structures, and erodes public trust in state institutions.

“it is the baseline for everything we are trying to achieve (political stability), You can't ask a system to mobilize resources effectively if that system's foundation is shifting.”

Frequent turnover of political and technical leadership has eroded institutional memory and stalled long-term financing initiatives. As one official explained:

“Rapid turnover of officials leads to loss of institutional memory, weak follow-up of programmes creating instability in financing decisions again and again.”

Widespread poverty is also outlined as a dominant socio-economic factor constraining health financing.

“Over two-thirds of the population live below the poverty line, severely limiting household ability to pay for health services or contribute to insurance schemes.”

Discussion

Governance for health financing

Overall, roles of stakeholders in health financing in South Sudan can be broadly categorized into three interlinked functions: 1. Policy formulation and budget execution, led by the Ministry of Health in collaboration with the Ministry of Finance; 2. Strategic and catalytic financing leadership, largely driven by donors; 3. Implementation and service continuity, carried out by NGOs and civil society organizations.

Therefore, health financing is negotiated across a network of stakeholders. While the government institutions remain central to policy and budgeting (yet their influence is often constrained by limited fiscal space and institutional capacity), international donors provide crucial strategic investments, with both implementation agencies providing operational support.

Adequacy and Sustainability

A consistent narrative emerged that health financing in South Sudan remains profoundly inadequate and structurally fragile. Current funding levels fall far below the estimated costs required to deliver essential health services.

From a sustainability perspective, the current financing model carries extreme exposure risk. South Sudan remains highly reliant on external resources, with donor contributions constituting nearly half of total health expenditure and additional spending by households filling critical gaps. Similar patterns have been observed in other Fragile, Conflict-affected and Violent (FCV) countries, where donor-dominated financing undermines long-term system resilience.^[10]

Measured against essential health service cost packages commonly employed in East African health reforms, South Sudan's financing envelope remains substantially below minimum adequacy thresholds. Neighbouring countries

such as Kenya, and Uganda have progressively expanded domestic financing for primary healthcare through tax revenues and insurance mechanisms, thereby diversifying revenue sources and reducing donor dependence.^[11]

Perceived barriers to health financing

Respondents overwhelmingly agreed that widespread poverty and low-income levels severely narrow the tax base. In FCV contexts, limited household incomes reduce both the capacity and willingness of citizens to pay taxes.^[12] Evidence suggests that countries with high poverty rates tend to rely disproportionately on external financing.^[12,13]

Moreover, political stability is seen as a critical enabling condition for domestic resource mobilization. When instability occurs, it disrupts economies and weakens state authority, which directly reduces tax compliance and enforcement.^[14] Recent evidence confirms that post-conflict countries need prolonged peace and stronger institutions before their tax revenues improve significantly.^[13]

Weak institutional capacity was also recognized as a key factor undermining domestic financing. In fragile states, these structural weaknesses drive widespread economic informality, which eventually obstruct effective revenue mobilization.^[15]

Recommendations

Building on the findings, the following recommendations are categorized by stakeholder groups:

Government

- **Expand Domestic Revenue:** Gradually introduce incremental strategies such as expanded taxation, and health insurance schemes.
- **Embed Health in State-Building:** Integrate health financing initiatives into broader national agendas, including peacebuilding and transparent public financial management.
- **Strengthen Institutional Capacity:** Prioritize targeted interventions to enhance policy formulation, and financial management.

Donors

- **Enhance Coordination:** Reduce duplication and stabilize resource flows by aligning priorities through joint planning with government institutions.
- **Harmonize Funding Streams:** Bridge the gap between humanitarian and development financing through

pooled funds and integrated planning platforms.

- **Improve Predictability:** Foster accountability through transparent reporting and long-term commitments to support the transition towards sustainable systems.

Conclusion

The study identified multiple, interconnected determinants that influence health financing in South Sudan. Socio-economic fragility limits both household contributions and government revenue generation. Political instability and competing national priorities have consistently constrained health sector funding, while weak institutional capacity undermines effective allocation and utilization of available resources.

Health financing in South Sudan requires a phased and context-sensitive transition. In the short term, improved donor coordination and strengthened financial governance are essential to stabilize service delivery. In the longer term, increased government budget commitment, gradual expansion of domestic resource mobilization, and institutional strengthening are necessary to reduce donor dependence and move toward equitable and sustainable financing.

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Funding: None

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VIDEO: The Story of Ebola

Global Health Media Project has produced an ebola animation to help inform local communities during ebola outbreaks. It is in English, French, Lingala, and Swahili - and downloadable on our website.

<https://globalhealthmedia.org/video/the-story-of-ebola-english/>

This animation — produced in collaboration with International Federation of Red Cross and Red Crescent Societies, UNICEF, and Yoni Goodman — brings to life key messages that help people see and understand how Ebola spreads and how to protect themselves

Deborah Van Dyke, Director

Comments on the video: Excellent, very descriptive and easy to understand video. Well done animation and I really like the fact that a child was used as the narrator, this should help with communication.

Predictors of unsuccessful treatment outcomes among adults with pulmonary tuberculosis in a resource-limited setting

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ABSTRACT

Introduction: Tuberculosis (TB) remains a major health burden in low- and middle-income countries, where successful treatment is central to control efforts. This study aimed to determine the predictors of unsuccessful TB treatment in a resource-limited setting.

Method: A retrospective, record-based study was conducted at a district general hospital in Banten Province, Indonesia, and included 231 adults with pulmonary TB who were registered between January 2020 and December 2023. Outcomes were classified as successful (cured or treatment completed) or unsuccessful (treatment failure, loss to follow-up, or death) according to WHO definitions. Factors associated with unsuccessful outcome were assessed using chi-square tests, and variables with $p < 0.25$ were entered into a multivariable logistic regression model.

Results: Of 231 patients, 34 (14.7%) had an unsuccessful treatment outcome, comprising 18 deaths, 11 lost to follow-up, and 5 treatment failures. Independent predictors of unsuccessful outcome were age ≥ 60 years (adjusted odds ratio [aOR] 2.81, 95% CI 1.14–6.92), underweight nutritional status (aOR 2.47, 95% CI 1.08–5.65), previously treated TB (aOR 3.56, 95% CI 1.39–9.11), and HIV-positive status (aOR 5.74, 95% CI 1.71–19.24). HIV-positive status demonstrated the strongest association with unsuccessful treatment outcome.

Conclusion: Older age, undernutrition, retreatment, and HIV co-infection independently predicted unsuccessful TB treatment outcomes in this district setting. These factors help frontline clinicians to identify high-risk patients early and target nutritional support, integrated TB-HIV care, and closer monitoring.

Keywords: pulmonary tuberculosis; treatment outcome; unsuccessful outcome; predictor; HIV

Introduction

Tuberculosis (TB) remains one of the most pressing global health challenges. TB returned to being the world's leading cause of death from a single infectious agent.^[1] The burden is concentrated in low- and middle-income countries

(LMICs): just five nations accounted for 56% of global cases, with Indonesia ranking second and contributing an estimated 10% of the world's TB burden.^[2,3] This concentration reflects the close link between TB and poverty, undernutrition, and constrained health systems, making the disease a defining condition of socioeconomic deprivation.^[4]

Successful completion of treatment is the cornerstone of TB control and a key indicator tracked under the World Health Organization (WHO) End TB Strategy.^[5] Unsuccessful outcomes comprising treatment failure, loss to follow-up, and death prolong infectiousness, facilitate the emergence of drug-resistant strains, and impose substantial costs on patients and health systems. Identifying patients at risk of unsuccessful outcomes early in their treatment course is therefore essential for targeting supportive interventions.^[6,7] Although Indonesia reports a high national treatment success rate, this aggregate figure conceals considerable variation across regions and patient subgroups, and outcomes remain poorer among vulnerable populations.^[8]

Most data on the determinants of TB treatment outcomes in Indonesia derive from national datasets or tertiary referral centres.^[8,9] Far less is known about district-level hospitals, where the majority of patients are actually diagnosed and treated but where data are seldom reported and published. This represents an important gap, because the local determinants of unsuccessful treatment in a resource-limited district setting may differ from those identified in large, aggregated datasets and may be more directly actionable by frontline clinicians. The present study addresses this gap by examining treatment outcomes at a district hospital in Indonesia.

The aim of this study was to determine the predictors of unsuccessful TB treatment outcomes for pulmonary TB in a resource-limited district setting.

Method

This was a retrospective record-based study conducted at a district general hospital in Banten Province, Indonesia. The hospital is a referral facility for the surrounding district and provides TB diagnosis and treatment under the national TB programme. Banten is a densely populated province adjacent to greater Jakarta, with a mixed urban–rural population, representing a typical resource-limited district context.

All patients with pulmonary TB who were registered for anti-TB treatment at the hospital between 1 January 2020

and 31 December 2023 were included. Data extraction was performed only after treatment outcomes had been recorded in the TB register. Consequently, even patients registered at the end of 2023 were followed through routine programme records until a final treatment outcome was available, typically after completion of the standard treatment course. Inclusion criteria were: (1) a diagnosis of pulmonary TB (bacteriologically confirmed or clinically diagnosed) according to national guidelines; (2) age ≥ 18 years; and (3) a documented final treatment outcome in the medical records. Exclusion criteria were: (1) extrapulmonary TB only; (2) patients transferred out to another facility whose final outcome could not be ascertained; and (3) records with incomplete data on key variables.

Data were extracted from hospital medical records and/or the TB register using a standardised form. Information collected included demographic characteristics, clinical variables, and treatment outcomes. To ensure data accuracy, a proportion of entries were re-checked against the original medical records, and discrepancies were resolved through source-document verification.

The primary outcome was TB treatment outcome, classified according to WHO definitions. Outcomes were divided into successful (cured or treatment completed) and unsuccessful (treatment failure, lost to follow-up, or died).

The dependent variable was unsuccessful treatment outcome. Independent variables comprised age, sex, residence/address, body weight or nutritional status, TB classification (new or previously treated), bacteriological status (smear- or rapid molecular test-positive vs clinically diagnosed), HIV status, diabetes mellitus status, and treatment regimen category.

Statistical analysis

Data were analysed using SPSS version 30. Categorical variables were summarised as frequencies and percentages, and continuous variables as mean $\pm$ standard deviation. The distribution of continuous variables was assessed using the Shapiro–Wilk test and visual inspection of histograms. Variables with approximately normal distributions were presented as mean $\pm$ standard deviation. The association between each independent variable and unsuccessful treatment outcome was first assessed using the chi-square test for categorical variables. Variables with a p-value < 0.25 in bivariate analysis were entered into a multivariable logistic regression model to identify independent

predictors of unsuccessful outcome. Adjusted odds ratios (aOR) with 95% confidence intervals (CI) were calculated. A two-sided p -value ≤ 0.05 was considered statistically significant. Model performance was evaluated using the Hosmer–Lemeshow goodness-of-fit test and Nagelkerke's R^2 . The overall classification accuracy of the model was also assessed.

Ethical Approval

Ethics approval was obtained from the Health Research Ethics Committee of Banten Regional General Hospital, protocol number 98/KEPK-RSUD/8/2024. Because this study used retrospective and anonymized data, the requirement for informed consent was waived. This study was conducted in accordance with the Declaration of Helsinki.

Results

A total of 254 patients with pulmonary TB were registered during the study period: 231 met the inclusion criteria for analysis. Twenty-three patients were excluded (8 extrapulmonary TB only; 6 transferred out with unknown outcome; 9 incomplete data) (Figure 1).

Of the 231 patients included, 197 (85.3%) had a successful treatment outcome (cured or treatment completed), 34 (14.7%) had an unsuccessful outcome, comprising 5 treatment failures, 11 lost to follow-up, and 18 deaths. The baseline characteristics of the study population are presented in Table 1.

The mean age was 46.8 ± 15.2 years, and 142 (61.5%) were male. Most patients were newly diagnosed cases (198; 85.7%), 33 (14.3%) had previously received TB treatment. The majority were bacteriologically confirmed (171; 74.0%), whereas 60 (26.0%) were clinically diagnosed. HIV positivity was identified in 12 patients (5.2%), and diabetes mellitus was present in 49 (21.2%). In bivariate analysis, age group ($p = 0.018$), nutritional status ($p = 0.006$), TB classification ($p = 0.002$), HIV status ($p < 0.001$), and diabetes mellitus ($p = 0.097$) were associated with unsuccessful treatment outcome (Table 2). Older age, underweight nutritional status, previously treated TB, and HIV positivity were associated with a greater proportion of unsuccessful outcomes.

The logistic regression model demonstrated acceptable fit to the data (Hosmer–Lemeshow $\chi^2 = 6.84$, $df = 8$, $p = 0.553$). The model explained 28.7% of the variation in unsuccessful treatment outcomes according to Nagelkerke's R^2 (Cox & Snell $R^2 = 16.8\%$) and correctly

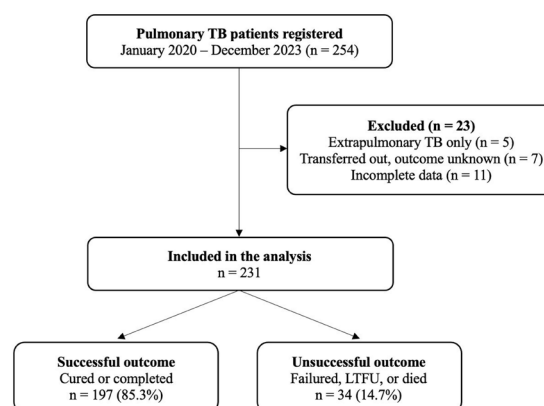


Figure 1. Flow diagram of patient selection.
(LTFU = Lost to follow-up)

Table 1. Baseline characteristics of pulmonary TB patients and treatment outcomes (N = 231)

Variable	Category	n (%)
Age (years)	Mean $\pm$ SD	46.8 ± 15.2
	<40	87 (37.7)
	40–59	96 (41.6)
	≥ 60	48 (20.7)
Sex	Male	142 (61.5)
	Female	89 (38.5)
Residence	Urban	139 (60.2)
	Rural	92 (39.8)
Nutritional status	Underweight	102 (44.2)
	Normal/above	129 (55.8)
TB classification	New	198 (85.7)
	Previously treated	33 (14.3)
Bacteriological status	Confirmed	171 (74.0)
	Clinically diagnosed	60 (26.0)
HIV status	Positive	12 (5.2)
	Negative	201 (87.0)
	Unknown	18 (7.8)
Diabetes mellitus	Yes	49 (21.2)
	No	182 (78.8)
Treatment regimen	Category 1	206 (89.2)
	Category 2	25 (10.8)
Treatment outcome	Successful	197 (85.3)
	Unsuccessful	34 (14.7)

classified 86.1% of cases, indicating satisfactory predictive performance. In the multivariable logistic regression model, independent predictors of unsuccessful treatment outcome were age ≥ 60 years (aOR 2.81, 95% CI 1.14–6.92, $p = 0.025$), underweight nutritional status (aOR 2.47, 95% CI 1.08–5.65, $p = 0.032$), previously treated TB (aOR 3.56, 95% CI 1.39–9.11, $p = 0.008$), and HIV-positive status (aOR 5.74, 95% CI 1.71–19.24, $p = 0.005$) (Table 3). HIV-positive status demonstrated the strongest association with unsuccessful treatment outcome.

Discussion

In this retrospective record-based study of 231 patients with pulmonary TB treated at a district hospital in Indonesia, 14.7% experienced an unsuccessful treatment outcome. Four factors were independently associated with unsuccessful outcomes: age ≥ 60 years, underweight nutritional status, previously treated TB, and HIV-positive status, with HIV infection showing the strongest association. These findings identify readily measurable,

routinely available characteristics that frontline clinicians can use to recognise patients at higher risk early in the treatment course.

The treatment success rate of 85.3% in this cohort fell just below the WHO End TB Strategy target of $\geq 90\%$ and was broadly consistent with the national Indonesian figure of approximately 86%.^[9] This suggests that, despite operating in a resource-limited district setting, the hospital achieved outcomes comparable to national performance, while still leaving a meaningful gap relative to the global target. Notably, deaths accounted for the largest share of unsuccessful outcomes (18 (53%) of 34), followed by loss to follow-up, a pattern that points to the clinical severity of cases rather than programmatic dropout alone.

HIV-positive status was the strongest independent predictor of unsuccessful outcome (aOR 5.74). This is consistent with a large body of evidence across high-burden settings. A six-year Ethiopian cohort reported substantially lower treatment success among TB-HIV co-infected patients than among HIV-negative patients,^[10]

Table 2. Bivariate analysis of factors associated with unsuccessful TB treatment outcome

Variable	Category	Successful n (%)	Unsuccessful n (%)	p-value
Age	<40	80 (92.0)	7 (8.0)	0.018
	40–59	84 (87.5)	12 (12.5)	
	≥ 60	33 (68.8)	15 (31.2)	
Sex	Male	118 (83.1)	24 (16.9)	0.284
	Female	79 (88.8)	10 (11.2)	
Residence	Urban	121 (87.1)	18 (12.9)	0.391
	Rural	76 (82.6)	16 (17.4)	
Nutritional status	Underweight	79 (77.5)	23 (22.5)	0.006
	Normal/above	118 (91.5)	11 (8.5)	
TB classification	New	175 (88.4)	23 (11.6)	0.002
	Previously treated	22 (66.7)	11 (33.3)	
Bacteriological status	Confirmed	149 (87.1)	22 (12.9)	0.217
	Clinically diagnosed	48 (80.0)	12 (20.0)	
HIV status	Positive	6 (50.0)	6 (50.0)	<0.001
	Negative	177 (88.1)	24 (11.9)	
	Unknown	14 (77.8)	4 (22.2)	
Diabetes mellitus	Yes	37 (75.5)	12 (24.5)	0.097
	No	160 (87.9)	22 (12.1)	
Treatment regimen	Category 1	179 (86.9)	27 (13.1)	0.118
	Category 2	18 (72.0)	7 (28.0)	

Chi-square test was used for categorical variables. Variables with $p < 0.25$ were entered into the multivariable logistic regression model.

Table 3. Multivariable logistic regression of independent predictors of unsuccessful TB treatment outcome

Variable	aOR	95% CI	p-value
Age			
40–59 years (vs <40)	1.42	0.52–3.89	0.491
≥60 years (vs <40)	2.81	1.14–6.92	0.025
Nutritional status			
Underweight (vs normal/above)	2.47	1.08–5.65	0.032
TB classification			
Previously treated (vs new)	3.56	1.39–9.11	0.008
Bacteriological status			
Clinically diagnosed (vs confirmed)	1.48	0.61–3.60	0.385
HIV status			
Positive (vs negative)	5.74	1.71–19.24	0.005
Unknown (vs negative)	1.59	0.44–5.77	0.482
Diabetes mellitus			
Yes (vs no)	1.76	0.77–4.01	0.181
Treatment regimen			
Category 2 (vs Category 1)	1.94	0.69–5.43	0.207

aOR = adjusted odds ratio; CI = confidence interval. Variables with $p < 0.25$ in bivariate analysis were entered into the multivariable logistic regression model.

and a Cameroonian study found HIV positivity to be the strongest predictor of death during TB treatment.^[11] The biological basis is well established: HIV-related immunosuppression increases the risk of disseminated disease, treatment complications, and mortality. The relatively high proportion of unsuccessful outcomes among the small number of HIV-positive patients in our cohort reinforces the importance of integrated TB-HIV care, including early antiretroviral therapy, in district settings.

Previously treated TB was also an independent predictor (aOR 3.56), in keeping with findings from both Indonesian and other LMIC studies, where retreatment cases consistently show poorer outcomes than new cases.^[12,13] Patients requiring retreatment may harbour drug-resistant strains, have a history of poor adherence, or carry a higher burden of comorbidity all impacting cure. This

underscores the value of drug-susceptibility testing and closer monitoring for retreatment patients, particularly where rapid molecular diagnostics may not be uniformly available.

Underweight nutritional status independently predicted an unsuccessful outcome (aOR 2.47). This aligns with a multisite Indonesian cohort that reported being underweight as an independent risk factor for unfavourable outcomes (aOR 1.93),^[8,14] and a similar Ethiopian study.^[10] The relationship between undernutrition and TB is bidirectional: malnutrition impairs cell-mediated immunity and worsens treatment response, while active TB accelerates wasting. This supports the integration of nutritional assessment into routine TB care, an intervention that is low-cost and feasible in constrained settings.

Older age (≥60 years) was likewise an independent predictor (aOR 2.81), consistent with the same multisite Indonesian study (age ≥50 years, aOR 2.54)^[8,9] and with broader evidence that elderly patients experience higher mortality and poorer outcomes owing to comorbidity, frailty, atypical presentation, and reduced treatment tolerance. As populations age in many LMICs, tailored care for older adults with TB is likely to become increasingly important.

The findings in this study are consistent with much larger national and multisite studies, despite originating from a single district hospital. This strengthens confidence that the determinants of unsuccessful treatment identified here are not artefacts of the local setting but reflect generalisable risk factors that operate even at the district level where most patients are actually managed. The practical implication is that a simple risk profile based on age, nutritional status, treatment history, and HIV status could help district clinicians prioritise intensified support without requiring sophisticated tools.

Study limitations

This study has several limitations. First, its retrospective single-centre design limits generalisability and is subject to the completeness and accuracy of routinely recorded data; patients with incomplete records were excluded, which may have introduced selection bias. Second, the number of unsatisfactory outcomes was relatively small ($n = 34$), limiting the statistical power and stability of the multivariable model, resulting in wider confidence intervals, particularly for HIV status. HIV status was unavailable for 18 patients (7.8%), which may have introduced some degree of misclassification. Therefore,

the magnitude of associations should be interpreted cautiously. Third, several potentially important variables were not available, including drug-susceptibility results, diabetes control (HbA1c), smoking, treatment adherence, and socioeconomic status, raising the possibility of residual confounding. Fourth, the study period (2020–2023) overlapped with the COVID-19 pandemic, which disrupted TB services in Indonesia and may have influenced follow-up and outcomes. Finally, the division of outcomes, while standard, may obscure differences between distinct unsuccessful outcomes such as death and loss to follow-up.

Recommendations and future research

The findings support several practical actions. District TB programmes should incorporate routine nutritional assessment and support, ensure HIV testing and timely antiretroviral therapy for all co-infected patients, and apply closer monitoring to retreatment cases and older adults. A simple, locally validated risk score incorporating these readily available predictors could help target limited resources to the patients most likely to benefit. Future research should include larger, multicentre, and prospective studies to confirm these associations with greater precision and to incorporate variables unavailable here, such as drug-susceptibility patterns, glycaemic control, and adherence. Studies evaluating whether targeted interventions, including nutritional support, enhanced adherence counselling, and integrated TB-HIV care, improve outcomes in district settings would be especially valuable for informing policy in resource-limited contexts.

Conclusion

In this resource-limited district hospital in Indonesia, nearly one in seven patients with pulmonary TB experienced an unsuccessful treatment outcome. Age ≥ 60 years, underweight nutritional status, previously treated TB, and HIV-positive status were independent predictors, with HIV co-infection carrying the greatest risk. Because these factors are routinely recorded and require no advanced technology to identify, they offer a practical basis for early risk stratification at the district level. Strengthening nutritional support, integrated TB-HIV care, and targeted monitoring of older and retreatment patients may help improve treatment success and advance progress towards the End TB Strategy targets.

Declaration of Generative AI and AI-assisted Technologies in the Writing Process

During the development of this manuscript, AI-assisted tools were utilized solely to support language refinement and clarity. All generated content was carefully reviewed, revised, and validated by the authors, who assume full responsibility for the accuracy and integrity of the final manuscript.

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Assessment of the understanding of evidence-based medicine among undergraduate medical students in Gadarif University, Sudan

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ABSTRACT

Introduction: Evidence-based Medicine (EBM) has become important for integrating critical appraisal of research evidence into routine clinical practice. Increasingly, acquiring knowledge and skills for this new concept is becoming a core competence for all doctors. This study aimed to assess knowledge and attitudes toward EBM among undergraduate medical students at the Faculty of Medicine, Gadarif University, Sudan.

Method: This cross-sectional descriptive study was conducted during the 2019-2020 academic year, and 150 undergraduate students from Gadarif University's Faculty of Medicine participated. Convenience sampling was employed to gather data. A self-administered questionnaire was used to assess students' knowledge and attitudes towards EBM. SPSS version 23 was used to analyse the data.

Results: Of the 150 students involved, 94 (62.7%) of them were not aware of EBM, and 96 (64%) did not understand the concept; 133 (88.7%) had poor knowledge of the basic components of EBM; 14 (9.3%) understood the term PICO (Problem, Information/Intervention, Comparison, Outcome) which is the standard method for searching evidence. Participants considered/mentioned the following methods for obtaining evidence: Google search 81 (54%), Cochrane Library 10 (6.7%), TRIP (Turning Research Into Practice) 3 (2%), others 42 (28%), and 14 (9.3%) did not respond. Students' perceptions of the validity of EBM implementation across learning phases were as follows: 35 (23.3%) for basic science, 88 (58.7%) for clinical practice, and 27 (18%) considered it not useful.

Conclusion: The study found that students had poor knowledge of EBM but positive attitudes towards it, supporting the recommendation to implement EBM in the curriculum.

Keywords: evidence-based medicine; clinical practice; undergraduate medicine; Sudan

Introduction

In today's fast-paced medical landscape, imagine a cardiac unit where physicians lack the skills to seamlessly integrate evidence-based medicine (EBM) into their practice. The consequence? Potentially outdated treatments could be administered, leading to suboptimal patient outcomes. This underscores the urgency of ingraining EBM training into medical education. EBM involves the systematic review, evaluation, and application of clinical research findings to optimise patient care. This approach has been widely endorsed by physicians globally.^[1]

Research indicates significant gaps between available evidence and routine clinical practice. Consequently, the instruction of EBM skills has become increasingly important in undergraduate, postgraduate, and continuing medical education programmes.^[2] While conducting studies on this topic, it is crucial to recognise the potential limitations of using convenience sampling, which may introduce selection bias. Such bias could undermine the generalizability of the findings to similar medical schools, thereby affecting the validity of the study results. Addressing these limitations transparently can strengthen readers' trust in the findings and emphasize the need for cautious interpretation.

The primary objective of EBM is to optimise patient care by integrating current research evidence with patient preferences and clinical expertise, including history-taking and physical examination.^[3] The EBM process consists of five key steps (5 As): Asking questions, Answering by identifying the best available evidence, Appraising its validity, Applying it to clinical scenarios, and Assessing the outcomes.^[4]

Many studies have assessed the knowledge, attitudes, barriers, and potential of EBM among health providers and have reported varied results with limited success in developing a strong strategy for implementing EBM. From an educational perspective, applying EBM requires multiple high-level skills, such as critical thinking and judgment. It also requires clinical expertise to make judgments and decisions.^[5] However, there are considerable challenges facing medical schools and health professional educators worldwide in meeting the high standards required for a competent medical graduate.

A descriptive study in Yemen assessed physicians' knowledge and awareness of EBM. Most participants had positive attitudes toward EBM (87%). However, only 14.7% had used EBM resources in their clinical decisions, and about 46.9% knew the basic EBM methods.^[6] In Iran,

a study of 143 medical students found that 24.5% had good basic knowledge and familiarity with EBM. Most students (89.3%) had a positive attitude and agreed that EBM is helpful for patient care, but 80.2% had little or no awareness of EBM resources.^[7] In Saudi Arabia, a large study among medical students showed poor knowledge and attitudes toward EBM: 80.8% answered incorrectly on EBM components, 40.4% knew that systematic reviews are the strongest evidence, and 95% were unaware of the Cochrane Library.^[8] In Ethiopia, a survey of physicians in public hospitals found that they supported the inclusion of EBM in the medical curriculum.^[9]

In Sudan, the sole undergraduate study on this topic was conducted at Shendi University in Northern Sudan to evaluate medical students' knowledge, attitudes, and perceptions of EBM. Over 50% of students had poor knowledge of EBM, 72% believed in its validity.^[10]

This study aimed to assess knowledge and attitudes toward EBM among undergraduate medical students at the Faculty of Medicine, Gadarif University, Sudan.

Method

This cross-sectional descriptive study was conducted during January and February of the academic year 2019 – 2020 at the Faculty of Medicine, University of Gadarif in Sudan. The faculty offers an integrated medical curriculum. The programme comprises 174 credit hours over 10 semesters and uses various teaching methods.

The sample included current undergraduate medical students in the clerkship phase of the medicine programme, who were selected via convenience sampling. Yamane's formula ($n = \frac{N}{1 + N(d^2)}$, where (n) was the sample size, (N) was the population size, and (d) was the degree of accuracy desired (0.05), was used to determine the sample size. Based on the Faculty's annual active student records, the population was estimated at 221 clerkship students. Using a 0.05 margin of error, the required sample size was determined to be 139 students. To account for potential attrition (estimated at 10%), the adjusted target sample size was increased to 150 participants.

A questionnaire with three sections was designed to collect participants' demographic characteristics and to assess their knowledge and attitudes towards EBM.

Although self-report questionnaires are standard tools for data collection, they are subject to response bias. To mitigate this, responses were anonymised, and participants were assured that their evaluations would not affect

their academic standing or grades. The questionnaire's validity and reliability were thoroughly evaluated. Ten knowledgeable faculty members with expertise in educational research were asked for their opinions to assess the validity of the qualitative content. The experts' level of agreement was measured using the Content Validity Index (CVI). Since the Kuder-Richardson-20 (KR-20) formula is suitable for instruments with dichotomous items, it was used to assess reliability. Reliability was tested with a sample of 30 participants.

The CVI and KR-20 reliability results are as follows: The questionnaire was a modified version to be compatible with the objectives of our study. The standard questionnaire is typically used for comprehensive KAP studies, but in our study, we omitted the practical section because EBM had not been incorporated into Sudanese medical schools at the time of the research. A discussion with experts in EBM, medical education, and research was held to obtain feedback on the questionnaire.

The researcher provided potential respondents with an orientation about the study. The main aims were to overcome knowledge bias, achieve uniformity in awareness of the questionnaire's technical details, and ensure confidentiality and the use of numbers rather than names. Sets of questionnaires (predesigned) and reviewed by the expert reviewers (content of the questionnaires) were distributed to participants, who then filled them out individually in the lecture room under the researcher's observation. The researcher collected the questionnaires after allowing the participants time to complete them. The questionnaire was designed by the researcher and included questions to assess knowledge and attitudes using personal

scaling methods identified by the researcher.

The principal investigator distributed the questionnaire and informed consent to target students in lecture halls. Participants received a 20-minute orientation by the investigator to ensure understanding of questionnaire sections and questions. Questionnaires were self-administered under the supervision of researchers and in a manner that ensured anonymity.

Data were analysed using SPSS/v26 software (SPSS Inc., Chicago, IL, USA).

Ethical approval was initially obtained from the Research Committees of Gezira University and Gadarif University in Sudan. Informed consent was obtained from medical students.

Results

150 students responded to the survey. On knowledge of EBM, 94 (62.7%) of them were not aware of EBM, and 96 (64%) did not understand the concept; 133 (88.7%) had poor knowledge of the basic components of EBM; 14 (9.3%) understood the term PICO (Problem, Information/Intervention, Comparison, Outcome which is the standard method for searching evidence), while 136 (90.7%) did not understand. Participants mentioned the following methods for obtaining evidence: Google search 81 (54%), Cochrane Library 10 (6.7%), TRIP 3 (2%), Others 42 (28%), and 14 (9.3%) did not respond (Table 1).

Regarding attitudes towards validity in clinical practice, 116 (77.3%) had a positive perception, and 34 (22.7%) had a negative perception. Regarding the implementation of EBM in the curriculum, 129 (86%) agreed, and 21 (14%) did not. Their attitudes towards the validity of implementing EBM were as follows: 35 (23.3%) for basic

Table 1. Study population's knowledge of evidence-based medicine

Knowledge	Who knew n (%)	Who did not know n (%)
Awareness about EBM	56 (37.3)	94 (62.7)
Understanding of concept of EBM	54 (36)	96 (64)
Familiar with term 5As	17 (11.3)	133(88.7)
Familiar with the term PICO	14 (9.3)	136 (90.7)
Ideal searching method	13 (8.7)	137 (91.3)

Table 2. Study population's attitudes towards evidence-based medicine

Attitude	Positive perception n (%)	Negative perception n (%)
Validity in clinical practice	116 (77.3)	34 (22.7)
Introduction in the curriculum	129 (86)	21(14)
Increasing the student competency	136 (90.7)	14 (9.3)

science, 88 (58.7%) for clinical practice, and 27 (18%) considered it not useful. Considering attitudes towards the value of EBM in increasing student competency, 136 (90.7%) thought it would increase it, and 14 (9.3%) thought it would not (Table 2).

Discussion

This study was conducted during the academic year 2019 – 2020 to evaluate the knowledge and attitudes of final-year undergraduate medical students toward EBM in Sudan. EBM is one of the WFME (World Federation for Medical Education) accreditation standards.

A striking finding was the limited awareness of EBM fundamentals among students, consistent with studies from similar settings. For instance, Ghahremanfard et al.^[7] reported comparable knowledge gaps among Iranian medical students, underscoring a regional deficit in early EBM education. The absence of structured EBM training likely contributes to this trend.

While students rarely applied EBM principles in clinical learning, they recognised its validity. Nearly 76% believed EBM enhances diagnostic and therapeutic decision-making, and 86% advocated for its inclusion in the curriculum, mirroring findings from Saudi Arabia.^[8] This enthusiasm parallels studies from Ethiopia^[9] and Sudan,^[10] suggesting a universal appreciation of EBM's theoretical value despite practical barriers.

Participants predominantly recommended introducing EBM in the final five semesters; this preference may reflect an understanding that EBM's utility becomes most apparent during advanced clinical training.

Notably, students associated EBM training with institutional accreditation (e.g., WFME standards). While this highlights awareness of global medical education benchmarks, it may also indicate a superficial grasp of EBM's role in accreditation processes. Further research should explore whether this perception stems from faculty advocacy or broader curricular reform discussions.

Limitations and future directions

This study's single-institution design and reliance on self-reported data limit generalizability. Future studies should incorporate objective assessments (e.g., EBM competency tests).

Conclusion

Sudanese medical students recognise the importance of EBM but lack the foundational skills to apply it. Curriculum reforms, including early, hands-on EBM training and faculty development, are urgently needed to align theoretical appreciation with clinical practice. Addressing these gaps will empower future physicians to deliver evidence-based care and meet global medical education standards. Although the master-apprentice model of teaching is more applicable to the current situation, we believe implementing EBM learning is important for properly preparing our future doctors to cope and compete.

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From Evidence to Action: WHO-UNICEF Implementation Guidance on Child Wasting

WHO and UNICEF have released new guidance to support countries in improving the prevention and treatment of child wasting (acute malnutrition) among children under five. Building on the 2023 WHO Guideline on Child Wasting, the resource provides practical direction for updating national protocols and strengthening service delivery across community, outpatient, and inpatient settings. It offers guidance on how to better identify, refer, and manage children affected by wasting, ensuring more timely and effective care.

Based on the 2023 WHO Guideline on Child Wasting, this guidance also includes a section on infants less than 6 months of age at risk of poor growth and development.

As countries work to strengthen national systems for the prevention and treatment of Child Wasting, this guidance provides the operational foundation for updated national protocols, staff training, and quality service delivery. Download the implementation guidance to access clinical protocols, referral pathway diagrams, and supporting annexes.

[Read the resource here >>](#)

Environmental health risks associated with open dumping practices in Central Kalimantan, Indonesia: an observational study

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ABSTRACT

Introduction: Rural and semi-urban communities in Central Kalimantan face severe environmental health risks due to inadequate municipal solid waste management. With waste generation exceeding 1,200 tons daily, local infrastructure is overwhelmed. This study investigates the complex interplay among environmental degradation, occupational hazards, and community health in this region resulting from open dumping practices.

Method: We used a cross-sectional observational study design with a mixed-methods approach across 14 regencies in Central Kalimantan. Data were collected through field observations of final disposal sites, qualitative focus group discussions with local stakeholders, and a review of the 2024 national waste registry. Thematic analysis was applied to identify sanitation deficits and health vulnerabilities.

Results: The region's waste stream is heavily organic (30%–57%). The study revealed that most disposal sites operate as unregulated open dumps lacking daily soil cover and functional leachate treatment plants, posing severe risks of groundwater contamination and vector-borne diseases. Furthermore, informal waste pickers were observed foraging for recyclables and livestock feed (e.g., for swine) without adequate personal protective equipment. This practice exposes them to acute physical and biological hazards, while the use of untreated refuse for animal feed introduces severe epidemiological risks, including zoonotic and parasitic pathogens (such as *Taenia solium*), into the human food chain.

Conclusion: This research highlights the critical environmental and public health crises driven by open dumping. Urgent multisectoral interventions are required to upgrade sanitation infrastructure, enforce occupational safety standards for informal workers, and develop culturally sensitive policies to mitigate the epidemiological risks posed by unmanaged waste.

Keywords: open dumping, environmental health, occupational hazard, informal waste pickers, sanitation, Indonesia.

Introduction

Inadequate municipal solid waste management (SWM) remains a critical public health and environmental challenge in developing countries. Despite the global push towards sustainable waste management, open dumping remains the predominant method of waste disposal in many low- and middle-income nations. This practice exposes surrounding communities to severe environmental health hazards, including groundwater contamination from toxic leachate, air pollution from spontaneous combustion and methane emissions, and the proliferation of disease vectors such as mosquitoes, flies, and rodents.^[1,2] Consequently, populations living near or working within these unregulated disposal sites experience a higher burden of waterborne, vector-borne, and respiratory diseases.^[3]

In Central Kalimantan, Indonesia, rural and semi-urban communities are already facing severe environmental health challenges. Previous studies have highlighted that local populations are highly vulnerable to water contamination from extractive industries, leading to significant outbreaks of gastroenteritis and chronic dermatitis.^[4] This fragile public health baseline is now further threatened by rapid population growth and urbanization, which have significantly increased daily waste generation to over 1,200 tons per day across the province.

Despite national regulations mandating environmentally sound waste management, local infrastructure is profoundly overwhelmed. Most final disposal sites still operate as unregulated open dumps rather than controlled sanitary landfills.^[5] The high organic waste content—often exceeding 50% of the total volume—combined with high rainfall in this tropical region accelerates the decomposition process. This leads to overwhelming leachate production and severe odour, which directly compromise the sanitation and health of nearby settlements.

Furthermore, these operational deficits pose direct occupational and epidemiological risks. Informal waste pickers frequently operate in these hazardous environments without adequate personal protective equipment (PPE), leaving them highly vulnerable to dermatological infections, biological pathogens, and physical injuries.^[6,7] Crucially, these individuals not only scavenge for recyclable plastics to sell for economic survival, but they also collect organic refuse to be used as livestock feed, particularly for swine. This specific practice creates a dangerous pathway for zoonotic pathogens and toxic bioaccumulation to enter the human food chain. Given the scarcity of literature focusing on

the intersection of waste infrastructure deficits, informal scavenging practices, and health outcomes in this specific region, this study aims to evaluate the environmental and occupational health risks associated with current open dumping practices in Central Kalimantan to inform evidence-based public health policies.

Method

This cross-sectional observational study, employing a mixed-methods approach, was conducted between August and November 2025 across 13 regencies and one municipality in Central Kalimantan Province, Indonesia. To evaluate the systemic environmental and occupational health risks associated with municipal solid waste management deficits, data triangulation was achieved through field observations, qualitative discussions, and secondary data analysis. Direct site inspections were conducted at 14 major final disposal sites and various intermediate community waste-processing facilities to assess sanitary conditions, leachate management, the application of daily soil cover, and occupational safety practices—particularly the use of personal protective equipment among informal waste pickers. Furthermore, qualitative data were gathered through focus group discussions involving local environmental agency officials, facility operators, and community representatives to explore operational challenges and perceived health risks. This primary data was complemented by quantitative baseline data regarding waste generation and composition extracted from the 2024–2025 national waste registry.

For data analysis, quantitative data regarding waste volume and infrastructure capacity were evaluated using descriptive statistics to identify systemic deficits. Qualitative transcripts from the discussions and field notes were subjected to thematic analysis to identify recurring patterns in environmental hazards, occupational vulnerabilities, and governance gaps. The study maintained strict ethical standards by anonymizing all participant identities and obtaining verbal consent before the discussions, ensuring that the research focused solely on documenting observable environmental health risks rather than making speculative clinical diagnoses.

Results

Waste generation and environmental hazards

Based on the national waste registry data for 2024, Central Kalimantan generates approximately 1,213 tons

Table 1. Summary of municipal solid waste characteristics and sanitation deficits in Central Kalimantan

Parameter	Observational findings	Public health implications
Daily Waste Generation	~1,213 tons/day across the province.	High volume of unmanaged waste increases the burden of environmental sanitation.
Waste Composition	Highly organic (30%–57% food/agricultural residue); Plastic (10%–50%).	Rapid decomposition in tropical climates creates severe odour and breeding grounds for disease vectors such as mosquitoes and flies.
Disposal Site Operation	Predominantly unregulated open dumping; lack of daily soil cover.	Spontaneous combustion causes respiratory hazards; exposed waste increases vector-borne disease transmission.
Leachate Management	Effluent treatment plants are either absent, unmaintained, or malfunctioning.	High risk of toxic leachate seeping into groundwater, potentially contaminating local drinking water sources.
Occupational Safety	Workers and informal waste pickers operate without adequate Personal Protective Equipment (PPE).	Extreme vulnerability to dermatological conditions, infections, biological pathogens, and sharp-object injuries.

of municipal solid waste daily. The composition analysis (Table 1) indicates a heavy dominance of organic waste, primarily food and agricultural residue, which constitutes between 30% and 57% of the total waste stream across various regencies, followed closely by plastics (10% to 50%). In a tropical climate characterized by high humidity and rainfall, this high organic load accelerates decomposition. Consequently, this generates substantial volumes of toxic leachate and noxious gases (such as methane and hydrogen sulphide), creating an optimal breeding environment for disease vectors, including flies, mosquitoes, and rodents.

Sanitation deficits at final disposal sites

Field observations across the province revealed severe systemic deficits in sanitation infrastructure. Despite initial designs intended for sanitary or controlled landfill operations, the vast majority of final disposal sites effectively function as unregulated open dumps. Primary operational failures include the absence of daily soil cover due to severe shortages of heavy equipment and operational budgets. Furthermore, qualitative assessments indicated that several sites suffer from chronic overloading. Most notably, essential environmental safeguards, such as

functional leachate treatment plants, are either completely absent or malfunctioning, allowing untreated effluent to potentially contaminate surrounding groundwater and soil.

Occupational health and safety vulnerabilities

The most critical public health concern identified was the severe occupational vulnerability of informal waste pickers and sanitation workers. Observational data confirmed that individuals routinely operate within these highly hazardous environments without basic personal protective equipment (PPE), such as thick gloves, safety boots, or respiratory masks (Figure 1).

During qualitative discussions, stakeholders acknowledged that these workers face daily, direct exposure to a triad of hazards: physical risks (puncture wounds from sharp objects and medical waste), biological risks (pathogen exposure leading to skin infections, tetanus, and diarrhoeal diseases), and chemical risks (inhalation of toxic gases and dust during waste transportation and dumping). Furthermore, the lack of routine medical check-ups and health insurance coverage for these frontline workers exacerbates their vulnerability to chronic and acute occupational diseases.



Figure 1. Environmental and occupational hazards at a final disposal site in Central Kalimantan.

(A) Aerial view demonstrating unregulated open dumping practices without daily soil cover, situated alarmingly close to green belts and potential water runoffs. (B) Informal waste pickers operating without adequate personal protective equipment (PPE). These individuals forage for economically valuable plastics and retrieve organic waste for livestock (swine) feed, exposing themselves to direct physical hazards and creating a pathway for zoonotic disease transmission (Source: Author's own photographs).

Discussion

The findings of this observational study highlight a critical intersection between municipal infrastructure deficits and public health vulnerabilities in Central Kalimantan. The persistent reliance on open dumping, despite initial plans for sanitary landfills, mirrors the systemic challenges frequently observed in rapidly urbanizing regions of developing nations.^[8] The high proportion of organic waste documented in this region is particularly concerning from an epidemiological perspective. In a tropical climate, exposed organic matter decomposes rapidly, producing highly concentrated leachate and noxious gases.

Without functional effluent treatment systems, as observed in multiple disposal sites across the province, the continuous discharge of raw leachate poses a severe threat to local groundwater quality. Leachate from mixed municipal waste often contains dangerous levels of organic pollutants and heavy metals. This is particularly critical in Central Kalimantan, where rural communities rely heavily on river water for daily sanitation and waterborne illnesses are already a primary public health concern.^[4,9] Furthermore, the lack of daily soil cover transforms these disposal sites into massive breeding habitats for disease vectors, including rodents and insects, thereby increasing the potential for vector-borne disease outbreaks.^[10]

The occupational health hazards identified in this study are equally alarming. Sanitation workers and informal waste pickers operate in environments saturated with

biological, chemical, and physical hazards. Continuous exposure to such environments without basic PPE and routine medical surveillance directly correlates with the high incidence of dermatological infections, respiratory issues, and puncture injuries reported globally among informal waste workers.^[11,12]

More importantly, the economic realities driving these informal workers to scavenge not only for sellable plastics but also for organic refuse to feed livestock introduce a severe epidemiological risk that extends far beyond the dump site. The practice of feeding untreated, contaminated municipal waste to swine creates a direct pathway for zoonotic disease transmission, including parasitic infections such as *Taenia solium* (pork tapeworm).^[13] Additionally, it facilitates the bioaccumulation of heavy metals and microplastics within the livestock, which eventually re-enter the human food chain, posing long-term chronic health risks to the broader population.^[14]

The root cause of these environmental health crises lies in governance and financial prioritization. The regional budget allocation for waste management remains critically low, severely restricting the procurement of heavy equipment, PPE, and the maintenance of sanitary infrastructure. Addressing these health hazards requires a paradigm shift, recognizing solid waste management not merely as a public works issue, but as a fundamental public health necessity. Cross-sectoral collaboration involving public health authorities, environmental agencies, and local governments is imperative to enforce occupational

safety standards, regulate informal scavenging practices, and transition towards sustainable waste processing.

Conclusion

Municipal solid waste management in Central Kalimantan currently functions below minimum sanitary standards, relying predominantly on unregulated open dumping. This infrastructural deficit creates severe environmental health risks, including potential groundwater contamination from untreated leachate and the proliferation of disease vectors. Furthermore, the presence of informal waste pickers scavenging for recyclables and organic livestock feed without adequate personal protective equipment exposes them to extreme occupational hazards. Crucially, the practice of feeding contaminated refuse to swine introduces severe zoonotic and toxicological risks into the human food chain. Urgent multi-sectoral public health interventions are required. Policymakers must prioritize financial investments to upgrade disposal sites, enforce occupational safety standards for informal workers, and develop culturally sensitive waste management policies to mitigate these cascading health impacts.

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WFP Scales Up Emergency Response in South Sudan As Catastrophic Hunger and Malnutrition Deepen

United Nations World Food Programme (Rome)

WFP is delivering vital food and nutritional assistance to hundreds of thousands of people in Akobo East, as insecurity, infrastructure damage and the onset of the rainy season hamper operations.

The United Nations World Food Programme (WFP) has scaled-up its emergency response in Akobo East, South Sudan, delivering vital food and nutrition assistance to hundreds of thousands of people facing catastrophic hunger and malnutrition, even as insecurity, infrastructure damage and the onset of the rainy season continue to hamper operations.

“The situation is critical and demands immediate attention to save lives of people who desperately need assistance,” said Mutinta Chimuka, WFP Country Director in South Sudan. “Our hope is to continue to reach people in need. Sustained safety and security of humanitarians and humanitarian cargo is therefore crucial to allow us to ramp up assistance and effectively reach all those in need.”

Food security situation in Akobo

1. According to the latest Integrated Food Security Phase Classification (IPC) update, parts of Akobo County are experiencing IPC Phase 5 (Catastrophe) - one of four counties at risk of famine if conditions deteriorate.
2. An estimated 97,000 people are projected to face IPC Phase 3 (Crisis), 85,000 Phase 4 (Emergency), and 12,000 Phase 5 (Catastrophe) through July
3. The malnutrition crisis has worsened to IPC Acute Malnutrition Phase 5 (Extremely Critical), driven by displacement, loss of livelihoods, disruption to health and nutrition services, and increased disease risks due to overcrowding.
4. Severe malnutrition among children under 5 and breastfeeding mothers is rising sharply, fuelling fears of famine-like conditions developing in the region.
5. Ongoing conflict has already displaced approximately 142,000 individuals from Akobo County and surrounding areas, with 100,000 having crossed into neighbouring Ethiopia.
6. The collapse of local markets due to conflict and looting has severely restricted access to food supplies.

Read more:

<https://www.wfp.org/stories/wfp-scales-emergency-response-south-sudan-catastrophic-hunger-and-malnutrition-deepen>

Assessing the quality of health facilities providing antenatal care services in Bor, South Sudan

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ABSTRACT

Introduction: Maternal and perinatal mortality remain a major challenge in developing countries, including South Sudan, where rates are among the highest in the world. Providing adequate antenatal care is regarded as a cornerstone of maternal and perinatal health care and is expected to have a considerable impact on achieving the Sustainable Development Goals. The objective of this study was to assess the quality of health facilities providing antenatal care services in Bor, South Sudan.

Method: Data were collected from six health facilities providing antenatal care in Bor town in June 2023. The availability of equipment for assessing pregnant women and fetuses at the facilities and the qualifications of the health care workers who provided care were assessed.

Results: Not all equipment considered necessary for antenatal care was available in every facility. Three of the six facilities had all three: a blood pressure (BP) apparatus, an examination couch or bed, and a thermometer. While all facilities had a thermometer, one had a BP apparatus and a couch, and only three had an examination couch. For foetal assessment, only one facility had an obstetric calendar, one had a tape measure for fundal height measurement, and four had Pinard's foetal stethoscope. For measuring nutritional status, only two facilities had adult mid-upper arm circumference (MUAC) tapes, weighing scales, and height measurements for calculating BMI. Of the 18 workers who provided antenatal care, 10 were not health professionals.

Conclusion: Health facilities providing antenatal care in Bor should be equipped with all necessary tools and staffed with trained health workers to improve maternal health outcomes.

Keywords: antenatal care; health facilities; skilled birth attendant; International Confederation of Midwives (ICM); South Sudan.

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Introduction

Maternal and perinatal mortality are major challenges in developing countries, including South Sudan, where the figures are among the highest in the world. The maternal mortality ratio is 1,223 per 100,000 live births, as reported by the

World Health Organization (WHO) in 2021.^[1] Recent studies indicate that South Sudan has one of the highest mortality rates globally, with early perinatal mortality reported at 122.3 per 1,000 total births in some areas and a neonatal mortality rate (NMR) of approximately 39.3 - 40.2 per 1,000 live births in 2025. High stillbirth rates (82.7 per 1,000) and maternal malnutrition contribute to these figures.^[2]

Adequate antenatal care is a cornerstone of maternal and perinatal health care and is expected to have a considerable impact on efforts to achieve the Sustainable Development Goals (SDGs). The SDG target 3.1 is to reduce the global maternal mortality ratio to less than 70 per 100,000 live births by 2030,^[3] and target 3.2 is ending preventable deaths of newborns and children under five years old and neonatal mortality to at least as low as 12 per 1,000 live births and under-five mortality at least as low as 25 per 1,000 live births by 2030.^[4]

The South Sudanese government introduced free maternal care in public health facilities, but access to quality antenatal care remains limited.

This research was conducted to evaluate the quality of antenatal care provided in health facilities in Bor town, in accordance with the South Sudan clinical guidelines.^[5] The guidelines follow WHO-recommended eight antenatal visits and provide guidance on nutrition, maternal and foetal assessment, prophylaxis, and hospital records.^[6]

Method

This facility-based, cross-sectional, observational study was conducted in two parts. The first part assessed the quality of antenatal care at the health facilities by examining personnel and equipment at the antenatal clinics in Bor, Jonglei State, South Sudan. The results are reported in this paper. The second part interviewed women of reproductive

age (15-49 years) attending antenatal care at these health facilities. The results will be reported in a second paper.

The research was conducted in July 2023 at six health facilities providing antenatal care: Bor State Referral Hospital; two government Primary Health Care Centres (PHCCs); two government Primary Health Care Units (PHCUs); and one faith-based private clinic (equivalent to a PHCU). Data for the first part were collected using a checklist. We assessed the equipment used at the antenatal clinics, including the nutrition status tool and examination and assessment tools, as well as the number and workload of qualified health personnel. The data were entered into Microsoft Excel, and simple calculations of averages and percentages were derived.

Permission to conduct the research was obtained from the institute's research ethics board, the heads of each facility, and the state Ministry of Health.

Results

The data in Table 1 were taken from the antenatal care registers and show the number of antenatal women who came to the six facilities in June 2023 - per month and per clinic day (antenatal clinics were held every weekday) and the type of facility. In one month, 220 pregnant women visited these facilities. Except for two facilities, the others had fewer than one client per day.

Regarding the availability of equipment for assessing mothers attending antenatal care, including blood pressure (BP) apparatus, an examination couch or bed, and a thermometer: Bor State Referral Hospital, Anyidi PHCC, and Taragok had all three assessment tools; Langbar PHCU had only a thermometer and lacked a BP apparatus or couch. Only three of the six facilities had an examination couch. See Table 2.

Table 1. Facility and workload in the health facility

Name of Facility	Type of Facility	Clients / Month	Clients / Clinic Day
Bor State Referral Hospital	Hospital	159	8
Anyidi	PHCC	36	1.8
Jalle	PHCC	10	0.5
Mathiang	PHCU	7	0.4
Langbar	PHCU	3	0.2
MCH Taragok	Private clinic	5	0.3
	Total	220	11

Table 3 lists the tools available for assessing nutritional status during pregnancy: adult mid-upper arm circumference (MUAC) tapes, weighing scales, and height measurements for calculating Body Mass Index (BMI). Only Bor State Referral Hospital and Jalle PHCC had adult MUAC tapes.

For assessing the foetus, Anyidi PHCC was the only facility with an obstetric calendar, and Jalle PHCC was the only facility with a tape measure. Mathiang PHCU and Taragok PHCU did not have a Pinard's foetal stethoscope – Table 4.

Table 2. Equipment for the assessment of the mother

Name of Facility	Type of Facility	BP Apparatus		Couch		Thermometer	
		Yes	No	Yes	No	Yes	No
Bor State Referral Hospital	Hospital	X		X		X	
Anyidi	PHCC	X		X		X	
Jalle	PHCC	X			X	X	
Mathiang	PHCU	X			X	X	
Langbar	PHCU		X		X	X	
MCH Taragok	Private clinic	X		X		X	

Table 3. Nutritional status assessment tool

Name of Facility	Type of Facility	Adult Mid-upper Arm Circumference (MUAC) Tape		Weighing Scale		Height Measuring Tool	
		Yes	No	Yes	No	Yes	No
Bor State Referral Hospital	Hospital	X		X		X	
Anyidi	PHCC		X	X			X
Jalle	PHCC	X			X		X
Mathiang	PHCU		X	X		X	
Langbar	PHCU		X		X		X
MCH Taragok	Private clinic		X	X			X

Table 4. Equipment for the assessment of the foetus

Name of Facility	Type of Facility	Obstetric Calendar		Pinard's Foetal Stethoscope		Tape Measure	
		Yes	No	Yes	No	Yes	No
Bor State Referral Hospital	Hospital		X	X			X
Anyidi	PHCC	X		X			X
Jalle	PHCC		X	X		X	
Mathiang	PHCU		X		X		X
Langbar	PHCU		X	X			X
MCH Taragok	Private clinic		X		X		X

Table 5. Number of qualified staff by facility

Name of Facility	Type of Facility	Staff		Total	Patient: Staff Ratio
		Qualified	Unqualified		
Bor State Referral Hospital	Hospital	3	1	4	8:4
Anyidi	PHCC	2	1	3	1.8:3
Jalle	PHCC	2	1	3	0.5:3
Mathiang	PHCU	0	4	4	0.4:4
Langbar	PHCU	0	2	2	0.2:2
MCH Taragok	Private clinic	1	1	2	0.3:2
		8	10	18	

Across all six health facilities, 18 staff members provided antenatal care, of whom only 8 were qualified midwives or nurses who had completed 3 years of health sciences training certified by the Ministry of Health. The staff-to-client ratio in each facility is shown in Table 5.

Discussion

The WHO published guidelines for antenatal care in 2016.^[6] These recommendations have been incorporated into the Ministry of Health's clinical care guidelines and cover nutrition, maternal and foetal assessment, prophylaxis, and hospital records.^[5]

In our study, tools for nutritional assessment were often lacking. The South Sudan clinical guidelines^[5] recommend using adult MUAC to assess the nutritional status of antenatal women and to enroll women with severe malnutrition in nutrition programmes.

Adult MUAC is a readily applicable anthropometric measure for assessing malnutrition in resource-poor settings and has been shown to correlate strongly with BMI.^[7] With acute food shortages and high rates of malnutrition, the lack of objective ways to assess nutritional status can lead to favouritism and nepotism in the distribution of nutritional assistance.

The tools for assessing the mother were suboptimal, with some facilities lacking BP apparatus. Routine testing of women for anaemia and asymptomatic bacteriuria was non-existent. Without routine investigations and the prescription of therapeutic doses of iron, the likelihood of maternal and foetal complications is high.

The only clinical test for assessing the foetus is to compare uterine height with gestational age. The other test is a routine ultrasound scan, as recommended by the 2016

WHO guidelines.^[6]

This study found limited knowledge of how to assess the foetus. Many health facilities did not use an obstetric calendar or a couch/bed to perform an abdominal examination to measure uterine height.

It is recommended that:

1. Trained skilled birth attendants, provided with the appropriate equipment and medicines, is the best strategy to improve maternal health and reduce maternal mortality, as recommended by the International Confederation of Midwives.^[8] All leaders of health facilities and leaders of NGOs and the Ministry of Health should make this one of the important strategies for improving maternal and reproductive health
2. These workers should be regularly updated on the latest antenatal care recommendations.
3. All health facilities should be provided with the necessary tools, reagents for testing, and medications for treatment and prophylaxis during the antenatal period, in accordance with the WHO antenatal care guidelines.^[6]

Conclusion

Not all facilities had all the equipment considered necessary for antenatal care. About half of the health workers providing antenatal care were qualified midwives or nurses. Health facilities providing antenatal care in Bor should be equipped with all necessary tools and staffed with trained health workers to improve maternal health outcomes.

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Prostate cancer awareness and factors influencing screening among men at St. Francis Referral Hospital, Tanzania

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ABSTRACT

Introduction: Prostate cancer (PCa) is among the top three cancers in men, after liver and lung cancers, accounting for 15%. Its incidence varies widely by region. The age-standardized incidence rates are 79.1/100,000 in Oceania, 73.7/100,000 in North America, and 62.1/100,000 in Europe. Although Africa currently has an incidence rate of 26.6/100,000, it is predicted to have the highest rate in the future. Without adequate public health education, men continue to suffer from PCa due to delayed diagnosis and treatment. This study aims to assess knowledge, awareness, and factors influencing PCa screening practices among adult men.

Method: A hospital-based cross-sectional study was conducted from July to December 2025 at Saint Francis Referral Hospital using a pretested, semi-structured questionnaire to collect data. All participants provided signed informed consent. The study collected information on socio-demographic factors, knowledge and awareness of PCa, screening, and factors affecting screening habits. Data were analysed and processed using SPSS.

Results: A total of 399 adult men participated in the study, most of whom were aged 60 to 74 years (58.9%). 24.1% of participants were aware of PCa screening, and only 30.3% knew that Prostate-Specific Antigen (PSA) is a screening method for PCa. Psychological fear and cultural beliefs were the leading factors hindering PCa screening behaviour.

Conclusion: Education is needed to improve access to PCa screening services and promote early detection to reduce morbidity and mortality.

Keywords: prostate cancer; screening; early detection; stigmatization; misconceptions; mortality; Tanzania

Introduction

Prostate cancer (PCa) is among the top three most frequent cancers in men worldwide, after liver and lung cancers,^[1,2] accounting for 15% of all cancers. Its incidence varies by region.^[3-5] The age-standardized incidence rates are 79.1/100,000 in Oceania, 73.7/100,000 in North America, and 62.1/100,000 in Europe.^[5-7] Incidence has been rising in European nations.^[8] Although

Africa currently has an incidence rate of 26.6/100,000, it is predicted to have the highest rate in the future.^[9] However, inadequate screening and a lack of cancer registries may compromise the data.^[6,8,10] An incidence rate for PCa screening uptake has been reported to rise from 20% to 58.8% in Sub-Saharan Africa,^[4,6,11] while the cancer registry in Tanzania indicates that prostate cancer is the most common cancer in men with an incidence of 3,434 cases per year, followed by Kaposi's sarcoma.^[5]

PCa is often asymptomatic and progresses insidiously.^[3,4] A major challenge is the limited availability of screening services, including prostate-specific antigen (PSA) testing and digital rectal examination (DRE).^[2,11] Most patients in Africa are diagnosed at a late stage.^[11] Early detection through screening reduces mortality rates.^[9,12,13] PCa is not prioritized relative to infectious diseases and other non-communicable diseases and is therefore considered a neglected disease.^[8] Without adequate public health education, men continue to suffer from PCa due to delayed diagnosis and treatment.^[2] Educational interventions are required and should target the specific population.^[8,14] In Tanzania, PCa screening uptake is about 0.92%.^[15] Limited awareness and cultural beliefs may be contributing factors.^[2,5,6,10,12]

This study aims to assess knowledge, awareness, and factors influencing PCa screening practices among adult men at risk.

Method

A descriptive, hospital-based, cross-sectional study was conducted for six months (from 1st July to 30th November 2025) at Saint Francis Referral Hospital (SFRR) in Ifakara, Tanzania, involving men aged 45 years and older who attended outpatient clinics. Convenience sampling was used, and all participants attending outpatient clinics had an equal chance of participating. However, only those who met the criteria were included.

Data were collected using pretested, semi-structured questionnaires administered through face-to-face interviews, with measures to ensure confidentiality and obtain informed consent. The questionnaire covered key parameters: socio-demographic factors, knowledge and awareness of PCa, screening, and factors affecting screening habits. Men at risk of PCa who provided signed informed consent and were willing to participate were eligible for inclusion. However, those with PCa, those unwilling to participate, or those who withdrew from the study were excluded.

Data analysis and processing were conducted using SPSS Statistics Version 30 (IBM). The Chi-square test was used to assess the association between awareness and demographic variables. A p-value less than 0.05 was considered significant.

Ethical approval was obtained from the Internal Review Board at St. Francis University College of Health and Allied Sciences. All data were anonymised.

Results

A total of 399 adult men participated in the study. The majority were aged 60–74 years (235, 58.9%), followed by the 45–59 age group (149, 37.3%). The religious distribution was nearly equal between Muslims (199; 49.9%) and Christians (200; 50.1%) (Table 1).

Only 96 participants (24.1%) were aware of PCa. Socioeconomic factors were the primary barrier to PCa screening (Table 2).

Multivariable logistic regression identified age, education level, and occupation as significant independent predictors of PCa screening awareness (Table 3). Men aged 60–74 years had significantly higher odds of awareness (AOR = 2.4, 95% CI: 1.4–4.1, $p = 0.002$). Participants with secondary education were nearly twice as likely to be aware as those with no formal education (AOR = 1.9, 95% CI: 1.1–3.3, $p = 0.01$). Men with college/university education had more than threefold higher odds of awareness (AOR = 3.5, 95% CI: 1.2–9.8, $p = 0.02$) (Table 3).

Table 1. Study population's knowledge of evidence-based medicine

Variables		n (%)
Age (years)	45-59	149 (37.2)
	60-74	235 (58.9)
	75 and above	15 (3.9)
Religion	Muslim	199 (49.9)
	Christian	200 (50.1)
Education level	No formal education	94 (23.6)
	Primary education	145 (36.3)
	Secondary education	134 (33.6)
	College/university	26 (6.5)
Occupation	Formal employment	49 (12.3)
	Informal employment	83 (20.8)
	Retired	234 (58.6)
	Unemployed	33 (8.3)

Discussion

This study assessed the level of awareness and the factors influencing PCa screening behaviour among men at risk who attended St. Francis Referral Hospital. The findings show that awareness of PCa screening was low (24.1%). This highlights a significant need for public health services to facilitate PCa screening behaviour.

Table 2. Level of prostate cancer screening awareness and barriers among the participants (N=399)

Variables		n (%)
Awareness about PCa screening	Yes	96 (24.1)
	No	303 (75.9)
Sociocultural factor	Taboo	189 (47.4)
	Cultural/religious belief	139 (34.8)
	Traditional treatment belief	150 (37.6)
Socio-economic factor	Social stigmatization	250 (62.6)
	Psychological barriers	267 (66.9)
	Lack of funds	155 (38.9)
	Lack of health insurance	262 (65.7)
	Unavailability of equipment	210 (52.6)
Screening methods awareness	Not willing to screen	77 (19.7)
	Serum PSA	121 (30.3)
	DRE	99 (24.8)
	Urine test (misconception)	105 (26.3)
	Diagnostic imaging	26 (6.5)
	Not any	48 (12.1)

Key: PSA= Prostate-Specific Antigen; DRE= Digital Rectal Examination; PCa= Prostate Cancer.

Table 3. Multivariate analysis of factors associated with PCa

Variable	AOR	95% CI	p-value
Age 60–74 years	2.4	1.4–4.1	0.002
Secondary education	1.9	1.1–3.3	0.01
College education	3.5	1.2–9.8	0.02
Retired	3.8	1.6–9.0	0.001

AOR = Adjusted Odds Ratio

CI = Confidence Interval

This low awareness aligns with studies from northern Tanzania, where limited knowledge appears to hinder PCa screening uptake.^[5,15] A study in Nigeria reported higher awareness of PCa screening among urban men than in rural populations.^[14] These variations may be explained by better access to health information and media in urban areas. This highlights the need for community-based education programmes to improve understanding of disease screening among underserved populations. Associations between education and PCa knowledge have been reported in Kenya and Lebanon.^[3,9] This suggests that education enhances medical service-seeking behaviour. However, public health campaigns often fail to reach low-literacy and marginalized populations.^[9,15]

Retired participants had the highest awareness (58.6%), whereas unemployed men had only 8.3%. Retirees may interact more frequently with health services than unemployed men.^[2,3,7]

The study found that fear and social stigmatization were two major obstacles, affecting about two-thirds of participants (66.92% and 62.65%, respectively). These findings align with those reported in South Africa, where norms and embarrassment related to DRE discouraged men from seeking PCa screening.^[6] Similar results have also been observed in Dar es Salaam, with misconceptions about sexual dysfunction and beliefs about screening.^[5] The study also identified a misconception that urine is included in PCa screening tools, as urine is not routinely used in Tanzania. However, this suggests that urine may have been collected for other diagnostic purposes.

Nearly half of participants perceived PCa as a taboo condition (47.37%). In many communities, cancer is associated with curses and supernatural causes, prompting individuals to seek traditional healers.^[3,10] Similar beliefs have been documented in other sub-Saharan African countries.^[1,11,13]

Overall, the findings reinforce evidence from Tanzania and other sub-Saharan African countries that limited knowledge, cultural stigma, and economic hardship remain major barriers to PCa screening.^[3,5,15] Addressing these challenges requires culturally sensitive education, expanded insurance coverage, accessible screening services, and robust community engagement.

Conclusion

This study has demonstrated that awareness of PCa among men at risk attending St. Francis Referral Hospital is low. Socio-cultural and economic factors limit

screening uptake. These findings underscore the urgent need for culturally sensitive education, improved access to screening services, and strengthened health financing mechanisms to promote early detection and reduce PCa morbidity and mortality.

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Long-standing aspirated foreign body in a child complicated by pneumothorax and empyema

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ABSTRACT

Foreign-body aspiration is a common paediatric emergency requiring immediate recognition and management. We report a case of a four-year-old boy who presented to the Emergency Department at Al Sabah Children's Hospital in Juba, South Sudan, with a two-month history of an inhaled foreign body (bead). He had previously attended several healthcare facilities with recurrent chest infections that led to acute respiratory distress. On admission, he was managed for respiratory failure, severe aspiration pneumonia, pleural empyema/lung abscess, and pneumothorax. Despite the prolonged aspiration and a prior unsuccessful bronchoscopic retrieval attempt, the foreign body was expelled after back blows. The child developed complications necessitating chest tube thoracostomy, prolonged intravenous antimicrobial therapy, oxygen supplementation, and anti-tuberculosis treatment. His clinical condition gradually improved. Prevention of foreign-body aspiration in children requires restricting access to high-risk choking objects and providing age-appropriate feeds.

Keywords: foreign body aspiration; recurrent respiratory tract infection; aspiration pneumonia; pneumothorax; paediatric emergency; South Sudan.

Introduction

Foreign-body aspiration is a common paediatric emergency and an important cause of accidental mortality among children in the home setting.^[1-3] Early diagnosis and immediate intervention are essential in preventing serious morbidity and mortality. Rigid bronchoscopy is the gold-standard treatment for paediatric tracheobronchial foreign bodies.^[4] The condition occurs most commonly in young children, who commonly place small objects in their mouths and may talk, laugh, or play while eating.^[5]

Clinical manifestations depend on the size, nature, and anatomical location of the aspirated foreign body. Patients may remain asymptomatic or present acutely with coughing, choking, respiratory distress, asphyxia, or acute respiratory failure.^[6] Delayed or subacute presentations may include recurrent pneumonia, persistent cough, haemoptysis, lung abscess, or chronic respiratory tract infection. Diagnostic evaluation includes chest radiography, computed tomography (CT), microlaryngoscopy, and bronchoscopy.^[7]

Case Report

Preventive strategies include avoiding high-risk choking hazards such as whole nuts, beads, coins, and pen caps, as well as ensuring age-appropriate feeding practices.^[5,8] Manufacturers should also provide clear warning labels for products that may pose aspiration hazards to children. Public health education and caregiver awareness remain crucial components of prevention.^[5,9]

We report a case of a four-year-old boy who presented to the Emergency Department at Al Sabah Children's Hospital in Juba, South Sudan, with a two-month history of an inhaled foreign body (bead).

Case Report

A four-year-old boy presented on 19 February 2024 to the hospital with a two-hour history of severe respiratory distress and gasping. Two months previously, he had aspirated a small object, possibly a bead, and immediately had choking that persisted for several days. Subsequently, he developed recurrent and worsening cough, chest pain, and fever. There was no history of haemoptysis or wheezing. Symptoms worsened when lying on the right side and were not relieved by any specific measures. Additional history revealed poor appetite and progressive weight loss.

The child had attended multiple healthcare facilities prior to presentation. Several attempts to remove the foreign body had been unsuccessful, including an otorhinolaryngological procedure (bronchoscopy). His condition acutely deteriorated, necessitating emergency admission to Al Sabah Children's Hospital. An initial chest X-ray performed on 23 December 2023 showed a foreign body in the bronchus and perihilar lymphadenopathy (Figure 1).

On examination, the child was semiconscious with a Glasgow Coma Scale (GCS) score of 10/15. He appeared cachectic and was in severe respiratory distress, characterised by nasal flaring, marked subcostal and intercostal recessions, and gasping respirations. Oxygen saturation was 42% on room air, pulse rate of 180 beats/minute, and temperature of 39.0°C. There was no digital clubbing or peripheral lymphadenopathy.

Respiratory examination revealed reduced movement of the right hemithorax with tracheal deviation to the left. Percussion demonstrated stony dullness over the right hemithorax, while auscultation revealed absent breath sounds over the right lung field. Fine crackles were heard over the left lung field without wheezes. Cardiovascular examination was unremarkable apart from sinus tachycardia. Abdominal examination was normal, and no focal neurological deficits were identified aside from the reduced GCS score.

Laboratory investigations demonstrated malaria parasitaemia (++) (*Plasmodium falciparum*), total white blood cell count of $23 \times 10^9/L$, predominantly granulocytes, platelet count of $400 \times 10^3/\mu L$, and haemoglobin concentration of 8.4 g/dL.

The child was managed for severe pneumonia/aspiration pneumonia complicated by impending respiratory failure and malaria. The medical doctor in charge positioned the child prone in a head-down position across his lap and administered four back blows using the heel of the hand. The child was subsequently repositioned into the right lateral position. Oxygen supplementation at 6 L/minute was initiated together with an intravenous bolus of 10% dextrose (60 mL) for presumed hypoglycaemia and intravenous hydrocortisone 25 mg every six hours. Shortly thereafter, the child expelled the foreign body

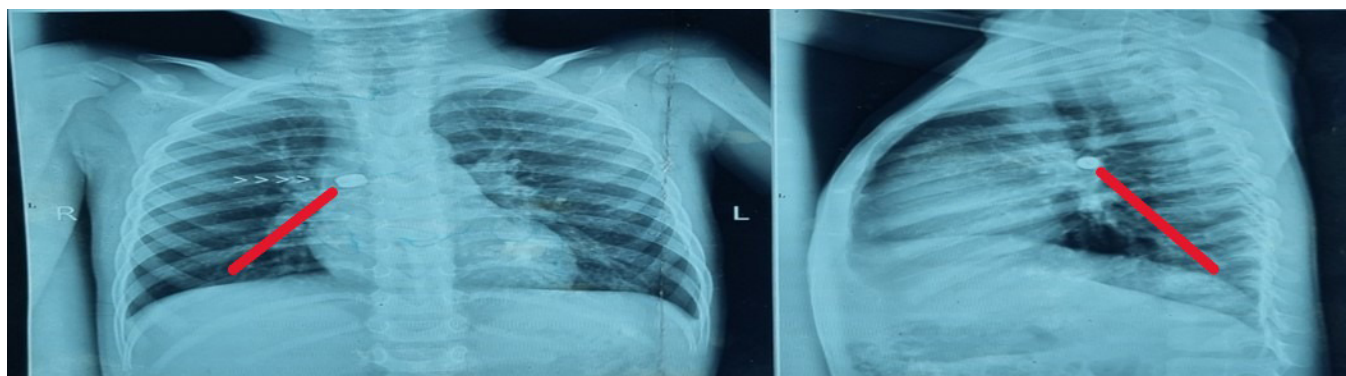


Figure 1. Initial chest X-ray done on 23/12/2023. Foreign body in the bronchus and perihilar lymphadenopathy. (Photo Credit: Juma Santino)

(Figure 2). Additional treatment included intravenous ceftriaxone 1,125 mg once daily for three days, intravenous artesunate 30 mg every 12 hours for three doses, followed by daily dosing for two days, and subsequent artemether-lumefantrine syrup therapy.

Several hours following expulsion of the foreign body, the child developed intermittent high-grade fever, dyspnoea, chest pain, and persistent cough. Oxygen saturation fluctuated between 85% and 92% despite oxygen supplementation at 6 L/minute during the first days of admission.

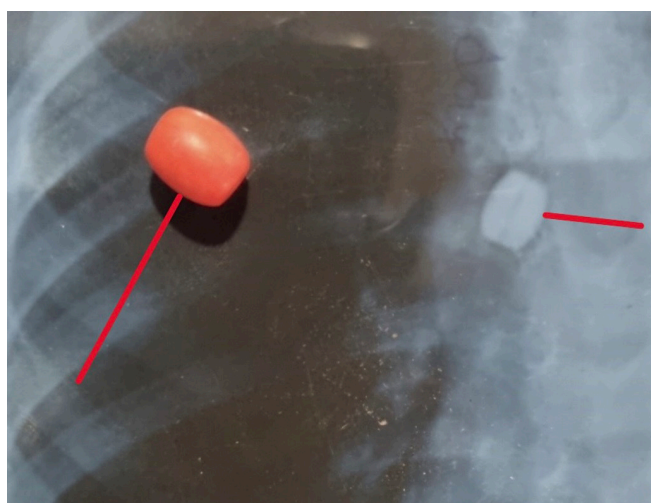


Figure 2. Photo of the foreign body (red bead) after expulsion from the lungs. The same bead is also identified by X-ray (white) prior to expulsion from the lung. (Photo Credit: Juma Santino)

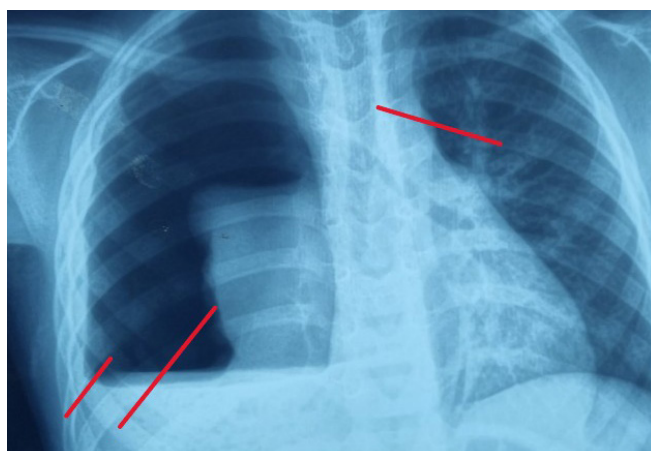


Figure 3. Right-sided pneumothorax, displaced trachea to the left, collapsed lung, and right-sided pleural effusion/lung abscess. (Photo credit: Dr. Juma Santino)

On the third day of admission, the child's clinical condition deteriorated further, with severe respiratory distress (respiratory rate 66 breaths/minute), pallor, and oxygen saturation of 76% on room air. Temperature was 39°C and pulse rate 156 beats/minute. Repeat respiratory examination demonstrated persistent tracheal deviation to the left and absent breath sounds over the right hemithorax. Repeat chest radiography revealed a right-sided pneumothorax associated with lung collapse, pleural empyema/lung abscess, and mediastinal shift to the left (Figure 3).

A chest tube thoracostomy was performed, draining thick yellow purulent fluid continuously for two weeks. Repeat chest radiography necessitated reinsertion of the chest tube, which remained in situ for an additional five days. On the third day of admission, the child was started on intravenous vancomycin 240 mg, diluted in 50 mL of normal saline, every six hours for 14 days; intravenous meropenem 360 mg every eight hours for 14 days; and continued oxygen supplementation. Due to poor clinical response and the local epidemiological context, anti-tuberculosis therapy (RHZE regimen) was initiated on day six of admission. Oxygen therapy was discontinued on day 10.

The patient subsequently demonstrated gradual clinical improvement, characterised by resolution of fever, improvement in oxygen saturation, and reduction in respiratory rate to 25–40 breaths/minute (Figure 4). The chest tube was removed after three consecutive days without drainage, having remained in situ for a total duration of 20 days (Figure 5).

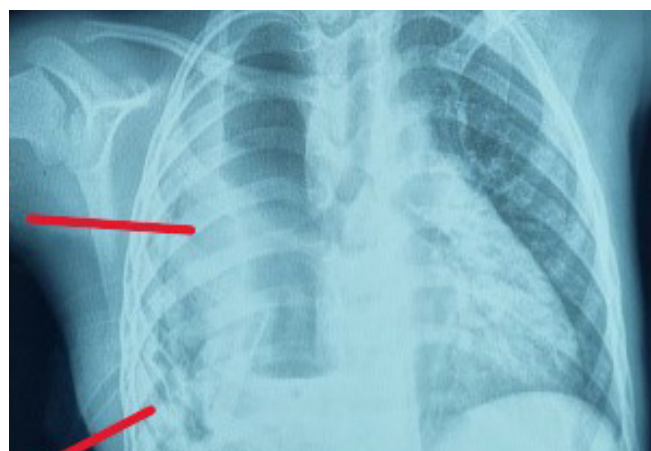


Figure 4. Improved aeration with resolved right-sided pneumothorax and pleural effusion post chest tube insertion. (Credit: Dr. Juma Santino)

Case Report



Figure 5 a and b. Locally made underwater seal chest tube. (Credit: Juma Santino)

On discharge, the child was afebrile, breathing comfortably, and maintaining oxygen saturation of 97% on room air. Chest auscultation demonstrated improved air entry in the right upper lung zone, although reduced aeration persisted in the right lower zone. No crackles or wheezes were detected. He was discharged on oral anti-tuberculosis therapy.

Follow-up over six months showed progressive improvement in appetite, weight gain, and respiratory function.

Discussion

Foreign body aspiration is a potentially life-threatening paediatric emergency that requires early diagnosis and timely intervention to prevent severe complications including death.^[1,3] In this case, the child presented two months after aspiration of the foreign body and had undergone multiple unsuccessful attempts at removal, including bronchoscopy. Bronchoscopy poses a great

Table 1. Dos and don'ts when dealing with foreign-body

	Dos	Don't
1	Maintain a high index of suspicion ¹ Infants (under 1 year): Place the baby face-down on your forearm, support the head, and give 5 firm back blows between the shoulder blades. If not relieved, turn the baby face up and give 5 chest thrusts (similar to CPR compressions but gentler). Children above 1 year: Perform the Heimlich manoeuvre	Don't perform blind finger sweeps, Try to remove what you can see ²
2	Perform a thorough physical examination	Don't give bronchodilators (it will not work)
3	Obtain decubitus or expiratory X-rays: Most aspirated objects are radiolucent	Don't rely solely on a normal chest X-ray to rule out aspiration: Up to 30% of patients with confirmed tracheobronchial foreign bodies
4	Keep the patient calm and nil per mouth Agitation can shift a stable bronchial foreign body back up into the subglottic space or trachea, converting a partial obstruction into a catastrophic complete airway obstruction.	Don't delay intervention: organic material (e.g., peanuts, beans) absorbs moisture rapidly, swells to cause worsening obstruction, and releases chemical irritants that lead to severe localized "vegetable bronchitis" and granulation tissue formation within hours.
5	Prepare for rigid/Flexible bronchoscopy	

¹ Sudden coughing, gagging, or choking while eating or playing, difficulty breathing, noisy breathing, or wheezing).

² It may cause trauma, unintentionally pushing the foreign object deeper into the airway, stimulate the person's gag reflex, introducing the risk of aspiration.

challenge even in the hands of the most experienced bronchoscopist or otolaryngologist due to many factors. Among these are the shape and surface characteristics of the bead or other foreign body. Beads are usually smooth, round, and slippery, making them difficult to grasp securely with standard bronchoscopy forceps. Repeated attempts at grasping may cause the bead to slip and migrate distally into smaller bronchi, further complicating retrieval. Large beads may become tightly impacted within the bronchus, making extraction difficult without causing trauma to the airway mucosa. Conversely, very small beads can move deeper into segmental bronchi where visualization and access are limited.

Another significant issue is the presence of a central hole in some beads. During bronchoscopy, forceps may repeatedly slip through or around the hole instead of obtaining a firm grip. Special retrieval instruments such as balloon catheters, baskets, magnets (for metallic objects), or optical forceps may be required for successful extraction. Delayed diagnosis can also contribute to bronchoscopy failure. Although beads do not induce the same inflammatory reaction as organic materials, prolonged retention may still lead to mucosal oedema, granulation tissue formation, secondary infection, and accumulation of secretions around the foreign body. These changes reduce visibility and make retrieval even more challenging.

In some cases, airway oedema, bronchospasm, oxygen desaturation, or bleeding during the procedure may force the surgeon to terminate the bronchoscopy before successful removal to avoid life-threatening complications. Other factors like repeated failed attempts may increase the risk of airway trauma, perforation, or complete obstruction.^[10,11,12]

In this patient, delayed diagnosis and prolonged retention of the foreign body contributed to recurrent respiratory tract infections and severe pulmonary complications, including pleural empyema, lung abscess, pneumothorax, atelectasis, and respiratory failure. Such complications are well recognised in cases of long-standing foreign-body aspiration. In most cases, diagnostic delays were attributed to physician misdiagnosis, failure by parents to seek medical advice, patients left against medical advice, and, in this setting, inaccessibility to specialized care is a challenge.^[6,13]

Children presenting with recurrent or non-resolving respiratory tract infections should always be evaluated for possible foreign-body aspiration, particularly when there is a history of choking. Differential diagnoses of recurrent

respiratory tract infections include bronchial asthma, primary or secondary immunodeficiency disorders, congenital cardiopulmonary anomalies, and genetic predisposition to chronic respiratory disease.^[14,15]

Our patient required prolonged broad-spectrum antimicrobial therapy because of severe secondary pulmonary infection and empyema. Although antibiotics are not routinely indicated in uncomplicated foreign body aspiration, they must be considered in patients presenting with aspiration pneumonia, abscess formation, empyema, or sepsis. Management should therefore be individualised according to the clinical presentation and supported by appropriate microbiological investigations to minimise unnecessary antimicrobial exposure and antimicrobial resistance. Anti-tuberculosis therapy was initiated due to a poor response to broad-spectrum antibiotics and the prevailing local epidemiological context. The child subsequently completed six months of anti-tuberculosis treatment.

Several manoeuvres are available for management of foreign-body airway obstruction in children, including back blows, chest thrusts, abdominal thrusts (Heimlich manoeuvre), Magill forceps extraction, suction-assisted airway clearance devices, and bronchoscopic retrieval.^[16,17] In this case, expulsion of the foreign body following back blows was unexpected, given the prolonged duration of aspiration and previously failed bronchoscopic intervention. Forceful coughing may also have contributed to spontaneous dislodgement of the object.

Prevention of foreign-body aspiration requires a multidisciplinary approach involving caregivers, healthcare workers, manufacturers, and public health systems. Caregivers should be educated not only on appropriate first-aid responses but also on harmful practices to avoid, such as blind finger sweeps, which may inadvertently push the object deeper into the airway. Improved public awareness regarding choking hazards and basic life-support skills could significantly reduce the morbidity and mortality associated with foreign body aspiration (Table 1).^[14,15]

Conclusion

Foreign-body aspiration is a common paediatric emergency that may result in life-threatening complications when diagnosis and treatment are delayed. Complications include pneumothorax, pleural empyema, lung abscess, atelectasis, and respiratory failure. Early recognition, prompt intervention, and appropriate supportive

management are essential for improving clinical outcomes. Public education regarding choking hazards, preventive strategies, and first-aid manoeuvres such as the Heimlich manoeuvre and back blows in young children may contribute significantly to reducing morbidity and mortality in children.

Declarations: Written informed consent for publication of this case report was obtained from the patient's parent.

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South Sudan: Hunger and Conflict in South Sudan - Families Trapped in Jonglei State

3 June 2026

[United Nations World Food Programme \(Rome\)](#)

In South Sudan's Jonglei State, families like Chol's are trapped by conflict, displacement and rising hunger, as violence destroys livelihoods and leaves communities struggling to survive without food or support. Countrywide, more than half of the population faces crisis hunger levels.

There is not much left of Chol's old life in Akobo, [South Sudan](#). Like many families across Jonglei State, she is caught in a wider crisis where conflict and repeated displacement are pushing communities deeper into hunger.

Her husband is dead, killed by armed fighters who also torched her home and many others. Hunger is everywhere. Dirt tracks winding through clusters of straw-and-reed shelters have turned to mud under heavy rains that will last for months, threatening to cut off vital supply routes.

"This is our reality," says Chol of ongoing conflict smashing lives and hopes in this young country. "We have no power." (Chol's last name is being withheld for her protection).

Caught between conflict and hunger in Jonglei State

South Sudan's hunger emergency is not down the road - it is now. It is seen in the stick-thin, [malnourished children](#) and their parents arriving in this eastern town and finding almost nothing. It is why the World Food Programme (WFP) and our partners are now surging food and other assistance to Akobo, to prevent a humanitarian crisis from getting worse.

Read the [original article](#) on [WFP](#).

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Clinical rabies in an HIV-positive pregnant mother with surviving newborn

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ABSTRACT

In South Sudan, rabies is a serious public health burden with an estimated 204 deaths per year. According to the Global Alliance for Rabies Control 2024 report, this is exacerbated by limited dog vaccination coverage and high annual cost of rabies treatment and control, with approximately 9,290 people receiving post-exposure prophylaxis (PEP) annually. In Pariang and the surrounding area, dog bites are very common. In the last two years, four patients died in the hospital due to clinical rabies. Reported cases of clinical rabies in pregnancy with surviving infants are very rare. A 2019 non-systematic review reported only 16 cases worldwide, with four identified in Africa. There are few reported cases of rabies exposure among Human Immunodeficiency Virus (HIV) positive individuals, but none of them was in pregnancy. This is a case report of an HIV-positive pregnant mother who was referred to Pariang Civil Hospital at 37 weeks of gestation with a history of a dog bite six weeks previously, restlessness, inability to swallow, hydrophobia, vomiting, fear, hypersalivation, and fever. Diagnosis of clinical rabies in pregnancy was made, and an emergency Caesarean Section was done with a live baby girl. The mother died 49 hours after delivery. The baby received nevirapine syrup at birth and tested negative for HIV at six weeks and at nine months but does not seem to have received rabies vaccine. One year later, she has no symptoms of rabies. This case report highlights the unique co-occurrence of clinical rabies and HIV infection in a pregnant mother, with a good outcome for the newborn. Community awareness, ensuring the availability of rabies vaccines in all health facilities, plus mass vaccination of dogs and the elimination of street dogs may help reduce rabies cases in Greater Pariang and South Sudan at large.

Keywords: rabies; Human Immunodeficiency Virus; pregnancy; newborn; South Sudan.

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Introduction

Rabies is a viral zoonotic disease responsible for an estimated 59,000 human deaths every year globally. It is almost invariably fatal once clinical signs appear, because of acute progressive encephalitis.^[1] Rabies is very rare in developed countries but still affects resource-limited countries.^[2]

In 2018, the World Health Organization (WHO), the Food and Agriculture

Organization of the United Nations (FAO), the World Organization for Animal Health (WOAH), and the Global Alliance for Rabies Control (GARC) set the global target of zero human deaths from dog-transmitted rabies by 2030 ("Zero by 30").^[3]

In South Sudan, rabies is a serious public health burden, with an estimated 204 deaths per year. This burden is exacerbated by limited dog vaccination coverage and the high annual cost of rabies treatment and control. Furthermore, approximately 9,290 people receive post-exposure prophylaxis (PEP) annually.^[4] In Pariang and its surroundings, dog bites are very common. In the last two years, four patients died in the hospital from clinical rabies after being bitten by rabid dogs.^[5]

Reported cases of clinical rabies in pregnancy with surviving infants are very rare, and a literature search revealed only four cases reported from Africa and 16 cases from around the globe.^[6] There are few reported cases of rabies exposure among HIV (Human Immunodeficiency Virus) positive individuals, but none occurred during pregnancy.^[7,8]

We report the case of an HIV-positive pregnant woman who presented with signs of clinical rabies after a dog bite at Pariang Hospital in South Sudan.

Case Report

A 23-year-old mother was referred to Pariang Hospital from Jamjang Primary Health Care Center (PHCC) on 1/11/2024. She was Gravida 3 Para 2+0 (one previous Caesarean Section), known HIV positive for four years and on Anti-retroviral therapy (ART). The viral load and CD4 count were unknown.

She presented with a history of restlessness, inability to swallow, hydrophobia, vomiting, fear, hypersalivation and fever for two days. She had been bitten by a dog on the anterior aspect of her left forearm one and a half months previously. The same dog had bitten four other people in the village and was later killed by villagers.

When she was bitten by the dog, she immediately went to the Primary Health Care Centre, where the health worker cleaned her wound with antiseptic, but no rabies vaccine was available. She was also told by some community members that pregnant women should not receive rabies vaccine, making her reluctant to seek further medical help. The wound healed a few days later, and she was stable until the symptoms appeared.

On examination, she was irritable but oriented to time

and place, spoke with difficulty due to throat pain, and was febrile with a temperature of 38.3 °C, BP 100/60 mmHg, pulse rate 80 bpm, and respiratory rate 22 per minute. Obstetrics examination showed a symmetrically enlarged abdomen with a Pfannestiel's scar, symphysio-fundal length of 37cm, and the foetus in a longitudinal lie, cephalic presentation; heart sounds were audible and regular at the rate of 110bpm, and the presenting part was 5/5 palpable above the symphysis pubis. There were no uterine contractions. The patient had increased limb tone and exaggerated tendon reflexes. There was no neck stiffness.

The laboratory at Pariang Civil Hospital does not have the capacity to isolate rabies virus or perform rabies virus antigen testing. The diagnosis of clinical rabies in an HIV positive pregnant mother was made based on the history, clinical presentation, and examination findings. She was isolated immediately, given IV Ringer Lactate 2,000ml and IV ampicillin 2g stat. A full blood count was carried out (Hb. 10.4g/dl) with Blood grouping and preparations made for an emergency Caesarean Section. A live baby girl was delivered with an Apgar score of 4/10 at 1st minute, 8/10 at 5th minute, and 10/10 at 10th minute, with a weight of 2.8 Kg. The amniotic fluid was meconium-stained. Precautions were strictly followed to ensure blood and other maternal body fluids did not come in contact with foetal mucous membranes. The operation was uneventful. All reusable anaesthetic equipment used during the operation were immediately decontaminated and sterilized. The baby was given nevirapine syrup immediately after delivery. Maternal vital signs were monitored regularly.

When recovering from anaesthesia she became irritable and was sedated again with diazepam 10 mg every 4 hours. The following morning, she was stable and oriented to time and place, with no adverse changes in vital signs. The lower abdomen was slightly distended with a fundal height of 18 cm from the symphysis pubis. A few hours later she developed vomiting, fear, restlessness, and hypersalivation despite being on diazepam.

On the second postoperative day, her condition deteriorated, and she was unresponsive to diazepam: BP 100/60 mmHg, PR 80 /min, RR 16 /min, and temperature 38.3 °C. Her clinical condition worsened with very severe difficulty in breathing. She died 49 hours after the delivery.

All co-patients who had direct contact with the patient were advised to receive the rabies vaccine; the father was advised to vaccinate the baby against rabies, but

there was no confirmation that this had occurred. The baby was enrolled in the Early Infant Diagnosis (EID) program. A Polymerase Chain Reaction (PCR) HIV test was performed at six weeks, and a Rapid Diagnostic Test (RDT) at nine months: both were negative. The baby is now one year old and progressing well.

Discussion

Post-exposure prophylaxis (PEP) administered after the exposure is highly protective against the development of rabies symptoms. However, in low-resource settings, the availability and sustainability of this lifesaving vaccine's supply are frequently a challenge. In this case, the exposed mother did not receive PEP.

Previous case studies indicate that infants have survived birth from rabies-infected mothers without immediate infection and some even without vaccination.^[2,6,9] However, prompt administration of rabies PEP is highly recommended for all infants born to infected mothers.^[6,10] For this reported case, the relatives were unable to buy the expensive vaccine, which would have had to have been purchased from Juba, far from Pariang.

Even though the baby did not receive PEP, she survived without manifesting any symptoms of rabies infection, and is now one year old. This supports previous reports about the role of the placenta in protecting the foetus against the rabies virus.^[6] There is only one case reported in the literature of confirmed transplacental rabies transmission. [11] This finding reinforces the rarity of vertical (in utero) transmission of the rabies virus, which could be attributed to a lack of maternal viremia or to the protective role of the placenta, as reported earlier.^[10,12] This baby was born with a low Apgar score and meconium-stained amniotic fluid; similar findings were reported by other authors.^[12] Only a few cases of HIV positive individuals with rabies exposure have been reported in the literature, and the discussions are always centered on immunity, specifically regarding how effective the rabies vaccine is in an HIV positive individual.^[7,8]

Without PEP, the risk of developing rabies after a bite from a rabid animal is high, and being an HIV-positive patient, particularly with low CD4 (<200 cells/ μ L), may have a weak or nonexistent immune response to rabies vaccination.^[13] In this case, we could not assess the effectiveness of PEP because the mother did not receive it; we also could not assess her CD4 count or viral load, nor obtain laboratory confirmation of rabies infection due to poor laboratory setup. So, the fact that she did not receive

PEP, coupled with poor laboratory capacity, has made it very difficult for me to come up with any fruitful discussion regarding clinical rabies in HIV-positive individuals.

Recommendations:

- Community awareness should be enhanced in the Ruweng Administrative Area and elsewhere in South Sudan where rabies is endemic. The importance of PEP in preventing clinical rabies should be emphasised, and it should be noted that rabies vaccines and Rabies Immunoglobulins (RIG) are not contraindicated in pregnancy.
- The most common types of human rabies vaccines available in South Sudan are Purified Chick Embryo Cell Vaccine (PCECV) and Human Diploid Cell Vaccine (HDCV), which are often manufactured by global pharmaceutical companies located in India and supplied via international health organizations and commercial companies. Because these vaccines are predominantly administered intramuscularly, the cost of the full multi-dose course remains prohibitively high for many in rural communities. Although the World Health Organization recommends Rabies Immunoglobulin (RIG), it remains unavailable nationwide. To align with global standards and prevent avoidable deaths, the National and State Ministries of Health, in collaboration with partners, must prioritize the procurement, subsidization, and distribution of rabies vaccines while actively adopting the cost-effective Intradermal (ID) route and expanding access to RIG in high-risk, endemic areas.
- The Ministry of Health and the Ministry of Livestock and Fisheries, together with relevant partners, should develop a plan for mass dog vaccination and the elimination of street dogs.
- All babies born to rabid mothers should receive PEP immediately regardless of the mode of delivery. All precautions taken to prevent mother-to-child transmission of rabies may not be 100% protective. Rabies is invariably fatal when the symptoms appear.
- Although laboratory confirmation of rabies infection by PCR on saliva or skin biopsy samples, or by detecting rabies antibodies in serum or cerebrospinal fluid (CSF), is helpful, the government hospitals' laboratories in South Sudan do not have the capacity to perform these tests. Therefore, State and National Ministries of Health should endeavour to equip these laboratories.

- Although rabies is a notifiable disease in South Sudan, cases are not being reported due to miscommunication between the surveillance officers. The Integrated Disease Surveillance and Response needs strengthening.

Conclusion

This case report highlights the co-occurrence of clinical rabies and HIV infection in a pregnant mother, with a good outcome for the baby. This underscores the critical need for heightened awareness and prompt intervention in similar cases, as rabies remains a preventable yet fatal disease. The findings also emphasize the importance of thorough clinical evaluation and vaccination strategies for high-risk populations, particularly in regions such as the Ruweng Administrative Area, which has limited access to healthcare resources. This report calls on healthcare providers, healthcare managers, local and national governments, and all concerned stakeholders to prioritize rabies prevention measures for vulnerable populations.

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WHO-Guidelines for the management of pregnant and breastfeeding women in the context of Ebola virus disease

To save the lives of mothers and their babies, mitigate complications, and limit the spread of disease, it is critical that recommendations are made on the prevention, treatment, and surveillance of women who are exposed to EVD, acquire EVD during pregnancy or breastfeeding, or survive EVD with ongoing pregnancies. These guidelines are the first to provide such recommendations. <https://www.who.int/publications/i/item/9789240001381>

Guidelines for the management of pregnant and breastfeeding women in the context of Ebola virus disease



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Every effort has been made to ensure that the information and the drug names and doses quoted in this Journal are correct. However readers are advised to check information and doses before making prescriptions. Unless otherwise stated the doses quoted are for adults.