BMJ Paediatrics Open

Sepsis beyond bundles: contextualising paediatric care in resource-limited settings through situational analysis

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To cite: Ratner L, Warling A, Owusu SA, *et al*. Sepsis beyond bundles: contextualising paediatric care in resource-limited settings through situational analysis. *BMJ Paediatrics Open* 2025;**9**:e003134. doi:10.1136/bmjpo-2024-003134

Received 15 October 2024
Accepted 25 January 2025

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ABSTRACT

Background Paediatric sepsis remains a significant contributor to morbidity and mortality, particularly in low- and middle-income countries (LMICs), where healthcare resources are often limited. Paediatric sepsis bundles, which include prompt administration of antibiotics, fluid resuscitation and continuous organ function monitoring, are crucial for improving outcomes, especially when initiated within the first 'golden hour' of sepsis recognition. These bundles, adapted from adult sepsis care protocols through the Surviving Sepsis Campaign, are increasingly emphasised in global sepsis management guidelines. However, the implementation of these protocols in LMICs is challenged by resource limitations and systemic barriers.

Methods This situational analysis, conducted at two hospitals in Ghana—a tertiary facility and a district (secondary) facility—maps the availability of critical resources for paediatric sepsis care through a structured environmental scan using survey methodology. We assess staffing levels, access to medications, airway support and diagnostic capabilities. Methods were conceptualised through inner and outer settings of the Consolidated Framework for Implementation Research (CFIR) and reported through the Donabedian model for healthcare quality.

Results This study compared paediatric care at a tertiary hospital (Komfo Anokye Teaching Hosptial (KATH)) and a district hospital (Presbyterian Hospital, Agogo (PreHA)) in Ghana, highlighting KATH's emergency and intensive care unit (ICU) services, specialised staff and broader respiratory support. PreHA, although without a paediatric-specific ICU, leveraged research funding to enhance clinical care capacity. Both hospitals experienced regular power outages but had reliable generators, and while they offered basic medications and treatments, resource limitations, including out-of-pocket costs for families, impacted access to essential medications and laboratory tests.

Conclusion Concerns around resource availability, compounded by structural determinants such as financial barriers and historical underfunding hypothesised to be rooted in colonialism, highlight the need for context-sensitive adaptations of paediatric sepsis bundles. Our findings underscore the importance of a participatory approach to guideline adaptation and resource distribution, incorporating local expertise and addressing structural inequities to improve paediatric sepsis outcomes in Ghana. Future qualitative research will explore pre- and peri-hospital barriers to care and inform more effective, contextually appropriate interventions.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Paediatric sepsis remains a significant contributor to morbidity and mortality, particularly in low- and middle-income countries, where healthcare resources are often limited.

WHAT THIS STUDY ADDS

⇒ This study, guided by the Consolidated Framework for Implementation Research and Donabedian Model of health service delivery, emphasises that while the pathophysiology and clinical management of sepsis are well understood, addressing the social constructs before, within and after hospitalisation is equally critical.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ With these findings, we advocate that it is essential to adopt a holistic approach that addresses not only the medical aspects of sepsis management but also the broader context in which children and their families live.

INTRODUCTION

Sepsis is a critical global health concern and disproportionately affects children in low- and middle-income countries (LMICs),[1] where healthcare resources are often limited. Sepsis is generally recognised as a clinical condition characterised by dysregulated host response to infection, leading to multi-organ dysfunction. Early detection of paediatric sepsis is particularly challenging due to the complexity of paediatric physiology, confounding presentations with other febrile illnesses, and the fact that presentation varies with age.[2]

The Society of Critical Care Medicine (SCCM) recently established paediatric sepsis criteria for children below the age of 18.[3] The concept of 'bundles of care' for sepsis originated with the Surviving Sepsis Campaign (SSC) in 2002 and initially focused on reducing sepsis mortality in adult populations, but has since expanded to include paediatric patients. Over the past few decades, paediatric sepsis bundles have evolved significantly and have become a cornerstone in global efforts to improve early recognition and management of sepsis in children.

Paediatric sepsis bundles typically involve a series of time-sensitive interventions, including the prompt administration of antibiotics, fluid resuscitation and continuous monitoring of organ function. The goal is to initiate these interventions within the first hour of recognising sepsis—often called the 'golden hour'. A landmark 2020 publication from the SSC[3] advocated for globally standardised care practices and tailored recommendations to paediatric patients based on extensive international research. Further advancements came in 2024 with the SCCM's introduction of the Phoenix Sepsis Score,[4] which offers refined respiratory, cardiovascular, coagulation and neurologic dysfunction criteria. This score was designed to improve paediatric sepsis management, particularly in resource-limited settings, by triggering specific interventions when a score of two or more points is reached.[4]

Global estimates suggest that paediatric sepsis can confer mortality rates of 9–20%[5 6] and that despite overall improvements in sepsis care, these rates have worsened in resource-limited settings. Previous research in Sub-Saharan Africa shows that the mortality rate for paediatric sepsis in hospitals can exceed 10%, especially where timely and adequate treatment is lacking.[7–10] These statistics have been borne out in Ghana as well, where a 1 year audit at Komfo Anokye Teaching Hosptial (KATH), a large tertiary care centre in the Ashanti region, revealed a 9% prevalence of paediatric sepsis among admitted patients and a mortality rate as high as 79%.[7 8] Another study identified sepsis as the leading cause of death within the first 24 hours of admission to KATH's paediatric emergency unit (PEU).[9]

In Ghana, as in other Sub-Saharan African countries, we hypothesise based on the literature that these care disparities are structurally driven by historical underfunding of healthcare systems, rooted in colonial-era practices.[10] International funding support shaped healthcare in Ghana during the post-colonial period and was continually expanded during the structural adjustment era of the 1980s and 1990s.[10] This pattern has resulted in a health system that remains heavily dependent on foreign aid today.[10 11] Ghana does have a National Health Insurance Scheme (NHIS), but there are often large gaps in coverage.[12] Additionally, while the WHO's Essential Medication List[13] and Ghana's Essential Medications List[12 13] guide resource intents for medication availability, persistent shortages of essential medical supplies such as antibiotics, intravenous fluids and personal protective equipment have been previously shown to complicate sepsis management in Ghana.[14] Other previously demonstrated structural and social determinants of paediatric sepsis outcomes in Ghana include fear of hospitalisation, financial constraints, transportation issues, delays in transfers from referring hospitals, cultural and spiritual differences and concerns over privacy and confidentiality.[8 12]

With these histories, contexts and challenges surrounding paediatric sepsis care in Ghana, several members of our team (JAA, LR, EM) conducted an internal baseline provider survey in the KATH paediatric intensive care unit(PICU) in 2018.[7] This survey revealed significant gaps in paediatric sepsis management. Although healthcare providers could often identify sepsis clinically, resource constraints were a significant barrier to effective management. This survey highlighted the need for expanded education and actionable intervention protocols tailored to the local context, particularly as resource limitations at KATH impaired adherence to the time-sensitive 'golden hour' for administering fluids, antibiotics and appropriate blood pressure support. These findings also led to a collaboration with Open Paediatrics, which resulted in peer-reviewed educational video modules[15] that addressed knowledge gaps for patients and providers.

Building off this groundwork, we have designed a comprehensive Participatory Hybrid Effectiveness Trial[16] centred on paediatric sepsis care at two hospitals in the Ashanti region of Ghana: KATH, which is located in the large city of Kumasi, and Presbyterian Hospital, Agogo (PreHA), a district-level hospital located in the smaller town of Agogo. Our full trial will have three arms: (a) qualitative interviews focused on sepsis care with paediatric patients, families and providers at KATH and PreHA; (b) an educational intervention for paediatric sepsis care providers at both hospitals, based on the previously developed Open Paediatrics modules; and (c) a comprehensive chart review of paediatric sepsis cases and outcomes at KATH. The present paper focuses on a situational analysis, which serves as a needs assessment in preparation for the effectiveness trial. The results of the full trial will be published at a later date.

We initiated our work with a situational analysis at both hospitals because understanding resource availability is essential when studying and delivering high-acuity paediatric care in resource-limited settings. Specifically, these analyses can be used to identify gaps that hinder the implementation of clinical protocols (eg, paediatric sepsis bundles). Using comprehensive environmental scans, this situational analysis (i) assessed physical and systemic factors that influenced paediatric sepsis care outcomes in the Ashanti region of Ghana and (ii) aimed to understand this care from the Ghanaian perspective. Global sepsis guidelines may not fully align with the realities of healthcare delivery in Ghana, and, in addition to guiding the other arms of our effectiveness trial, we hope our findings will inform the development of context-specific approaches to sepsis care that consider local resources and systems.

METHODS

This study is a situational analysis—a form of needs assessment—conducted in preparation for a future paediatric-sepsis-focused Participatory Type 1 Hybrid Effectiveness Trial.[16] This team conceptualised the study's outputs with the Consolidated Framework for Implementation Research (CFIR),[16] which helps assess the multi-level factors influencing intervention implementation and outcomes. Specifically, we use the CFIR framework as a structure for assessing both inner settings and outer settings. CFIR defines the *inner setting* as the structural, cultural and contextual factors within an organisation (eg, resources, communication and team dynamics). In contrast, the *outer setting* refers to external influences such as policies, funding, patient needs and societal pressures that impact implementation efforts. Inner and outer settings will be discussed within the first aspect of the Donabedian model (structure).

While CFIR provides an implementation framing, the Donabedian model offers a comprehensive framework for evaluating *healthcare quality* by examining three interrelated components: (a) structure, (b) process and (c) outcome. In this context, *structure* refers to the physical, organisational and financial resources that support care delivery, such as infrastructure, medications and staffing. *Process* captures the interactions and workflows through which care is delivered, including clinical guidelines, referral patterns and patient–provider interactions. Finally, *outcome* focuses on the measurable effects of care, such as patient survival, recovery and quality of life. *Outcomes will be discussed in the Discussion section.*

By analysing healthcare delivery through this lens, we can better understand how resource limitations, system inefficiencies and broader contextual factors shape outcomes, particularly in resource-constrained settings like the Ashanti Region of Ghana. The combination of both frameworks creates a holistic conversation for framing this needs assessment—and allows for the identification of key barriers to care, informing future targeted and locally relevant interventions.

Intervention characteristics

This analysis sought to evaluate the local capacity to implement paediatric sepsis bundles, focusing on how resource availability and systemic realities might influence implementation. We systematically assessed gaps in care delivery to inform future context-specific interventions.

Study setting

The study was conducted at two hospitals in the Ashanti Region of Ghana: KATH and PreHA. Ethical approval was obtained from KATH's Institutional Review Board (KATH IRB/AP/203/23).

A. Structure (Donabedian model) (*divided by inner and outer setting from CFIR*):

I. Inner setting (CFIR)

- **Environmental scans**: environmental scans of paediatric units were used to understand structural characteristics (eg, resource availability, infrastructure and staffing levels) and the implementation climate (ability to deliver acuity-appropriate care as defined by the current bundled care). At KATH, the scans covered the PEU, PICU and three paediatric wards. At PreHA, scans were aggregated due to the smaller size of the facility. Data collection involved conducting resource inventories (eg, beds, oxygen supplies, medications) through structured interviews with key stakeholders. Data were systematically recorded using a standardised Google form or documented by hand when necessary (eg, when internet connectivity was down). To ensure accuracy and rigor, the collected data underwent a thorough verification process by the author group. Any discrepancies or ambiguities were resolved through follow-up conversations with stakeholders to clarify and contextualise the findings. For example, an initial discrepancy regarding the availability of point-of-care ultrasound POCUS across different wards at KATH was identified; on further clarification, it was determined that the initial respondent had misunderstood the question. This issue was resolved through targeted discussions, leading to corrected and validated data.
- **Comparative analysis**: medication availability was compared with the WHO Essential Medications List[13] and Ghana's NHIS.[12] This comparison was completed to identify discrepancies between policy and practice in resource allocation and clinical care delivery.

II. Outer setting (CFIR)

- **External funding:** the study considered the broader contextual factors influencing care delivery, such as Ghana's reliance on foreign aid and external funding.[10 11] Embedded within the existing literature, these systemic influences were hypothesised to contribute to unequal resource distribution and misalignment between global clinical guidelines and local realities.
- **Characteristics of individuals:** key stakeholders, including healthcare providers and administrators, were integral to shaping this study by ensuring it reflected systemic realities and resource limitations unique to each hospital. Their input grounded the research in external factors such as patient needs, organisational priorities and broader contextual challenges influencing sepsis care. While direct patient involvement was limited due to the study's clinical focus, paediatric staff working at both KATH and PreHA contributed to the study design, data collection tools and interpretation of findings. The full hybrid effectiveness trial will include patient and family perspectives, providing critical insights into barriers to sepsis care and aligning with the CFIR emphasis on meeting external patient and community needs.

B. Process (Donabedian model) The situational analysis represents the pre-implementation phase of our larger hybrid effectiveness trial. Findings will inform the development of contextually tailored bundled care, with ongoing engagement of key stakeholders to ensure feasibility and fidelity. Key steps in the process include:

1. **Data collection**: environmental scans provided insights into infrastructure, workflows and systemic gaps.
2. **Systematic assessment**: resource availability was quantified, and stakeholder conversations corroborated and validated findings to map the capacity for sepsis bundle implementation.
3. **Feedback and dissemination**: findings will be disseminated (at the conclusion of the future hybrid study) to healthcare providers to promote dialogue and identify actionable improvements for paediatric sepsis care in the Ashanti region of Ghana as well as in other resource-limited settings.

C. Outcomes (Donabedian model) (*see Results and Discussion*)

PATIENT PUBLIC INVOLVEMENT

This study was conducted with significant input from local healthcare providers and administrators at KATH and PreHA, ensuring that the research was grounded in local realities. The paediatric staff at both hospitals were involved in identifying key resource limitations and provided feedback on the study design, data collection tools and the interpretation of findings. While direct patient involvement in the study design was limited due to the clinical nature of the research, future work will incorporate patient and family perspectives through qualitative interviews to explore barriers to sepsis care. The other aspects of the study and the umbrella study design (to be published subsequently) were designed to intentionally include patient's lived experience. For example, the educational aspect of the overall study includes a specific module on patient and family interaction with providers that was directly informed by lived experience. The findings of this situational analysis will be disseminated back to local communities and healthcare providers to foster dialogue around actionable improvements for paediatric sepsis care.

RESULTS

As a tertiary care hospital, KATH had a dedicated PEU with 16 beds, a PICU with four beds, and three paediatric wards with 49 beds (total paediatric beds=69; see figure 1 for the process map). Each ward also had dedicated inpatient paediatricians and nurses (figure 1). Specialised paediatric nurses were concentrated in the PEU (29) and PICU (23), with the highest number of on-site paediatricians in the PEU (22) (Table 1: staffing by ward).

PreHA, as a district-level hospital, had a dedicated paediatric triage space and an inpatient paediatric ward with 60 beds, but no paediatric-specific emergency unit or ICU (figure 2). PreHA did have one paediatric emergency bed (within their paediatric outpatient department), as well as an adult ICU which could care for paediatric patients over the age of 14. Other paediatric patients needing high-acuity care had to be transferred to KATH. PreHA has no paediatric nurse specialists. However, they do have nurses who have been trained to manage paediatric cases. Additionally, paediatricians covered inpatient and outpatient paediatric spaces (ie, there were no dedicated inpatient paediatricians at PreHA); see figures 1 and 2 for the process map at both sites and see table 1 for staffing).

Both hospitals had generator access for cases of power outages. All wards at KATH reported power outages approximately once a week, but it was also noted that the generator was reliable in those situations. Those at PreHA also reported that power outages occurred with somewhat regular (but unexpected) intervals, but similarly that the generator worked well. At KATH, all wards reported reliable access to oxygen through a central oxygen plant, supplemented by oxygen cylinders for patient transport. PreHA also had a central oxygen plant with oxygen cylinders for backup and patient transport.

Patient monitoring tools, including oxygen saturation and heart rate monitors, were available across both sites. However, invasive blood pressure monitoring and telemetry were unavailable at either hospital. At the time of data collection, imaging services such as CT scans were available at KATH but not at PreHA. Although formal ultrasounds were available at both hospitals, there were some discrepancies at both hospitals regarding the availability of trained staff to do POCUS.

Regarding airway support, at KATH, all wards had resuscitation masks available and continuous positive airway pressure (CPAP) capacity. With its 16-bed PEU and four-bed PICU, KATH also offered more advanced care options, including intubation, ventilation and dialysis. Peritoneal dialysis was available at PreHA; however, these other capabilities were not available. Only KATH's PICU and PEU had endotracheal tubes, oral airways, intubation supplies, nasal cannulae and non-rebreather masks, and only the PICU had HiFlow oxygen available. At PreHA, airway support resources included oral airways, resuscitation masks, non-rebreather oxygen masks and improvised bubble CPAP for patients aged 0–2 years. Endotracheal tubes, intubation, nasal cannulas, bilevel positive airway pressure and high-flow nasal cannula HiFlow oxygen were unavailable for paediatric PreHA patients.

The KATH PICU also had various lines and tubes, including central venous lines, nasogastric tubes and intraosseous access. In contrast, peripheral intravenous lines and nasogastric tubes could be placed in all paediatric wards. PreHA had the same capabilities as the PICU at KATH, except for paediatric central line access. For code or high-acuity clinical presentations, the KATH PICU had a well-staffed code team, which other wards, however lacked. There was no reported dedicated paediatric code team available at PreHA.

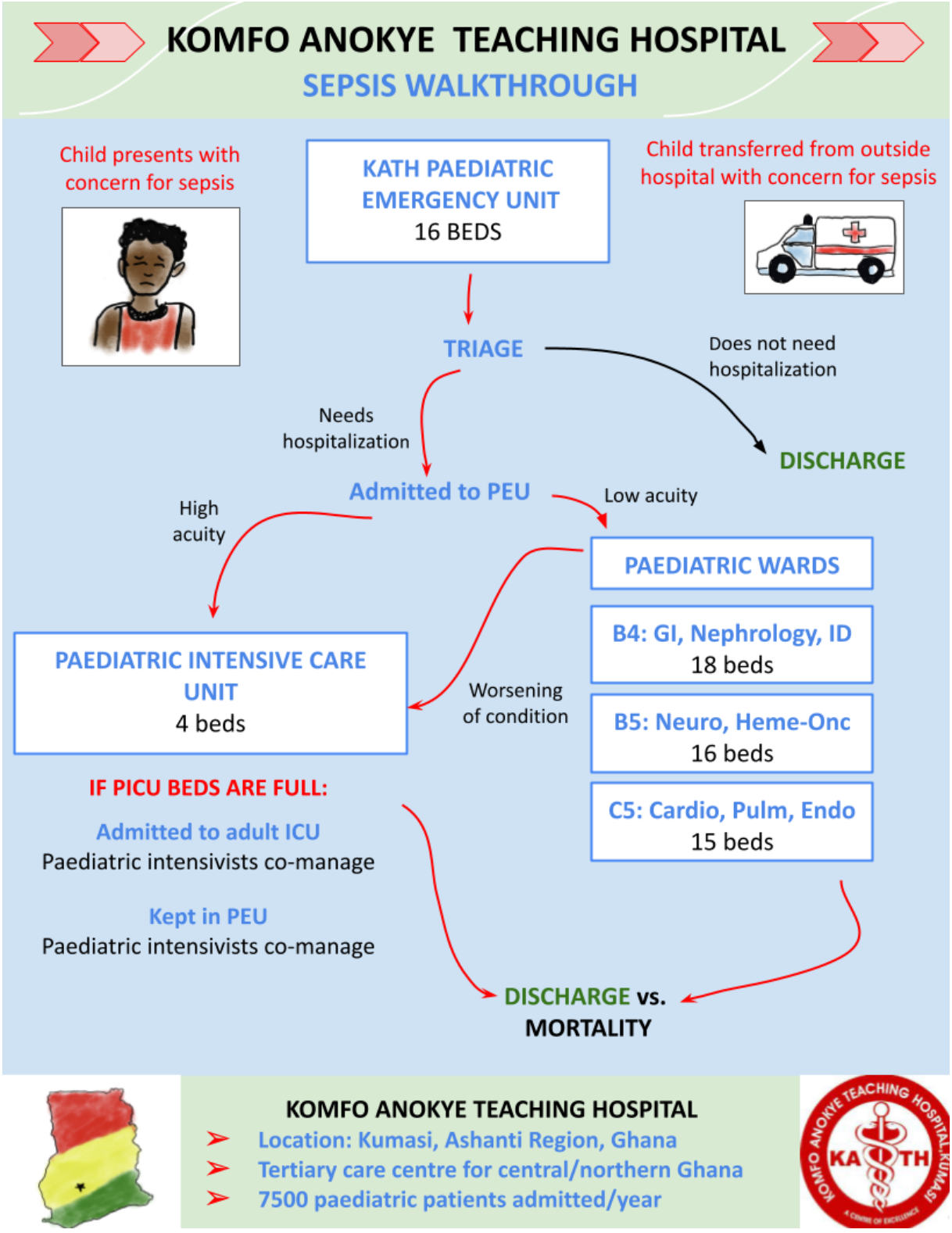

Figure 1 Process map for sepsis admissions at Komfo Anokye Teaching Hospital. All paediatric patients with concern for sepsis who present or are transferred to KATH are first triaged by nurses and paediatricians in a dedicated paediatric emergency unit (PEU). If a paediatric patient requires hospitalisation, they are initially admitted to the PEU, where primary interventions are initiated. Low-acuity patients are either discharged directly from the PEU or transferred to one of Komfo Anokye's three paediatric wards within a few days. High-acuity patients are transferred to the paediatric intensive care unit (PICU) if beds are available. If PICU beds are not available, high-acuity patients are kept in the PEU and co-managed by a paediatric intensivist or transferred to the adult ICU and co-managed by a paediatric intensivist. High-acuity patients are typically transferred to the wards prior to discharge. Low-acuity patients will be discharged either directly from the PEU or the wards.

Table 1 Staffing by ward at both Komfo Anokye Teaching Hosptial and Presbyterian Hospital, Agogo

Ward	KATH PICU	KATH PEU	KATH ward C5	KATH ward B4	KATH ward B5	PreHA PEU	PreHA ward
Number of beds	4	16	15	18	16	1	60
Staff							
Physicians (paediatrician)	9	22	16	11	17	1	1
Nursing	23	29	21	23	18	1	23

KATH, Komfo Anokye Teaching Hosptial; PEU, paedriatric emergency unit; PICU, paediatric intensive care unit; PreHA, Presbyterian Hospital, Agogo.

Both hospitals had the capacity to administer intravenous fluids, limited broad-spectrum antibiotics, antipyretic therapy (see table 2) and vasopressors (see table 3). However, both sites faced significant challenges with resource accessibility, as certain medications were only available if families paid out-of-pocket, and there were also frequent stockouts of laboratory reagents. Medication availability was compared with Ghana's NHIS[12] as well as the WHO Essential Medication List.[13]

See tables 2 and 3 for medications, microbiology tests and imaging tests available at both locations. Of note, medications are only listed as available if they were deemed regularly ready on the unit (accessible within 1 hour) and did not require that the family paid for them before administration. Laboratory, microbiology and imaging capabilities were similarly included only if they were available at the point of the interview, without the family having to pay an upfront cost for use. For example, the MRI machine was noted to be broken at KATH and therefore was not included as it would not be available at the time of interview. Similarly, PreHA did not have access to a radiologist but will have in the future. Therefore, that was not included either. Additionally, there was some discrepancy over the availability of POCUS across the varying wards, as this is dependent on clinician comfort and therefore may not always be used despite having the equipment available.

Contextually, it is vital to note that PreHA, though a district hospital, has significant clinical and community research capacity, which likely increased its clinical care delivery capacity relative to other district-level hospitals. Though the exact amount of research funding that comes to PreHA is outside of the context of this study, data and subsequent conversations revealed the hospital is recognised for its active involvement in research collaborations, particularly in areas like bacteriology and antimicrobial resistance. PreHA partners with institutions such as the Kumasi Centre for Collaborative Research in Tropical Medicine (KCCR) and the Bernhard Nocht Institute for Tropical Medicine in Hamburg, Germany, focusing on studies that address infectious challenges across sub-Saharan Africa.[17] Though less likely to influence these findings, but may contribute to the overall resource availability, the hospital has also been acknowledged for its contributions to maternal health connected to its significant research collaboration with KCCR.[18] Thus, most laboratory investigations and microbiology tests were supported through research funding, allowing for rapid care delivery without families having to pay upfront. Lastly, compared with both essential medication lists, both hospitals did well in terms of medication availability.

DISCUSSION

Structure: resource availability and system capacity

In the Ashanti Region, our analysis identified impressive consistency in the availability of medications across sites, aligning with both country wide and WHO essential medication lists (table 2). However, resource constraints became apparent in laboratory tests and imaging, where access was contingent on families' ability to afford these services. This disparity highlights a critical structural determinant impacting paediatric sepsis management.

Notably, differences between the two hospitals—KATH and PreHA—suggest inequities shaped by external funding, thus *outer settings*. At PreHA, research funding enables faster access to care, but reliance on such financing introduces an element of 'luck' in high-acuity care.

International paedatiric sepsis management guidelines underline the importance of IV fluids, antibiotics and blood pressure support. The lack of consistent access to these key clinical tools at KATH and PreHA underscores the need for equitable resource allocation informed by local realities. Additionally, interhospital transfers are worth mentioning here (see figures 1 and 2) as there were often limited beds in the PICU at KATH, meaning that patients had to remain in the PEU, which may have had fewer staff/clinical resources. Any paediatrics patients at PreHA needing intensive level care had to be transferred to KATH, but this requires a several hour drive, which is often further delayed by family having to raise money for a ride to Kumasi.

Addressing this requires participatory approaches that centre on Ghanaian priorities, ensuring guidelines adapt to the structural limitations of resource-constrained settings.

The literature suggests that the healthcare system in Ghana faces structural challenges, many of which stem from a historical reliance on external aid and foreign investment. While such funding has provided critical resources, it has also contributed to a fragmented and under-resourced system. This reliance often prioritises

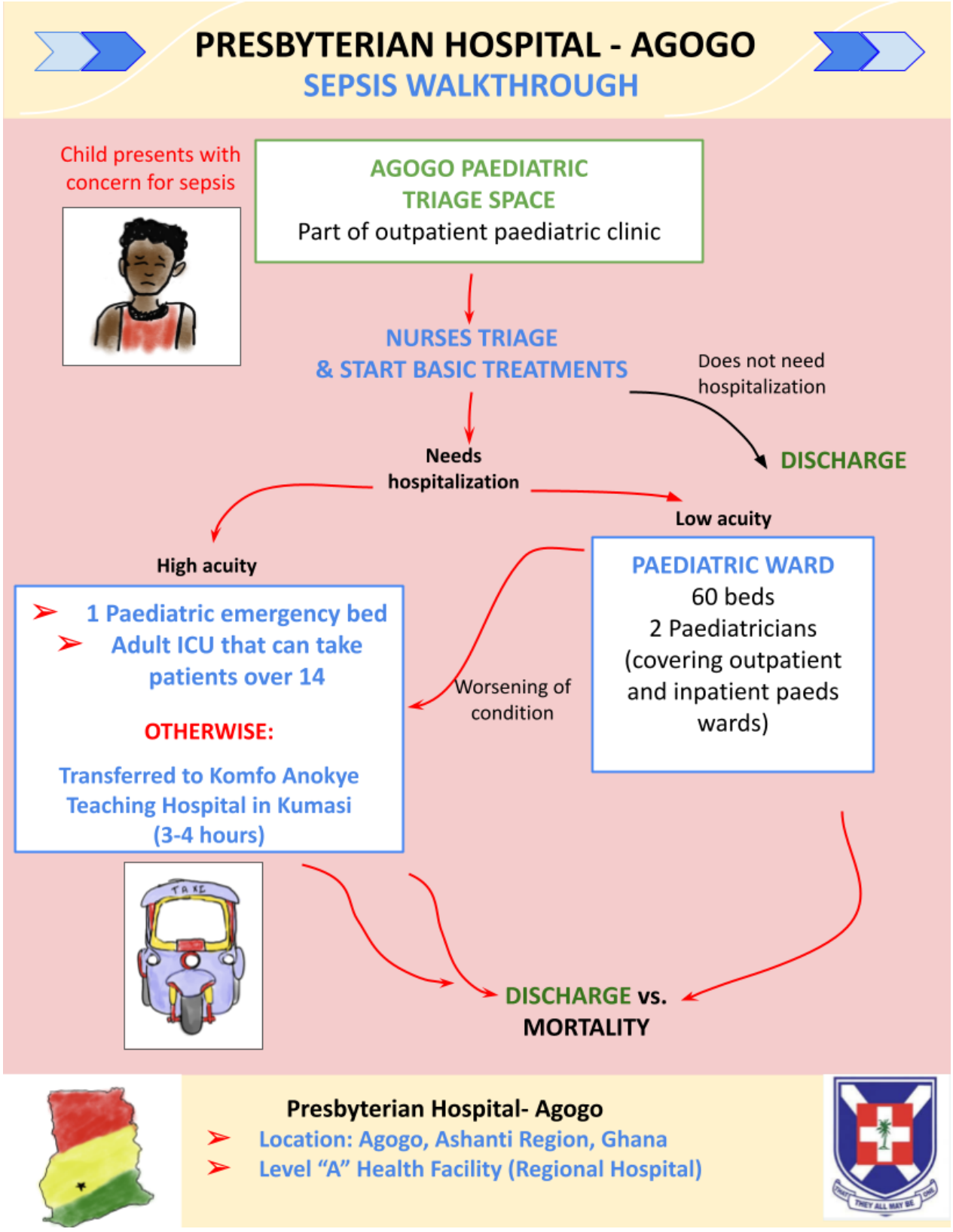

Figure 2 Process map for sepsis admissions at Presbyterian Hospital, Agogo (PreHA). All paediatric patients with concern for sepsis who present to PreHA are first triaged by nurses in a dedicated paediatric triage area, which is located within the outpatient paediatric clinic. Nurses in this space will also start basic treatments. Low-acuity paediatric patients requiring hospitalisation are admitted to the inpatient paediatric ward, which is overseen by two paediatricians. For high-acuity paediatric patients requiring hospitalisation, PreHA has one paediatric emergency bed within the adult emergency unit, and an adult intensive care unit which can treat patients over age 14. All other high-acuity patients must be transferred to Komfo Anokye Teaching Hospital (family arranges private transportation; this is a 3–4 hour journey by car or TukTuk).

Table 2 Availability of medications

Hospital and ward	KATH	PreHA	Ghana EML	Who eml
Antibiotics, anti-parasite, antifungals				
Ampicillin	√	√	√	√
Amoxicillin-clavulanic acid	√	√	√	√
Gentamicin (inj)	√	√	√	√
first, second, and third-generation cephalosporins	√	√	√	√
Metronidazole	√	√	√	√
Fluconazole	√		√	√
IV Artesunate	√	√	√	√
Antiretrovirals	√	√	√	√

IV, intravenous; KATH, Komfo Anokye Teaching Hosptial; PreHA, Presbyterian Hospital, Agogo.

practices studied in the global North and global donor agendas over locally driven priorities, creating misalignment with the realities and needs of Ghanaian healthcare delivery. As a result, health systems in Ghana may struggle to deliver comprehensive care.

Our findings align with this concern, as the availability of essential resources—such as laboratory tests, imaging and sepsis management tools—varied across facilities. This may be exacerbated by foreign funding mechanisms that do not integrate local concerns or traditional medical practices. For instance, PreHA benefits from research-driven funding,[17] but other regional hospitals without similar external support face greater limitations. These inequities emphasise the need for participatory approaches to resource allocation that are informed by local expertise and priorities rather than external agendas.

Process: contextual adaptation of clinical guidelines and workflow

Our situational analysis suggests that global paediatric sepsis guidelines do not fully align with the healthcare realities in Ghana. Differences in pre-hospital referral, financial gatekeeping and intra-hospital logistics emerged as critical process barriers. For example, it was noted that families' financial constraints could delay access to diagnostics and treatment, even when the delay could cause morbidity or mortality. Another example included a possible variability in referral patterns—which we concluded could indicate structural barriers in the pre-hospital system, compounded by inconsistent emergency transport availability.

To improve processes, a contextualised re-evaluation of clinical sepsis protocols is needed. LMIC expertise must guide the adaptation of international standards, ensuring protocols account for systemic delays, limited resources and the realities of financial constraints. Without such adaptations, bundled sepsis care risks becoming fragmented and inequitable.

The processes of care delivery—including the development and implementation of clinical guidelines—are also shaped by external influences (*outer settings*). This could perpetuate a divided system that struggles to adapt global sepsis guidelines to the local healthcare context.

Our situational analysis raises critical questions about the adaptation of clinical guidelines: are global standards reflective of all realities or are they implemented without adequate consideration of historical and ongoing power imbalances and resource-constraints? Addressing these questions requires a contextually driven re-evaluation of sepsis management protocols. LMIC-based stakeholders must be at the forefront of this process to ensure that guidelines are both effective and sustainable in different healthcare environments.

Outcome: paediatric sepsis survival and systemic barriers

We hope that future research could help determine if outcomes in healthcare delivery are directly influenced by the structures and processes outlined above. We look forward to further exploring a holistic understanding of system-wide barriers such as structural inequities, social and historical factors and process limitations through the broader study. As an example, we hope to further explore if pre-hospital and intra-hospital delays could result from or cause systemic inefficiencies and economic challenges (such as having to pay up front prior to receiving care).[19] Without universal coverage for essential medications and therapies, improving outcomes through earlier hospital presentation alone is unlikely. We hope further research explores if addressing financial barriers could reduce paediatric sepsis morbidity and mortality.

CONCLUSION

This analysis highlights the structural limitations, process inefficiencies and their potential for direct impact on paediatric sepsis outcomes in Ghana.

Table 3 Vasopressors, sedations, laboratory and imaging at both sites

Vasopressors/Sedation	KATH	preHA
IV fluids	√	√
Norepinephrine	√	√
Dobutamine	√	√
Midazolam	√	
Ketamine	√	√
Morphine	√	√
Blood products	√	
Albumin		
Microbiology/Lab		
Rapid HIV test	√	√
HIV viral load	√	√
Blood cultures	√	√
Urinalysis	√	√
Urine culture	√	√
Wound culture		
Sputum culture	√	√
Lumbar puncture	√	√
Acid fast bacillus (AFB and NAAT)	√	√
Malaria rapid test	√	√
Malaria smear	√	
Hepatitis serology	√	
Cryptococcus (India ink)	√	√
Filiarisis screen		√
Full blood count	√	√
Comprehensive metabolic panel	√	√
CRP/ESR	√	
Procalcitonin	√	
ABG		
VBG	√	
Imaging		
Chest X-ray	√	√
Abdominal X-ray	√	√
Formal ultrasound	√	√
Point-of-care ultrasound	√	
CT scan	√	
Radiologist for consult	√	

KATH, Komfo Anokye Teaching Hosptial; PreHA, Presbyterian Hospital, Agogo.

While our findings do not reflect poor leadership or management, they underscore the need for systemic (and possibly global) reforms that address the legacy of inequitable resource distribution. A participatory and context-sensitive approach is crucial to adapt guidelines, improve processes and promote equitable care delivery that meets the needs of all populations. By adopting a holistic framework guided by the Donabedian model, future efforts can integrate structural, process and outcome improvements to enhance healthcare delivery in resource-limited settings.

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Acknowledgements We want to acknowledge paediatric staff at both Komfo Anokye Teaching Hospital and Presbyterian Hospital, Agogo, for their support in helping us better understand paediatric sepsis in Ashanti, Ghana. We also acknowledge our identities as physicians and researchers in Ghana and the USA who aspire to contextualise the practice of medicine within our social contexts. Though we took steps to mitigate bias, we also recognise that our views have inherent blind spots due to the nature of our social positions. We look forward to ongoing discussion on how to continue to support paediatric sepsis care globally.

Contributors Author contributions: LR is the guarantor. LR, SAO and CM-D conceptualised the study design. AW and GKN collected data and designed data collection tools. AW designed the data visualisations including the figures for this study. ESO and FK-M supported data collection at Presbyterian Hospital, Agogo. LR wrote the manuscript with support and edits from AW, SAO, CM-D, ESO and FK-M. Senior mentorship was provided by REC, AU, JAA and EM.

Funding Research reported in this publication was supported by the Fogarty International Center of the National Institutes of Health under Award Number D43 TW010543. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Competing interests No, there are no competing interests.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Ethical approval for this study was obtained from Komfo Anokye Teaching Hospital, (KATH IRB/AP/203/23). All participants provided informed consent prior to participation in the study, and the research was conducted in accordance with the Declaration of Helsinki.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information. All data is included in this manuscript and in the tables provided.

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