Original Article/Research

Innovative dashboard for optimising emergency obstetric care geographical accessibility in Nigeria: Qualitative study with technocrats

Aduragbemi Banke-Thomas [a,b,c,*], Ibukun-Oluwa Omolade Abejirinde [d,e], Olakunmi Ogunyemi [f], Uchenna Gwacham-Anisiobi [g]

[a] School of Human Sciences, University of Greenwich, London, United Kingdom
[b] Maternal and Reproductive Health Research Collective, Lagos, Nigeria
[c] Faculty of Epidemiology and Public health, London School of Hygiene & Tropical Medicine, London, United Kingdom
[d] Women's College Hospital Institute for Health System Solutions and Virtual Care, Toronto, Canada
[e] Dalla Lana School of Public Health, University of Toronto, Canada
[f] Department of Obstetrics and Gynaecology, College of Medicine of the University of Lagos, Lagos, Nigeria
[g] Nuffield Department of Population Health, University of Oxford, Oxford, United Kingdom

ARTICLE INFO

ABSTRACT

Objective: To explore perspectives of public sector technocrats on the role of and considerations needed for implementing an innovative dashboard that leverages geographic information systems (GIS) in supporting optimisation of emergency obstetric care (EmOC) geographical accessibility in Nigeria.

Methods: Twenty-three semi-structured interviews were conducted in person or virtually with six policymakers and 17 senior civil servants in Nigeria. Braun and Clarke's six-step approach to thematic analysis, which involved data familiarisation, initial code generation, searching for themes, reviewing themes, defining themes, and producing the report, was applied.

Results: Despite recognising the ideal of data-driven needs assessment, in reality, factors such as political pressure, persistent community advocacy, and donor funding drive decisions on siting EmOC facilities. Irregular short-term political cycles and exigencies in health systems prevent new facilities from being established or motivate a focus on facility quality over quantity. There was a strong appetite for using GIS-enabled dashboards to support planning, with enthusiasm for such technology more apparent where innovation was already part of government's philosophy. A digital dashboard that is dynamic, reflective of reality, inclusive of public and private providers, incorporates facility characteristics, and can test accessibility scenarios, was deemed particularly valuable. Its value proposition extended beyond EmOC and provider type. However, its success as a policy tool will depend on the veracity and currency of the data informing it.

Conclusions: Technocrats welcome dynamic GIS-enabled dashboards as it offers a significant step-change compared to the current practice for EmOC service planning. Value-for-money of such innovations must be considered if implemented.

Public Interest Summary: Planning and siting of emergency services used by pregnant women (EmOC) in many low-resource countries are mostly haphazard. However, there is increasing recognition that technology can refine this process. In this study, we explored perspectives of public sector technocrats in Nigeria on the role of and considerations needed for implementing an innovative digital dashboard that leverages geographic information systems in optimising EmOC geographical accessibility. We found that current planning is mainly driven by political pressure, community advocacy, and donor funding. However, there is a strong appetite in government for using GIS-enabled dashboards to inform service planning, with enthusiasm for such technology appearing to be more grounded in states where innovation was already part of the government's philosophy. Yet, concerns about data accuracy were expressed. Broadly, dashboards that are dynamic, reflective of reality, inclusive of public and private providers, incorporate facility characteristics, and can test access scenarios, were deemed particularly valuable.

---

* Corresponding author at: School of Human Sciences, University of Greenwich, Old Royal Naval College, Park Row, London, SE10 9LS, United Kingdom
 E-mail address: a.bankethomas@gre.ac.uk (A. Banke-Thomas).

Introduction

Universal health coverage (UHC), which aims to guarantee access to crucial promotive, preventive, curative, and rehabilitative health interventions for all at an affordable cost, is a key component in achieving Sustainable Development Goal 3 [1,2]. While there has been a global emphasis on UHC regarding access to promotive and preventive care [3,4], the 72nd World Health Assembly highlighted the need to guarantee universal coverage for emergency care if UHC is to be achieved [5]. This refocusing was logical as 50% of global mortality and over 40% of all disability-adjusted life years (DALYs) results from emergency conditions. A higher proportion (approximately 70%) of DALYs are lost to emergency conditions in low and middle-income countries (LMICs) like Nigeria [6]. For emergencies following complications in pregnancy and childbirth, access to emergency obstetric care (EmOC) has been shown to reduce intra-facility maternal deaths by 15–50% and intrapartum stillbirths by 45–75% [7].

While UHC initiatives, including removal of user fees and service and population coverage expansion schemes, are routinely implemented in LMICs [8], there is clear recognition that geographical barriers limit access to emergency services and ultimately deter the realisation of UHC [9,10]. This has considerable implications in terms of health outcomes. For example, delays in reaching comprehensive EmOC facilities significantly affect maternal and neonatal outcomes [11,12]. Indeed, access to emergency care is a fundamental human right for people, and governments have an ethical obligation to guarantee access for their entire population [13]. There is some indication of government commitment to strategically locating EmOC facilities. However, siting these facilities in many LMICs remains mostly haphazard [14,15].

To support service planning towards realising equitable geographical distribution of EmOC in many LMICs, researchers mainly use reported and modelled approaches to assess geographical accessibility [16]. However, evidence generated from both approaches has limitations in their capacity to support policymaking. Studies that use reported approaches which involve requiring service users or health workers to estimate the travel time to care are usually small-scale, and estimates are based on conjecture and influenced by recall bias [16]. On the other hand, modelled approaches, which for the most part are large-scale, do not reflect the reality of travel, including traffic, terrain, and weather conditions [17,18]. Ignoring variability in traffic conditions results in as much as a three-fold overestimation of geographic accessibility [19]. In addition, almost all studies using modelled approaches estimate travel time to the nearest health facility to reflect geographical accessibility, despite the widely recognised fact that for different reasons, many pregnant women, even in an emergency, bypass the nearest health facility [16,20].

There is clear recognition that digital technology based on geographic information systems (GIS) has a significant role to play in healthcare planning and siting [21–25]. In recent times, there has been a call to action towards a 'GIS utopia' for maternal health services, where systems built on better data for better analytics will be available to support policymaking [22]. Integration of navigation-based software such as Google Maps and Waze, which have been shown to offer closer-to-reality travel time estimates, in digital dashboards designed for service planning provides a new opportunity to get the field closer to this utopia [18,26]. However, before this is done, it is essential to gather user requirements at the point of developing such solutions [27]. Building on a newly proposed digital technology based on GIS which is to be presented in a dashboard [28], we set out to explore perspectives of technocrats involved in EmOC service planning on the role of and considerations needed for implementing an innovative dashboard that leverages GIS in supporting optimisation of EmOC geographical accessibility in Nigeria.

Methods

Study design

This qualitative study was conducted using semi-structured key informant interviews (KIIs) with individuals responsible for service planning, including EmOC, at the federal and state levels of governance in Nigeria. The study was reported using the Consolidated criteria for Reporting Qualitative Research (COREQ) checklist [29].

Study setting

Nigeria, a sub-Saharan African country in West Africa with six geopolitical zones (North Central, North-East, North-West, South-East, South-South, South-West), has 36 states and the Federal Capital Territory, Abuja. Health care in Nigeria is delivered in a three-tiered system (primary, secondary, and tertiary) with an expectation that all emergencies will be handled in secondary and tertiary health facilities. Across these three tiers, there are a range of public and private service providers. However, Nigeria has one of the world's lowest emergency services utilisation rates at 0.7 per 1000 population [30]. Outcomes of care following emergency care are also poor, with mortality as high as 8% recorded amongst patients who arrived at a hospital [31]. At 67,000, Nigeria contributes the highest number of maternal deaths annually [32]. Challenges in geographical accessibility of emergency care have been flagged as a priority issue by stakeholders in the country [20,33]. This qualitative study was conducted within the context of a proposed digital intervention led by the OnTIME Consortium to support decision-making of policymakers relating to EmOC service planning [28],

Recruitment of interviewees

Interviewees for the study were public sector technocrats, who were either policymakers serving in government or senior civil servants. Identification of eligible officials was informed by discussions with colleagues from the Nigerian caucus of the West African Network of Emerging Leaders in Research, many of whom have long-standing relationships with policymakers in the country. Potential interviewees were contacted via email to participate in the study. Policymakers who agreed then recommended civil servants involved in health service planning that could be contacted for interview. Recruitment was purposive to ensure geographical spread and that a diversity of opinions was captured.

Ethical considerations

Ethical approval was obtained from the National Health Research and Ethics Committee (NHREC/01/01/2007–11/04/2022) in Nigeria and the University of Greenwich Research and Ethics Committee (UREC/21.4.7.8). Participation was voluntary, and recruitment to the study was only done after informed consent had been obtained from interviewees, with privacy and confidentiality guaranteed. Anonymity of interviewees was preserved through data collection and analysis.

Data collection

KIIs were conducted in the interviewee's office or remotely via Microsoft Teams (Microsoft Corporation, Redmond, Washington, United States), whichever was deemed most convenient for the interviewee. Interviews were conducted using a pre-tested topic guide which included open questions exploring their role and experience as it relates to geographical access to emergency health services in Nigeria, insights as to how planning and decision-making on location of EmOC services are conducted in their jurisdiction (state or national), the role of digital technology in EmOC service planning, and factors that need to be

considered for implementation and integration of digital technology leveraging GIS in EmOC service planning (See Supplementary file 1 for topic guide). The discussion on the role of digital technology in EmOC service planning was guided by possibilities described in previous research using Google Maps to identify travel hotspots to care in Nigeria [26]. KIIs were held in English language by the principal investigator (AB-T) and audio-recorded. During the interviews, AB-T's understanding of the key informants' answers was repeated back to them to verify that their intended meaning was accurately captured (confirmability). Data collection commenced in April 2022 and continued until August 2022.

Data analysis

All audio recordings were transcribed verbatim by OO, with the resulting transcripts reviewed for accuracy by AB-T. Braun and Clarke's six-step approach involving data familiarisation, initial code generation, searching for themes, reviewing themes, defining themes, and producing the report-guided analysis and writing was applied [34]. IOA, U-GA and AB-T reviewed all transcripts independently and met regularly to compare categories, define codes, discuss interesting points of convergence and divergence of views, and contextualise findings.

Results

We conducted KIIs with 23 technocrats, including six policymakers and 17 senior civil servants. Our sample included 20 technocrats at the state level and three at the federal level, who were from five of the six geo-political zones in Nigeria. Specifically, interviewees were from seven states: Akwa Ibom, Anambra, Edo, Kebbi, Lagos, Oyo, Plateau, and the Federal Capital Territory. Duration of KIIs ranged from 32 to 60 min (average: 48 min) [Table 1].

Findings are presented below under three main themes and several distinct subthemes related to each theme Table 2.

Theme 1: The ideal and reality of decision-making in efforts to address EmOC geographical accessibility

Though interviewees recognised the ideal expectations, they submitted that several factors, institutions, and contextual forces were involved in EmOC service planning.

The ideal for siting EmOC facilities

Stakeholders at both federal and state levels, irrespective of their positions, described what they considered an ideal scenario for determining where a health facility was situated - one that is based on an established need at the community level and informed by data. Data for decision-making most referenced by technocrats included unmet needs for specific health services, poor maternal or newborn outcomes linked to unmet EmOC needs or inadequate access to care. Though desirable, these types of data were mostly unavailable to policymakers in formats that were regular, reliable, and actionable.

> *"I have a proposal before me on where to site a Maternal and Child Care facility… to use our map to see where there is a paucity. If we have this type of data, it will make the job in terms of talking to the government on where to put our money [easier]."* (Policymaker, South-South)

While a data-driven needs assessment was generally recognized as central to health service organizations, a few respondents emphasized that such assessments ideally needed to go beyond health data on unmet needs and mortality rates. This included infrastructural assessments such as terrain and road networks, water, and electricity. Such a holistic approach would ensure that newly situated facilities are genuinely functional and do not become *"investment sinkholes"*.

Table 1

Distribution and characteristics of key informants.

S/No	Stakeholder jurisdiction	State	Geopolitical zone	Position/role
P1	State	Lagos	Southwest	Policymaker
P2	State	Lagos	Southwest	Policymaker
P3	State	Lagos	Southwest	Senior civil servant
P4	State	Lagos	Southwest	Policymaker
P5	State	Anambra	Southeast	Senior civil servant
P6	State	Anambra	Southeast	Policymaker
P7	State	Oyo	Southwest	Senior civil servant
P8	State	Edo	South-South	Senior civil servant
P9	State	Edo	South-South	Senior civil servant
P10	Federal	Federal Capital Territory	Federal	Senior civil servant
P11	Federal	Federal Capital Territory	Federal	Policymaker
P12	Federal	Federal Capital Territory	Federal	Policymaker
P13	State	Akwa Ibom	South-South	Senior civil servant
P14	State	Akwa Ibom	South-South	Senior civil servant
P15	State	Akwa Ibom	South-South	Senior civil servant
P16	State	Akwa Ibom	South-South	Senior civil servant
P17	State	Akwa Ibom	South-South	Senior civil servant
P18	State	Plateau	Northcentral	Senior civil servant
P19	State	Kebbi state	Northwest	Senior civil servant
P20	State	Kebbi state	Northwest	Senior civil servant
P21	State	Kebbi state	Northwest	Senior civil servant
P22	State	Kebbi state	Northwest	Senior civil servant
P23	State	Kebbi state	Northwest	Senior civil servant

Footnote: In this study we distinguished two sets of technocrats: policymakers (those that have the mandate to make decisions and enact legislation) and senior civil servants (those that implement legislation on-the-ground and can influence decision-making). In terms of the specific roles that stakeholders occupied, these included Honourable Commissioners for Health, Special Adviser on Health, Permanent Secretaries of Ministries of Health, Directors of Planning, Research and Statistics, Directors of Medical Services, Director of Budget and Planning, Maternal and Reproductive Health Coordinators, and Monitoring and Evaluation Officers of the Ministry of Health.

Table 2

Themes and subthemes.

Theme	Subtheme
The ideal and reality of decision-making in efforts to address EmOC geographical accessibility	• The ideal for siting EmOC facilities • Factors influencing EmOC service planning and siting
Current climate and potential role of technology in planning location of EmOC facilities	• Current climate for technology-driven health service planning • Technology readiness • Potential role of a data-driven dashboard in siting of health facilities
Considerations for adopting technology to support health service planning	• Stakeholders' value propositions and opportunities of an EmOC geographical accessibility dashboard • Risks • Approach to implementation

Factors influencing EmOC service planning and siting

While all respondents communicated similar ideals for health facility siting, there was an acknowledgement that other factors mostly influenced how and where new facilities are located. These include persistent community advocacy, political pressure, and timely opportunities such as large donor funding.

"It is a bit complex. Generally, I will tell you that most times, siting health facility is not based on evidence but political patronage and pressure." (Senior civil servant, Federal Level)

"Unfortunately, that [needs assessment] is never really done. It looks as if decisions are made based on political considerations and say: 'Oh, I want to build a hospital in this local government', irrespective of the fact that there's another facility in that local government." (Senior civil servant, South-South)

Political realities also mean that despite intentions to improve EmOC coverage, the government is not able to construct facilities. Indeed, rapid political cycles and leadership turnaround do not allow new ideas to take root for implementation.

"I am aware that the present governor is working on improving EmOC coverage… Previously, I had the opportunity to serve as Commissioner of Health in [redacted state] many years back under [redacted name], and that was one of the strategies. However, the government didn't have stability, so we were only able to cover a few LGAs with some general hospitals." (Senior civil servant, Federal level)

Some interviewees added that due to other exigencies in the health system and the numerous ongoing challenges being faced by the existing health facilities, governance priorities are channelled towards strengthening the current quality-of-service provision rather than establishing new facilities.

"…at this moment, we haven't really had need to go and put down new facilities … but we have taken adequate steps to ensure that the facilities that we have are in shape to render services to women. That's why several of our facilities have been renovated…" (Policymaker, South-South)

For those who established new health facilities, its location was also informed by the number of public health facilities already available and accessible to the population., This consideration was deemed an important one because it is more likely that public facilities are part of UHC schemes in the country compared to private ones, which will then ensure access to care when needed. In addition, some states depend on feedback received during community outreaches or on observations made during general health service mapping activities that focus on hard-to-reach areas.

"…cost of care will always be a determining factor [for planning], especially in our environment where there's no universal health coverage." (Senior civil servant, South-South)

"We discovered some communities that do not have health care services at their door post, so we came up with erecting structures and deploying some of our staff to go and serve there…" (Senior civil servant, North Central)

Theme 2: current climate and potential role of technology in planning location of EmOC facilities

Stakeholders shared their views on the current and potential role of technology in their decisions in planning the location of EmOC facilities.

Current climate for technology-driven health service planning

At the federal level, there appeared to be significant interest in exploring the potential of technology in guiding health users to specific service-ready facilities that offer the services they desire. Similarly, at the State level, most interviewees acknowledged the potential of technology, specifically when reliant on real-time GIS data, to improve the efficiency and precision of health service planning.

"I mentioned that we were already thinking about the need to have Google Maps on the health management information systems platform so that at the click of a button, if I want to go to centres where they provide certain services, I can easily know that in this place I can get this…" (Senior civil servant, Federal level)

"…we would need a little bit of technology to not only refine our strategy [for addressing EmOC accessibility] as we build more… it will become more of a science and a robust process where you now start looking at traffic movement, access, distribution of human resources, the particular location, those kinds of things." (Policymaker, South-West)

Technology readiness

In states where the broad government philosophy tilted towards a transition into technology-supported governance, there appeared to be a greater sense of readiness to adopt new technology for health service planning. In some settings, stakeholders welcomed the idea of layering-on GIS data to their existing data systems but expressed concern about varying degrees of challenges that characterized previous attempts. The introduction of electronic medical records offered great benefits vis-à-vis improved efficiency, transparency, and accountability in the system. However, this is yet to record success at scale.

"Yeah! Obviously, everything is digital in [redacted] state, …we're moving digital. [We want to start what we call a] Health facility monitoring and accreditation agency, and one of the things it has to do is that we want to bring all the hospitals [in one database linked to Google Maps] … this is what we are planning." (Policymaker, South-East)

"As we speak, we have an electronic health record system that was bedevilled with several challenges… Unfortunately, in our primary health centres, there is a strong incentive not to allow technology to work because if it works, it will expose a lot of things… So, we have been able to make technology work for education, but despite our best efforts, technology is not working for healthcare." (Policymaker, South-South)

Potential role of a data-driven dashboard in siting of health facilities

When presented with the scenario of a data-driven electronic dashboard which could be used to inform decision-making, all participants affirmed the invaluable role of data and its potential to strengthen advocacy and secure buy-in with relevant stakeholders, especially those outside the health sector.

"Data is supposed to drive every decision… What should inform the siting of health facilities should be figures, data, and facts like this… I think this is excellent, and it is a thing that, if done well, can go to the National Council on health and then the relevant state government will be in a better position for evidence to influence how they spend the money in their health sector." (Senior civil servant, Federal level)

"It will really provide evidence to push for government at the federal and state levels to know the best places to site facilities… So, I feel that this has the potential to provide the much-needed guide, and if it is strongly communicated to the government in a way they will understand, there will be a strong buy-in". (Senior civil servant, Federal level)

"But you know the additional thing that this [proposed dashboard] does is that it is something I can use to advocate to the Commissioner for transport – you know what, the potholes in this area it's not just causing traffic, it is costing lives of women and babies…" (Policymaker, South-West)

Interviewees described the possibility of integrating the dashboard with data sources like the District Health Information System, Maternal Perinatal Death Surveillance and Response, and health facility registries. They shared that, though these sources had varying levels of reliability and completeness, an analytic dashboard could build on them to provide

broader insights that will aid service planning and provision.

> *"Some of the data we generate now can be linked to the location data to give us more insight for planning and provision of services…"* (Senior civil servant, Federal level)

Theme 3: considerations for adopting technology to support health service planning

With a view of findings from this study informing the development of a technological solution that translates GIS data from Google Maps into actionable analytic insights in formats that could inform policymakers' decisions on health facility siting for obstetric emergencies, interviews sought to identify the potential value of such a solution and the necessary considerations that need to be factored into its design and implementation.

Stakeholders' value propositions and opportunities of an EmOC geographical accessibility dashboard

Beyond planning EmOC services, the proposed dashboard will be useful for real-time mapping of healthcare access for other emergency services and for strengthening the referral system.

> *"…So, for me, I would say this dashboard is for strengthening referral system to link PHCs [primary health centres] to secondary facilities."* (Senior civil servant, Federal level)

> *"This dashboard could assist the Ministry to monitor other emergency services in our facilities. If we can have that, we will minimize a lot of problems."* (Senior civil servant, North-West)

One interviewee highlighted that the dashboard could also serve as a *"guide"* for potential private sector investors or mission agencies seeking to set up new facilities. It could also inform a rationale for new health interventions by identifying areas with the greatest need for the proposed services.

> *"I think this [dashboard] may be useful to guide the location of private facilities… For instance, if [redacted private hospital name] wants to have an annex facility, the dashboard can provide them with where the needs are most and then they can be guided to contribute to the supply side …. There are also some mission universities now, and some have the approval to train doctors so if they have the guide as to the best place where they can situate their hospitals, and this will be helpful to them and to the government."* (Senior civil servant, Federal level)

Many interviewees submitted that the proposed dashboard presents a unique opportunity for real-time quality assessment of health facilities by healthcare users at a state-wide level. In elaborating on this point, a few respondents compared the proposed dashboard to platforms such as *"Expedia"*, which enables users to rate the quality of services and provide feedback on the services received. This quality rating could serve as motivation for health providers and an incentive for potential care users.

> *"There's a need for this project which definitely will help with the mapping of health facilities, to go beyond that maybe up on a phone or an app or something which someone will easily be able to access the care that they need."* (Senior civil servant, South-South)

Risks

The most significant risk participants expressed concern about was the *"veracity"* and *"currency"* of the data informing the dashboard, so that governments are not planning with certain facilities, but when women arrive there in an emergency, they realise that either the facility or the health service they desire is not available. Interviewees stated that for the platform to be effective, there is a need to frequently update the information provided to avoid misdirecting health service users and inadvertently causing harm.

> *"Private practices rarely own the buildings they operate in. They are usually rented real estate, so their geographical location can change easily. You may come back next year and find out that the mapping has changed, so when the patient arrives at the destination and not find a hospital, they will blame it on [the project]."* (Policymaker, South-South)

> *"The veracity of the information you put [on the dashboard], and the currency of it, not that this hospital used to be here and it's not there…"* (Policymaker, South-West)

Approach to implementation

One participant suggested that a phased approach to deploying this technology would be more valuable compared to a national roll-out scenario. This is to account for variability in capacity and readiness at the State level and to give researchers the flexibility to course-correct during piloting, scale and spread.

> *"Looking at it now, we are trying to develop a dashboard, but it should be in phases. The first thing we should consider is how it will be used. We should also know that state's capacity when it comes to funding as they are not all at the same level."* (Senior civil servant, Federal level)

Stakeholders talked about a need for strong public-private partnerships for EmOC planning and multisectoral collaborations to support the dashboard's success. Agencies responsible for transportation, communication, technology as well as health need to be a part of the concept design, implementation, and management.

> *"I also feel at one time or the other, there might be a need to relate with the stakeholders who work on transportation like NURTW [National Union of Road Transport Workers] and others to ensure that they are able to transport pregnant women in an emergency to health services. (…) I think this should be multisectoral, so the Ministry of Communications should be involved as there is a need to improve communication…"* (Senior civil servant, Federal level)

> *"There have to be collaborations with private and public sector… We must have a minimum standard of care that is expected of any facility."* (Policymaker, South-South)

Discussion

Our objective in this study was to explore perspectives of Nigerian technocrats on the role of and considerations needed for implementing an innovative digital technology that leverages GIS in supporting EmOC service planning in Nigeria. Despite recognising the 'ideal', policymakers and senior civil servants in this study highlighted that as per the current approach, the choice of where to situate health facilities is for the most part based on political pressure, persistent community advocacy, and timely opportunities. This undermines previous descriptions by policymakers that they *"strategically place"* EmOC facilities as part of their planning efforts [14] and highlights a minimal use of GIS evidence to support the decision-making process for siting health facilities in countries like Nigeria [16,35]. In instances where GIS has been used in sub-Saharan Africa, it has been mostly used to identify gaps in the availability and geographic accessibility of health facilities with capacity for maternal health services, including EmOC. However, several authors have flagged challenges of unrealistic assumptions used for geospatial models and a scarcity of reliable, up-to-date, large-scale georeferenced data [16,35]. In our study, stakeholders noted that political instability, leadership turnaround, and health system exigencies requiring refocusing of priorities impede the use of GIS evidence even if these were available and optimal for use.

We found a strong appetite for digital technology leveraging GIS to support EmOC service planning amongst policy stakeholders. This was

contrary to the *"limited policy buy-in by stakeholders"* reported by Ibe-neme et al. in their commentary, which discussed an approach to strengthening African health systems using innovative digital health technologies [24]. It appears the issue that stakeholders have is not with the technology itself but the approach in which it is implemented – vertical, dated, and siloed versus horizontal, current, and interoperable. In our study, stakeholders demonstrated a very clear recognition of the value and potential of digital technology in supporting evidence-based decision-making.

As per our findings, it was clear that to maximise value to policy-makers, a digital initiative to support EmOC service planning needs to be dynamic, reflective of reality, inclusive of public and private providers, incorporate facility functionality characteristics, and have the ability to test diverse accessibility scenarios. These features are embedded in the current efforts of the OnTIME project. However, cost and sustainability challenges need to be considered in implementing some of these features [28]. A consensus point emerging from our study though is that poli-cymakers will benefit substantially from a tool with all the desired characteristics. Being reflective of reality also means that it points out health facilities that are actually used by pregnant women in emergen-cies. Other researchers have noted that proximity to a hospital does not guarantee access to emergency care since many facilities in LMICs lack the trained staff and resources necessary to deliver good-quality emer-gency care [36]. Identification of areas of geographical inequities of functional EmOC facilities builds on work that has been done previously, which was underpinned by closer-to-reality estimates of travel time to EmOC facilities [26]. Also, consideration relating to actual health fa-cility functionality to provide much-needed care was deemed particu-larly crucial. Evidence shows that there is an infrastructure gap in emergency service functionality in sub-Saharan Africa, with only about 20 to 50% of hospitals able to provide 24-hour emergency care [37]. This is an even more critical consideration if private health facilities are to be included in the digital tool. Indeed, the capacity of LMIC private health facilities to provide EmOC is heterogenous, even in the cities [38, 39].

The other key consideration identified by key informants is an op-portunity to integrate or combine data from multiple sources into any such digital technology that leverages GIS for planning. To achieve this incorporation of other vital data points, any digital technology will need to be linked with other databases. This also feeds into the interopera-bility recommendation that has been suggested for digital public health initiatives to strengthen health systems in sub-Saharan Africa [24]. Ul-timately, such interconnectedness of GIS platforms will extend their use and make them more robust for identification of inequalities in maternal and neonatal morbidity, mortality, and healthcare utilisation [35]. As interviewees alluded to, the value position of such an innovation goes beyond EmOC only, as the same platform can support the planning and positioning of health facilities for treating other emergency medical and surgical conditions and assessing the current distribution of health fa-cilities to identify any mismatch with population needs [40].

A key strength of this study is that it incorporates perspectives from policymakers and senior civil servants who are the street-level bureau-crats responsible for enacting and implementing policies. Their views are particularly important as they tend to transcend term-limited po-litical cycles. One limitation of note is that it was the policymakers whom we first engaged who identified civil servants who were engaged for this study. As such, the included senior civil servants consented to participate in interviews only after express permission from the poli-cymakers. This may have diminished the voluntary nature of their participation and the extent to which they provided responses. Another limitation is that we included participants from only five of the six geo-political zones in Nigeria. This was mostly because of security issues and a lack of accessible contacts in the North-East zone.

In conclusion, as countries ramp up efforts to cogently address issues of access inequities in line with the Sustainable Development Goals, findings from our study suggest that there is an appetite for digital technology leveraging GIS that is dynamic, offers more realistic esti-mates, includes public and private providers, incorporates individual facility characteristics and other baseline population features, and has the ability to test scenarios. Such an innovation offers a significant step-change compared to the current practice for EmOC service planning. If implemented, it can take the field closer towards the much-desired *'GIS utopia'* and contribute to improving EmOC accessibility for pregnant women. The value for money of such innovations needs to be considered if implemented.

Funding

Ethical approval

Ethical approval was obtained from the National Health Research and Ethics Committee (NHREC/01/01/2007–11/04/2022) and the University of Greenwich Research and Ethics Committee (UREC/ 21.4.7.8).

CRediT authorship contribution statement

AB-T and I-OA conceptualised the study. AB-T conducted the liter-ature review that informed the study and all the interviews with the key informants. OO and UG-A led the transcription of the recordings emanating from interviews. AB-T, UG-A, and I-OA conducted the data coding and theme development. AB-T and I-OA prepared the first draft of the manuscript. All authors were involved in the preparation of subsequent drafts. All authors approved the final version.

Acknowledgements

Declaration of Competing Interest

None declared

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.hlpt.2023.100756.

References

[1] United Nations. Sustainable development goals: 17 goals to transform our world [Internet]. Sustain Dev Goals. 2016 [cited 2020 Oct 12]. Available from: http://www.un.org/sustainabledevelopment/sustainable-development-goals/.

[2] Acharya S, Lin V, Dhingra N. The role of health in achieving the sustainable development goals. Bull World Health Organ 2018;96(9):591.

[3] Sacks E, Schleiff M, Were M, Chowdhury AM, Perry HB. Communities, universal health coverage and primary health care. Bull World Health Organ 2020;98(11): 780.

[4] McKee M, Balabanova D, Basu S, Ricciardi W, Stuckler D. Universal health coverage: a quest for all countries but under threat in some. Value in Health 2013; 16(1):S39–45.

[5] World Health Assembly. Emergency care systems for universal health coverage: ensuring timely care for the acutely ill and injured [Internet]. Seventy-second world health assembly. Geneva, Switzerland: World Health Organization; 2019. p. 1–5. Available from: https://apps.who.int/gb/ebwha/pdf_files/WHA72/A72_R 16-en.pdf.

[6] Razzak J, Usmani MF, Bhutta ZA. Global, regional and national burden of emergency medical diseases using specific emergency disease indicators: analysis of the 2015 global burden of disease study. BMJ Glob Health 2019;4(2):e000733.

[7] Paxton A, Maine D, Freedman L. The evidence for emergency obstetric care. Int J Gynaecol Obstetrics 2005;88:181–93.

[8] Sachs JD. Achieving universal health coverage in low-income settings. Lancet 2012;380(9845):944–7.

[9] Falchetta G, Hammad AT, Shayegh S. Planning universal accessibility to public health care in sub-Saharan Africa. Proc Natl Acad Sci U S A 2020;117(50):31760–9.

[10] Garchitorena A, Ihantamalala FA, Révillion C, Cordier LF, Randriamihaja M, Razafinjato B, et al. Geographic barriers to achieving universal health coverage: evidence from rural Madagascar. Health Policy Plan 2021 Nov 11;36(10):1659–70.

[11] Banke-Thomas A, on Avoka CK, Gwacham-Anisiobi U, Benova L. Influence of travel time and distance to the hospital of care on stillbirths: a retrospective facility-based cross-sectional study in Lagos, Nigeria. BMJ Glob Health 2021;6(10):e007052.

[12] Banke-Thomas A, on Avoka CK, Gwacham-Anisiobi U, Omololu O, Balogun M, Wright K, et al. Travel of pregnant women in emergency situations to hospital and maternal mortality in Lagos, Nigeria: a retrospective cohort study. BMJ Glob Health 2022 Apr 1;7(4):e008604.

[13] Office of the United Nations High Commissioner for Human Rights. CESCR general comment no. 14: the right to the highest attainable standard of health (Art. 12). in: twenty-second session of the committee on economic, social and cultural rights [Internet]. Geneva, Switzerland: United Nations; 2000. p. 1–21. Available from: https://www.refworld.org/pdfid/4538838d0.pdf.

[14] Banke-Thomas A, Wright K, Sonoiki O, Ilozumba O, Ajayi B, Okikiolu O, et al. Multi-stakeholder perspectives on access, availability and utilization of emergency obstetric care services in Lagos, Nigeria: a mixed-methods study. J Public Health Afr 2017;8(2):717.

[15] Calvello EJB, Tenner AG, Broccoli MC, Skog AP, Muck AE, Tupesis JP, et al. Operationalising emergency care delivery in sub-Saharan Africa: consensus-based recommendations for healthcare facilities. Emerg Med J 2016;33(8):573–80.

[16] Banke-Thomas A, Wright K, Collins L. Assessing geographical distribution and accessibility of emergency obstetric care in sub-Saharan Africa: a systematic review. J Glob Health 2019;9(1):010414.

[17] Ouma P, Macharia PM, Okiro E, Alegana V, Ouma P, Macharia PM, et al. Methods of Measuring Spatial Accessibility to Health Care in Uganda. editor. In: Makanga PT, editor. Practicing health geography global perspectives on health geography. Cham: Springer; 2021. p. 77–90.

[18] Banke-Thomas A, Wong KLM, Ayomoh FI, Giwa-Ayedun RO, Benova L. In cities, it's not far, but it takes long": comparing estimated and replicated travel times to reach life-saving obstetric care in Lagos, Nigeria. BMJ Glob Health [Internet] 2021;6(1) [cited 2021 Jan 26]e004318. Available from: https://gh.bmj.com/lookup/doi/10.1136/bmjgh-2020-004318.

[19] Ahmed S, Adams AM, Islam R, Hasan SM, Panciera R. Impact of traffic variability on geographic accessibility to 24/7 emergency healthcare for the urban poor: a GIS study in Dhaka, Bangladesh. Wilson FA. editor PLoS ONE 2019;14(9):e0222488.

[20] Banke-Thomas A, Balogun M, Wright O, Ajayi A, Abejirinde IOO, Olaniran A, et al. Reaching health facilities in situations of emergency: qualitative study capturing experiences of pregnant women in Africa's largest megacity. Reprod Health 2020;17(1):145.

[21] Thimbleby H. Technology and the future of healthcare. J Public Health Res 2013;2(3):e28.

[22] Matthews Z, Rawlins B, Duong J, Molla YB, Moran AC, Singh K, et al. Geospatial analysis for reproductive, maternal, newborn, child and adolescent health: gaps and opportunities. BMJ Glob Health 2019;4(Suppl 5):e001702.

[23] Boulos MNK, Rocha A, Martins A, Vicente ME, Bolz A, Feld R, et al. CAALYX: a new generation of location-based services in healthcare. Int J Health Geogr 2007;6:9.

[24] Ibeneme S, Karamagi H, Muneene D, Goswami K, Chisaka N, Okeibunor J. Strengthening Health Systems Using Innovative Digital Health Technologies in Africa. Front Digit Health 2022;4:854339.

[25] Novillo-Ortiz D, de Fátima Marin H, Saigí-Rubió F. The role of digital health in supporting the achievement of the sustainable development goals (SDGs). Int J Med Inform 2018;114:106–7.

[26] Banke-Thomas A, Wong KLM, Collins L, Olaniran A, Balogun M, Wright O, et al. An assessment of geographical access and factors influencing travel time to emergency obstetric care in the urban state of Lagos, Nigeria. Health Policy Plan 2021;36(9):1384–96.

[27] Salgado M, Nogueira P, Torres A, Oliveira MD. Setting requirements for a dashboard to inform Portuguese decision-makers about environment health in an urban setting. Front Public Health 2022;10:1723.

[28] Banke-Thomas A, Macharia PM, Makanga PT, Beňová L, Wong KLM, Gwacham-Anisiobi U, et al. Leveraging big data for improving the estimation of close to reality travel time to obstetric emergency services in urban low- and middle-income settings. Front Public Health 2022;10:931401.

[29] Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. Int J Quality in Health Care 2007;19(6):349–57.

[30] Chang CY, Abujaber S, Reynolds TA, Camargo CA, Obermeyer Z. Burden of emergency conditions and emergency care utilization: new estimates from 40 countries. Emerg Med J 2016;33(11):800.

[31] Olusegun-Joseph AD, Akande O, Otrofanowei E, Nwoye EO, Olopade OB, Ajuluchukwu JN. Medical mortality in an emergency department in Nigeria: the transition is obvious! Afr Health Sci 2021;21(1):179.

[32] WHO, UNICEF, UNFPA, World Bank Group, UNDP. Trends in maternal mortality 2000 to 2017: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations population division [Internet]. Geneva: World Health Organization; 2019. 1–119 p. Available from: https://www.unfpa.org/sites/default/files/pub-pdf/Maternal_mortality_report.pdf.

[33] Usoro A, Aiwonodagbon B, Strong J, Kivlehan S, Akodu BA, Olufadeji A. Perspectives on the current state of Nigeria's emergency care system among participants of an emergency medicine symposium: a qualitative appraisal. BMJ Open 2021;11(8):e043869.

[34] Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol 2006;3(2):77–101.

[35] Alemu SM, Tura AK, do Amaral GSG, Moughalian C, Weitkamp G, Stekelenburg J, et al. How applicable is geospatial analysis in maternal and neonatal health in sub-Saharan Africa? A systematic review. J Glob Health 2022;12:04066.

[36] Geduld H, Hynes EJC, Wallis LA, Reynolds T. Hospital proximity does not guarantee access to emergency care. Lancet Glob Health 2018;6(7):e731.

[37] Hsia RY, Mbembati NA, MacFarlane S, Kruk ME. Access to emergency and surgical care in sub-Saharan Africa: the infrastructure gap. Health Policy Plan 2012;27(3):234–44.

[38] Benova L, Macleod D, Footman K, Cavallaro F, Lynch CA, Campbell OMR. Role of the private sector in childbirth care: cross-sectional survey evidence from 57 low- and middle-income countries using demographic and health surveys. Tropical Med Int Health 2015;20(12):1657–73.

[39] Wong KL, Banke-Thomas A, Sholkamy H, Dennis ML, Pembe AB, Birabwa C, et al. A tale of 22 cities: utilisation patterns and content of maternal care in large African cities. BMJ Glob Health 2022;7(3):e007803.

[40] Ouma PO, Maina J, Thuranira PN, Macharia PM, Alegana VA, English M, et al. Access to emergency hospital care provided by the public sector in sub-Saharan Africa in 2015: a geocoded inventory and spatial analysis. Lancet Glob Health 2018;6(3):e342–50.