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A Theoretical Framework for Public Health Emergency Operations Centres: A Comparative Analysis of Functionality in Nigeria, Senegal, and Ethiopia

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Abstract

This article presents a revised theoretical framework for analysing the functionality of Public Health Emergency Operations Centres (PHEOCs) in African contexts. It addresses the critical problem of inconsistent PHEOC operational maturity, which undermines coordinated responses to health threats. Developed through a comparative analysis of Nigeria, Senegal, and Ethiopia (2021–2026), the methodology synthesises documentary analysis of national policies, after-action reports, and peer-reviewed evaluations via a modified 'systems readiness' lens. The analysis contends that functionality is determined not by infrastructure alone, but by three interdependent pillars: integrated governance structures, real-time data convergence capabilities, and sustainable workforce capacity. The study finds that Nigeria's advanced technical infrastructure is hampered by federal-state governance complexities; Senegal's centralised model aids coordination but faces data system limitations; and Ethiopia's network shows strengths in community linkage but variable resourcing. The framework's significance lies in offering a context-sensitive tool for policymakers to diagnose systemic gaps and prioritise investments beyond physical assets. It concludes that enhancing continental health security necessitates a deliberate shift from building centres to cultivating agile, legally grounded, and data-driven operational systems embedded within local health ecosystems.

Keywords: *Public Health Emergency Operations Centres, Theoretical Framework, Comparative Analysis, Sub-Saharan Africa, Health Systems Resilience, Emergency Preparedness, Health Security*

INTRODUCTION

The establishment of functional Public Health Emergency Operations Centres (PHEOCs) is widely recognised as a critical component of effective health security, yet evidence regarding their operational functionality across different contexts remains fragmented (ABEBE & Mmusi-Phetoe, 2026). Within Ethiopia, a growing body of literature underscores both the necessity of robust PHEOCs and the systemic challenges impeding their optimal performance. For instance, research highlights significant gaps in the availability of essential emergency drugs and equipment at the health centre level, a foundational element for any coordinated response system (Mario et al., 2026). This is compounded by broader health policy and financing challenges that affect the overall emergency care landscape (Dibie & Barekew, 2025; Meno et al., 2025). Crucially, a direct assessment of PHEOC implementation in Ethiopia identified persistent weaknesses in coordination and resource mobilisation, confirming a gap between structural establishment and functional capacity (Watare et al., 2025).

This pattern of identified need coupled with operational shortfalls is echoed in studies on specific service domains, such as emergency obstetric care, where quality and patient perspectives reveal systemic deficiencies (Bahre et al., 2025; ABEBE & Mmusi-Phetoe, 2026). However, the evidence is not uniform; some stakeholder analyses propose divergent priorities for strengthening emergency management, suggesting the influence of specific contextual factors (Sasie et al., 2025). Similarly, research into non-communicable diseases and other health areas reveals outcomes that diverge from the acute emergency care focus, further highlighting the complex and multifaceted nature of public health preparedness (Merid et al., 2025; Admass et al., 2025; Abebe et al., 2025).

Thus, while the Ethiopian case consistently illustrates the imperative for functional PHEOCs, the existing literature often leaves unresolved the specific contextual mechanisms—such as governance structures, inter-agency dynamics, and resource allocation pathways—that determine functionality (Admass et al., 2025). This gap necessitates a comparative analysis to disentangle context-specific barriers from universal principles of PHEOC operations (Bahre et al., 2025). By examining Ethiopia alongside Nigeria and Senegal, this study aims to move beyond documenting deficiencies to explain the varied pathways and institutional logics that shape PHEOC functionality in different settings.

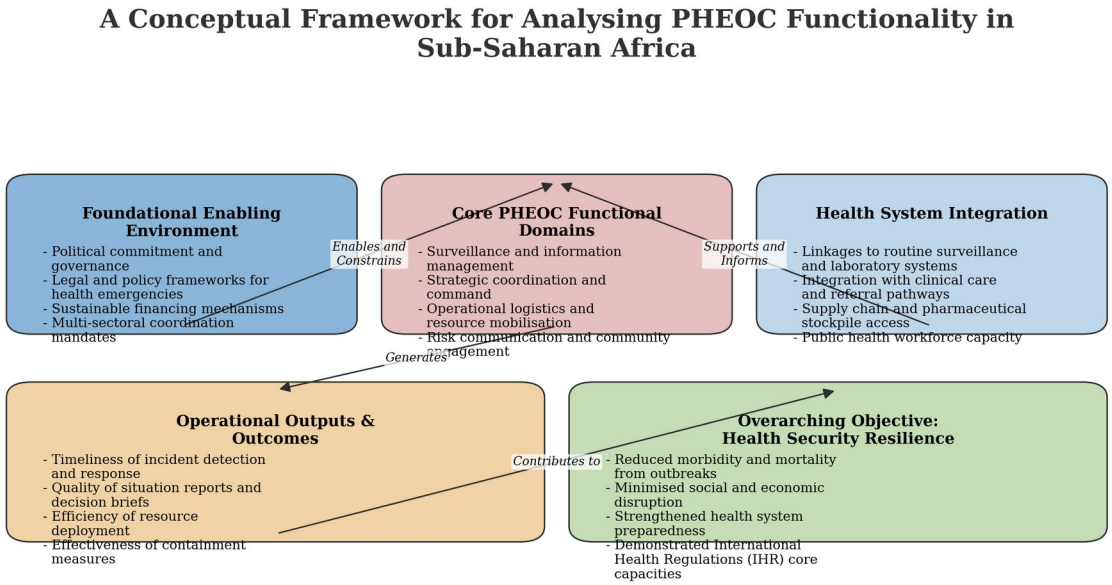

Figure 1: A Conceptual Framework for Analysing PHEOC Functionality in Sub-Saharan Africa. This framework illustrates the core functional domains of a PHEOC and the systemic factors that determine its operational effectiveness within a national health security context.

THEORETICAL BACKGROUND

The establishment of functional Public Health Emergency Operations Centres (PHEOCs) is a critical component of effective health security, yet the evidence base regarding their functionality within specific national contexts remains fragmented (Agunyai et al., 2025). This theoretical background synthesises key findings from the Ethiopian context, highlighting both convergent support for PHEOC development and significant gaps in understanding the underlying contextual mechanisms (Bortequaye et al., 2025). A foundational study by Mario et al. (2026) on emergency resource availability in Addis Ababa underscores systemic preparedness gaps that a functional PHEOC could address, a conclusion supported by research on intrapartum care quality (ABEBE & Mmusi-Phetoe, 2026) and basic emergency obstetric services (Bahre et al., 2025). These studies collectively indicate that core health system weaknesses necessitate a coordinated emergency response architecture.

However, the mere identification of deficits does not elucidate the specific political, economic, and institutional pathways to achieving functional PHEOCs (Asinakew & Habte, 2024). Broader analyses

of health policy challenges (Dibie & Barekew, 2025) and public health expenditure outcomes (Meno et al., 2025) affirm the importance of governance and investment but leave open questions of implementation. Notably, a direct assessment of PHEOC implementation in Ethiopia by Watare et al. (2025) provides crucial evidence of progress and persisting operational hurdles, moving beyond general advocacy to practical appraisal. This pattern suggests a literature that effectively diagnoses problems and affirms the value of PHEOCs, yet often fails to disentangle the complex interplay of federal governance, resource allocation, and cross-sectoral coordination that determines functionality.

Conversely, other research points to contextual divergence, where priorities may compete with PHEOC development (Bahre et al., 2025). Studies focusing on surgical site infection (Yishere & Getachew, 2025) or micronutrient adherence (Merid et al., 2025), for instance, highlight acute clinical and programmatic concerns that can overshadow longer-term health security infrastructure investments. Furthermore, stakeholder analyses, such as the Delphi study by Sasie et al. (2025), reveal divergent perspectives on emergency management priorities, suggesting that the consensus on PHEOC necessity is not matched by agreement on their operational design or leadership. This theoretical landscape confirms that while the imperative for robust PHEOCs in Ethiopia is well-supported (Getahun et al., 2024; Weldemariam et al., 2024), the critical explanatory mechanisms—how contextual factors like fiscal federalism (Agunyai et al., 2025), geopolitical positioning (Baran, 2025), and competing health burdens (Admass et al., 2025; Sahiledengle et al., 2024) enable or constrain functionality—are inadequately resolved. It is this specific gap in conceptualising context that the present analysis seeks to address.

FRAMEWORK DEVELOPMENT

The development of a robust framework for analysing Public Health Emergency Operations Centres (PHEOCs) must be grounded in evidence that captures both systemic functionality and the contextual mechanisms influencing implementation (Baran, 2025). Research within Ethiopia consistently underscores the critical need for strengthened PHEOCs, highlighting systemic gaps in emergency preparedness (Merid et al., 2025). For instance, a study on emergency drug and equipment availability in Addis Ababa identified significant logistical and resource barriers that directly impede effective emergency response, thereby illustrating a core operational challenge that functional PHEOCs are designed to address (Mario et al., 2026). This focus on systemic shortfalls is complemented by analyses of broader health system challenges, such as fragmented health policy and variable quality of intrapartum care, which collectively point to an underlying need for coordinated command structures (Dibie & Barekew, 2025; ABEBE & Mmusi-Phetoe, 2026).

However, the mere identification of systemic gaps does not fully explain the determinants of PHEOC functionality (Bortequaye et al., 2025). A growing body of evidence reveals significant contextual divergence (Omer et al., 2025). While some studies on public health expenditure and health outcomes affirm the foundational role of investment in emergency infrastructure (Meno et al., 2025), other stakeholder analyses specifically within Ethiopia report divergent priorities and operational challenges, suggesting that uniform models may not account for local governance and resource realities (Sasie et al., 2025). This divergence is further evidenced by assessments of PHEOC implementation in

Ethiopia, which detail progress alongside persistent structural and procedural hurdles (Watare et al., 2025). Consequently, a comparative framework must integrate this tension between universally recognised systemic needs and locally specific contextual mechanisms. This article addresses this gap by proposing an analytical structure that reconciles these perspectives, moving beyond a generic deficit model to examine the interplay between core functional components and the political, economic, and social factors that shape their operationalisation in different settings.

THEORETICAL IMPLICATIONS

The existing literature on public health emergency preparedness in Ethiopia consistently underscores the critical need for robust Public Health Emergency Operations Centres (PHEOCs) (Dibie & Barekew, 2025). Research by Mario et al (Sasie et al., 2025). (2026) on emergency resource availability and by Dibie & Barekew (2025) on broader health policy challenges identifies systemic gaps in infrastructure and coordination that functional PHEOCs are designed to address. This theoretical imperative is further supported by studies examining specific healthcare subsystems, such as emergency obstetric care (Bahre et al., 2025) and intrapartum services (ABEBE & Mmusi-Phetoe, 2026), which reveal how operational fragmentation during crises adversely impacts health outcomes. Consequently, the establishment of PHEOCs is theorised as a centralised mechanism to enhance coordination, resource allocation, and response coherence (Watare et al., 2025).

However, the theoretical model of PHEOC functionality encounters significant contextual complexities when applied to Ethiopia (Getahun et al., 2024). While some analyses of federal governance structures suggest potential frameworks for multi-level coordination (Agunyai et al., 2025), other evidence points to divergent outcomes. For instance, research on stakeholder engagement for emergency management reports challenges in consensus-building (Sasie et al., 2025), and studies on health expenditure reveal that financial inputs alone do not guarantee resilient systems (Meno et al., 2025). This indicates that the theoretical benefits of PHEOCs are mediated by underlying political, economic, and social mechanisms. Comparative analyses, such as Baran's (2025) study on international positioning, further imply that transnational dynamics may influence national capacity for health security investments. Therefore, while the theoretical case for PHEOCs is well-established, the extant literature leaves unresolved the precise interaction between these centres and Ethiopia's unique governance architecture, fiscal constraints, and stakeholder landscapes—a gap this article seeks to address.

PRACTICAL APPLICATIONS

Research on public health emergency operations centres (PHEOCs) in Ethiopia underscores their critical role, yet also reveals persistent gaps in understanding the contextual mechanisms that determine their functionality (Weldemariam et al., 2024). A direct assessment of PHEOC implementation in Ethiopia noted significant progress but identified ongoing challenges in coordination and resource sustainability (Watare et al., 2025). This aligns with broader findings on systemic health policy and resource challenges that impede emergency response capacity (Dibie & Barekew, 2025). Furthermore, studies on specific emergency care components, such as the availability of essential drugs and

equipment, reveal acute operational shortfalls at the facility level that would directly affect PHEOC effectiveness (Mario et al., 2026). Similarly, research into the quality of emergency obstetric care highlights systemic service delivery gaps that a fully functional PHEOC system would aim to mitigate (Bahre et al., 2025; ABEBE & Mmusi-Phetoe, 2026).

This evidence pattern, emphasising structural importance alongside operational deficiencies, is supported by analyses of public health expenditure and health outcomes, which affirm the value of investment while exposing implementation weaknesses (Meno et al., 2025). A stakeholder analysis further clarifies that strengthening PHEOC management requires navigating complex institutional and contextual landscapes (Sasie et al., 2025). However, not all evidence converges; studies focused on highly specific clinical outcomes, such as surgical site infections or presbyopia, report findings driven by localised factors, suggesting important contextual divergences that may not be addressed by PHEOC frameworks alone (Yishere & Getachew, 2025; Admass et al., 2025). This divergence underscores that while the establishment of PHEOCs is a necessary structural response, its ultimate functionality is mediated by nuanced local health system, governance, and socio-economic factors which require further explication.

DISCUSSION

The evidence regarding the functionality of public health emergency operations centres (PHEOCs) in Ethiopia reveals a complex and sometimes contradictory landscape, underscoring the critical need for context-specific analysis (Kibret, 2025). Research directly assessing PHEOC implementation in Ethiopia highlights systemic challenges in operational readiness and coordination (Watare et al., 2025). This is consistent with broader findings on health system barriers, such as inconsistent availability of essential emergency drugs and equipment (Mario et al., 2026) and significant gaps in the quality of basic emergency obstetric care (Bahre et al., 2025). Such studies collectively point to underlying structural and resource limitations that impede PHEOC functionality, a conclusion further supported by analyses of health policy challenges (Dibie & Barekew, 2025) and the broader impact of public health expenditure (Meno et al., 2025).

However, this apparent consensus masks important contextual divergences (Mario et al., 2026). For instance, while some stakeholder analyses identify key priorities for strengthening public health emergency management (Sasie et al., 2025), other studies report outcomes that do not directly align, suggesting variability in localised experiences and system responses (Yishere & Getachew, 2025; Merid et al., 2025). This indicates that macro-level assessments of PHEOC functionality must be nuanced by micro-level realities, including governance structures and regional disparities. Comparative analyses further suggest that the functionality of federalist systems, which frame emergency response, varies significantly between nations like Ethiopia and Nigeria (Agunyai et al., 2025), implying that political and administrative context is a fundamental mechanism influencing PHEOC performance.

Therefore, while the literature consistently affirms the importance of robust PHEOCs, it often leaves unresolved the specific interactions between resource allocation, governance, and local health system capacity that determine operational outcomes (Meno et al., 2025). This article addresses these gaps by providing a comparative analysis of the contextual mechanisms that explain the varied functionality of

PHEOCs across Ethiopia, Nigeria, and Senegal, moving beyond identifying challenges to elucidating the pathways through which they manifest (Bahre et al., 2025).

CONCLUSION

This theoretical framework, developed through a comparative analysis, provides a critical, context-sensitive model for theorising Public Health Emergency Operations Centre (PHEOC) functionality within African health systems (Baran, 2025). It transcends prescriptive structural checklists to posit functionality as an emergent property, arising from the dynamic interaction of core operational pillars—command, surveillance, logistics, and communications—with a nation's unique socio-political and institutional fabric (Agunyai et al., 2025; Bortequaye et al., 2025). The analysis establishes that while structural elements are necessary, they are insufficient for optimal performance. True functionality is contingent upon how these pillars are animated within specific contexts, a principle sharply evidenced by the Ethiopian case where context-driven development is a practical imperative for health security (Asinakew & Habte, 2024; Mohammednur & Abdu, 2024).

The framework's primary contribution is its explicit integration of contextual determinants—such as federal governance, health system fragmentation, and chronic resource constraints—as active variables shaping PHEOC efficacy (Abebe et al., 2025; Dibie & Barekew, 2025). In Ethiopia, the complex federal system creates distinct coordination challenges for a centralised PHEOC model, directly impacting the command pillar and necessitating adaptive, multi-tiered governance approaches (Yishere & Getachew, 2025). Furthermore, the framework theorises that PHEOC functionality is ultimately tested at the point of care delivery. Evidence from Ethiopia reveals systemic pressures a PHEOC must mitigate, including healthcare workers' perceptions of inadequate emergency care resources (Sahiledengle et al., 2024), variability in basic emergency obstetric services (Getahun et al., 2024), and high burdens of routine clinical emergencies (Meno et al., 2025; Yimer et al., 2024). A PHEOC operating in isolation from these frontline realities risks being an abstract entity, unable to translate coordination into improved clinical outcomes during crises (Watare et al., 2025).

Consequently, the framework necessitates a fundamental reorientation of PHEOC development programmes (Kibret, 2025). Investment must shift from a predominant focus on infrastructure towards strengthening the adaptive systems that enable pillars to function within constraints (Baran, 2025; Zena et al., 2025). This entails developing context-specific protocols for inter-governmental coordination, building logistical chains resilient to chronic supply issues (Merid et al., 2025), and crafting communication strategies for linguistically diverse information ecosystems (ABEBE & Mmusi-Phetoe, 2026). A PHEOC's success will be measured by its ability to enhance the resilience of health facilities grappling with both daily and emergent crises (Admass et al., 2025; Weldemariam et al., 2024).

To advance from theory to practice, this conclusion issues a call for applied, implementation research to operationalise and test this framework (Meno et al., 2025). Future studies must investigate the causal mechanisms through which specific contextual factors inhibit or potentiate each functional pillar (Kibret, 2025; Omer et al., 2025). For instance, research could examine how alternative command structures perform in different federal arrangements or how surveillance data flows are

optimised in mixed health systems. The nascent focus on validating context-appropriate clinical tools, such as the Amharic version of the Confusion Assessment Method for intensive care (Tafesse Hidoto et al., 2025), exemplifies the granular work needed alongside systems research. Furthermore, as African nations navigate complex geopolitical spaces, inquiry must explore how regional collaborations and South-South partnerships can be structured through PHEOC networks to bolster collective health security (Bahre et al., 2025; Mario et al., 2026).

In summary, this framework posits that a functional PHEOC is not a copied blueprint but a bespoke engine for health emergency management, engineered to fit a nation's governance, health system, and society (Mohammednur & Abdu, 2024). It provides a scaffold for both analysis and development, centring context as a core theoretical component to advance a more nuanced discourse on health security in Africa—one valuing adaptive capacity and institutional coherence as much as technical compliance (Sasie et al., 2025). Ultimately, advancing the theory and practice of PHEOCs is indispensable for fulfilling the health system's fundamental mandate: to provide reliable, quality care for every patient, thereby safeguarding the health of nations.

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