

Development of an indicator to measure emergency interfacility referral readiness for maternal and newborn care at national and sub-national levels

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ABSTRACT

Purpose: Emergency referral systems are vital to robust and resilient health systems, however, referral system strengthening efforts have been fragmented, often narrowly focused and lacking a clear measurement approach. We aimed to design a comprehensive standardized indicator to assess health facility readiness to refer emergency obstetric and newborn cases to a receiving health facility to improve the quality of referrals.

Methods: We first developed an overarching emergency referral system monitoring framework. Through literature review and content analysis, we defined key dimensions for measurement. We mapped existing indicators to the monitoring framework's dimensions and developed a tool to collect inputs for the emergency referral readiness indicator. We repeatedly sought consultation and feedback from stakeholders throughout the 2.5-year process and piloted the tool in Senegal and Mozambique. We consolidated feedback, adjusted and finalized the indicator.

Results: The final health facility assessment tool includes 123 questions across six dimensions. The dimensions include (1) Transportation readiness, (2) Referral efficiency and coordination of care, (3) Care during transport, (4) Financial accessibility of referral, (5) Family-centered referral, and (6) Inter-facility relational dynamics. Health facility responses can be scored by level of readiness (essential, improved or advanced) or by dimension. The pilot study showed that the tool was practical and effective.

Conclusion: Referral system strengthening efforts can benefit from the emergency interfacility referral readiness indicator put forward in this work. It considers the complexity of the referral system, yet offers a standardized approach to identify gaps in referral systems, focus efforts, and track progress over time.

1. Background

Emergency referral systems are vital to robust and resilient health systems. Ideally, they enable patients in an emergency to get to the right care at the right time, connecting health services and maximizing the potential impact of a health system (Kruk et al., 2018). Emergency referral systems are complex, multi-dimensional sub-systems of the overall health system. They are essential to a high-quality health system, yet they have received insufficient attention.

Well-functioning emergency referral systems are a requisite for most goals put forth by global and national health leaders. The aspiration of universal health coverage will require well-functioning emergency referral systems to ensure all people can reach the care they need when they need it most. Similarly, such a system is needed to meet the

Sustainable Development Goals of a global maternal mortality ratio less than 70 deaths per 100,000 live births and a neonatal mortality rate less than 12 deaths per 1000 live births by 2030 (United Nations, 2015). While the majority of maternal and newborn deaths are preventable, these deaths can only be averted when people have access to timely emergency obstetric and newborn care, facilitated by referral (Paxton et al., 2005). Research shows that efforts to improve referral systems can significantly reduce maternal and newborn mortality and stillbirths (Alaofe et al., 2020). Thus, referral system strengthening is considered a priority action to achieve the Every Newborn Action Plan (ENAP) and the Ending Preventable Maternal Mortality (EPMM) targets (World Health Organization, 2023a). Further, effective emergency referral systems serve all patients, enabling timely medical intervention for conditions such as trauma, heart attacks and stroke.

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Functional emergency referral systems are critical for health systems to respond to external shocks. Crises increase the number of emergency cases needing treatment and with conflict and violence currently on the rise, an increased burden on the health system is expected (Pettersson and Öberg, 2020). This is evidenced by estimates that 60 % of preventable maternal deaths, over half of deaths among children under five years, and 45 % of neonatal deaths occur in fragile states (World Health Organization, 2023a, 2020a). Recent epidemics, such as the 2014–2016 Ebola epidemic and the 2015–2016 Zika epidemic, as well as the COVID-19 pandemic, emphasize the need for effective emergency referral systems to manage infected individuals in addition to the regular caseload of obstetric and newborn complications (Sochas et al., 2017; Calvillo Hynes, 2020). As climate change worsens, a larger proportion of the population will be exposed to extreme weather events and natural disasters, with negative health effects. For example, hot weather and heat waves increase emergency room visits, as well as adverse pregnancy and birth outcomes (Ebi et al., 2021; Pappas et al., 2024). Robust referral systems mitigate the consequences of these events.

Despite evidence of the importance of emergency referral systems and widespread agreement of their critical role within the health system, guidance and efforts to strengthen them have been fragmented and often narrowly focused on one element of the system (e.g., transportation schemes). As a whole, emergency referral systems have been under-researched, under-monitored, and under-funded given their relative importance. There are some encouraging signs of momentum around more comprehensive, coordinated initiatives to focus on referral system improvements, however, there remains significant work to be done (World Health Organization, 2023a, 2023b).

Given the lack of attention to emergency referral systems, there is notably a gap in referral system measurement tools. The aim of the work presented here is to propose a harmonized measurement framework for emergency referral systems to enable comparisons across settings, to better classify and understand gaps in existing referral systems, and to track changes within a system over time. We aimed to develop a

framework that: 1) offers a practical guide to evaluate whether a health system can effectively refer patients in emergencies; 2) helps identify gaps in the referral system and provides guidance on components of emergency referral systems, and 3) can help organize and motivate collective action toward filling those gaps. Our work builds on and is linked with several other bodies of work including the World Health Organization's (WHO) Emergency Services Framework for Pregnancy and Delivery, the Lancet Global Health Commission on high-quality health systems, the concept of networks of care, long-standing efforts among experts in emergency medicine, the WHO's Quality of Care framework, and EPMM and ENAP initiatives.

The complexity of emergency referral systems – which is described in more detail below (Figs. 1 and 2) – required us to set clear boundaries around the extent of our work. To that point, we focused on 1) emergency referrals as provided within the framework of Emergency Obstetric and Newborn Care (EmONC), defined as the transfer of patients with life-threatening obstetric and neonatal conditions where timeliness matters; 2) emergency referral between two health facilities (i.e. inter-facility referral) – as this is the segment of a patient's journey to emergency care that sits squarely within the responsibility of the health system; and 3) developing an indicator that assesses a facility's readiness to provide emergency referral, rather than the functionality, effectiveness, efficiency, or outcomes of the entire referral system, though measures of those elements are equally important and call for a similar level of attention. This paper presents our proposed emergency referral system monitoring framework and the composite indicator to measure emergency referral system readiness for referring out, along with the process leading to their development.

2. Methods

2.1. Approach and collaboration structure

The Global Transport and Referral Community of Practice (GTR-

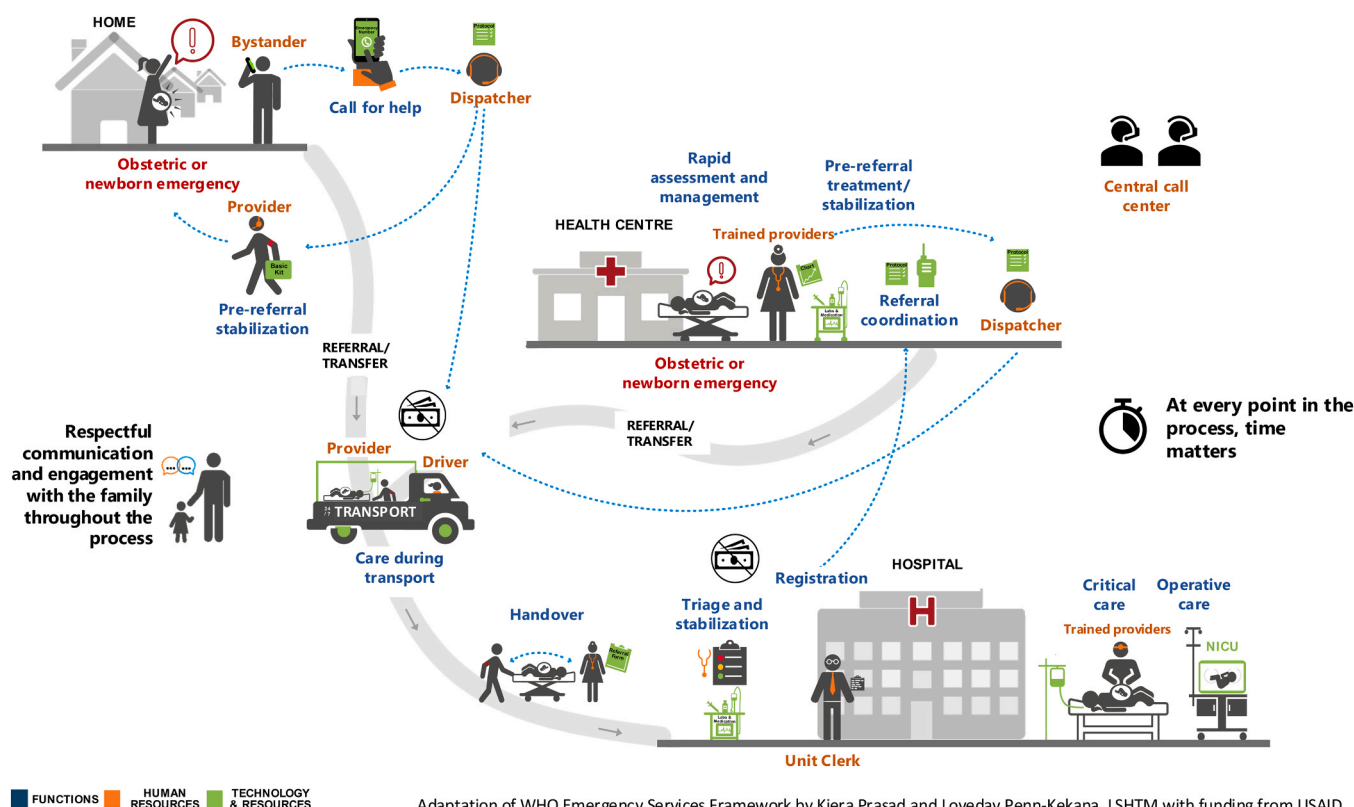


Fig. 1. Adaptation of the WHO emergency care system framework (World Health Organization, 2018) by Kiera Prasad and Loveday Penn-Kekana.

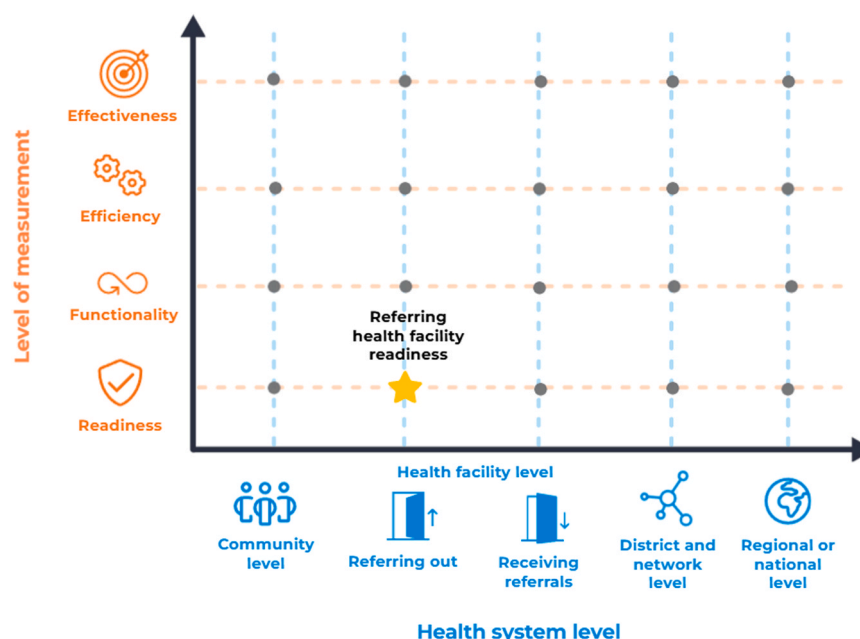


Fig. 2. Emergency referral system monitoring framework.

CoP), previously known as the Care Seeking and Referral CoP, was first created in 2019 with funding from the United States Agency for International Development (USAID) through the Circle Project. Due to project closure, the GTR-CoP migrated to the Maternal, Adolescent, Reproductive and Child Health (MARCH) Centre at the London School of Hygiene and Tropical Medicine (LSHTM) in October 2021, where it is currently hosted. The goal of the CoP is to advance transport and referral practices for mothers, newborns, and children in low- and middle-income countries (London School of Hygiene and Tropical Medicine, 2025). In 2020, the GTR-CoP became involved in the Revisioning Emergency Obstetric and Newborn Care project.

The Revisioning EmONC project is led by the Averting Maternal Death and Disability (AMDD) program, in collaboration with UNFPA, UNICEF, WHO, and LSHTM. The project aims to revise the existing EmONC framework to better meet the needs and real-world experiences of health systems globally (Maine et al., 2009). To this end, AMDD requested that the GTR-CoP lead a process to develop the referral aspects of the revised framework. This entailed developing a signal function and a measure of readiness to refer, that would be integrated into the broader revised EmONC framework. EmONC signal functions are “a parsimonious list of clinical tracer interventions, representing key processes of care, to treat the main complications of childbirth that would otherwise result in maternal or newborn death and disability, or stillbirth.” Example EmONC signal functions are the recent administration of medications to treat postpartum hemorrhage, or the recent performance of newborn resuscitation with bag and mask (Averting Maternal Death and Disability, 2024). In the EmONC framework, documentation of the actual performance of signal functions within a set period is used to signal whether a facility functions as an EmONC facility and at what level (i.e., basic, comprehensive or intensive EmONC). The EmONC indicators complement the signal functions as tools to assess the functioning of EmONC facilities and to assist health planners in ensuring their health system meets the needs of the population. EmONC indicators (for example, institutional delivery rate, or proportion of facilities that have all the EmONC tracer commodities) are intended to identify red flags, highlighting health system problems that must be addressed (Averting Maternal Death and Disability, 2024).

A core group was formed among the steering committee of the Global Transport and Referral Community of Practice (SC GTR-CoP), to lead the process of developing a referral indicator, with members from research,

implementation, and clinical practice backgrounds. This effort took place from January 2022 to June 2024 and followed an iterative process of seven overlapping steps including (1) developing an overarching emergency referral system monitoring framework, (2) defining key dimensions for measurement, (3) reviewing and mapping indicators, (4) developing a data collection tool to calculate an emergency referral readiness indicator, (5) consultation and feedback, (6) piloting the tool to measure the proposed indicator, and (7) consolidating and finalizing the referral readiness indicator and related guidance. The process to develop the related referral signal function followed a parallel and sometimes intersecting development and review process. The referral indicator and signal function were compared throughout the development process to ensure alignment and complementarity.

2.2. Step 1: developing an overarching emergency referral system monitoring framework

Based on the experience of the SC GTR-CoP members and review of the WHO Emergency Care System Framework (World Health Organization, 2018), and its related adaptation (see Fig. 1) (Prasad and Penn-Kekana,), we recognized the need for multiple indicators to fully monitor a referral system. This extends across health system levels, such that there is a need to measure different segments of the referral journey (e.g., from community to first facility, from a referring facility to a receiving facility), and different functions within a referral system (e.g., referring a client versus receiving a client). There is also a need to measure the structures that support the referral system at levels above the health facility; for example, districts or networks of care may share resources (e.g., financial and human resources, vehicles, etc.), use common referral tools (e.g., referral forms, protocols, guidance, etc.), and ensure accountability of the referral system. Areas that utilize centrally coordinated emergency services will also be best examined at this level rather than simply at the health facility level. At the national or regional level, policies and regulations bolster a referral system across all sub-national units. The inputs required to assess the referral system at each of these health system levels are different, as are the sources of the data to be collected. Many health facilities both receive referrals and refer patients onwards – in this case, a distinct measurement tool is needed to assess each of these functions as the systems and structures needed, differ.

Similarly, a suite of indicators must describe all aspects of a referral system that span the continuum of measurement types, assessing readiness, functionality, efficiency and effectiveness (see Fig. 2). These measurement categories align with Donabedian's model for evaluating the quality of health care through the lens of structures, processes, and outcomes (Donabedian, 1988). While much research applying this model considers both efficiency and effectiveness indicators as outcome measures, we believe their distinct goals warrant disaggregation (Goenka et al., 2024; Rysst Gustafsson and Eriksson, 2021; Tossaint-Schoenmakers et al., 2021). Here, readiness refers to the baseline inputs and structures in place to support referral at each level of the health system. Readiness measures can help understand if health facilities have what they need to enable a high-quality emergency referral. Assessment of functionality measures the frequency and quality of implementing referral processes and practices. These measures can address how well health facilities conduct emergency referrals, if they are correctly implementing their referral protocols, and how frequently they are doing so. Efficiency indicators aim to determine if referrals follow the most time- and resource-efficient path. For example, they may include the number of health facilities a patient is transferred to before reaching the care they need during an emergency, or the time it takes from the decision to refer until an obstetric or neonatal patient reaches the care they need. Measures of effectiveness explore the effects of the emergency referral system on health outcomes and the health system. Indicators of effectiveness may include the proportion of emergency obstetric referral patients who receive unanticipated surgical intervention, intensive care or die within 24 h of reaching the receiving health facility, or the proportion of newborns who arrive unresponsive at the receiving health facility following an emergency referral.

It is important to distinguish between the goals of measurement as they each warrant specific methodologies. For example, assessing referral readiness can be accomplished through surveys and document reviews, whereas assessing functionality or effectiveness may require clinical observation, case review, or time-motion studies. While many studies report on referral efficiency and effectiveness, there is a clear gap in assessing referral readiness, with no standardized or harmonized tools (Davies et al., 2001; Pembe et al., 2010; Sanders et al., 1998; Bossyns et al., 2006; Accorsi et al., 2017; Majoko et al., 2005). We chose to focus on developing a composite indicator of referral readiness, particularly among health facilities referring out for emergency care, as this is a function that most health facilities must be prepared to perform and represents a minimum responsibility of the health system. This is also the measure that would best support the revised EmONC framework which seeks to assess the readiness of Basic EmONC facilities, including readiness to ensure timely, quality referral to other facilities in an emergency. Fig. 2 illustrates the monitoring framework and the intersection of measures across health system levels and the continuum of measurement. Each point represents an indicator needed for comprehensive emergency referral system monitoring. The star reflects the composite indicator proposed in this paper in relation to the broader monitoring framework.

2.3. Step 2: defining key dimensions for measurement

We performed a literature review to identify existing surveys, indicator lists and frameworks that include emergency referral, that are designed for the health facility level or higher, and have a focus on global or low-income country settings. Source documents in English and French were identified by searching PubMed, Google, WHO webpages, and USAID's Development Experience Clearinghouse, as well as through engagement with stakeholders, with no restrictions on publication date. We explicitly included the existing EmONC Assessment tools in our review to compare them with the global literature. Further, we analyzed referral system data from previously conducted EmONC assessments to explore how survey questions would align with initial proposed dimensions and to identify variations across countries (Lydon et al., 2024).

With the gathered source documents, we performed content analysis using Nvivo v.12 (Lumivero, 2017; Hsieh and Shannon, 2005). One analyst coded content related to referrals through which a coding structure emerged. Codes were developed iteratively through immersive reading of the source documents. Initial coded documents were reviewed again at the end of coding to ensure consistency of coding over time. A similar process was undertaken simultaneously to review policy and guidance documents, which will be written about in a forthcoming article. The codes and code outputs of both the measurement review and policy review were compared to develop a set of emergency referral system dimensions. Dimensions are defined as the overarching distinct functional areas of referral systems. As such, codes that captured similar functions were grouped together to form an all-inclusive dimension while those that were outside the purview of the referral system (e.g., supply-chain management) were dropped. Definitions were developed based on the contents of each dimension and reviewed by members of the EmONC Revisioning Steering Committee as well as many stakeholder groups (see step 5) to determine and refine the final set of referral dimensions.

2.4. Step 3: reviewing and mapping indicators

Survey questions and indicators from the source documents were mapped to the final set of emergency referral system dimensions. The survey questions and indicators for each dimension were reviewed for (a) relevance, (b) clarity, (c) specificity, (d) breadth, (e) feasibility, and (f) utility. (a) We aimed to retain indicators that were relevant to the health facility level as well as a low-income country context. (b) Where multiple sources described similar items, we selected those that offered the greatest clarity in terms of terminology and phrasing to enable accurate data collection. (c) Items were selected that could distinguish between specific nuances of referral system components and (d) that allowed for coverage of a broad range of referral system experiences. (e) Measures were chosen that could be feasibly collected at the health facility level through a survey assessment on a routine basis. (f) Finally, only indicators that could be useful to health planners and decision-makers were selected for inclusion in the composite referral readiness indicator.

2.5. Step 4: developing a tool to collect data to calculate the emergency referral readiness indicator

The selected survey questions were organized into the six dimensions and built into a data collection tool. Questions were ordered to maximize logical flow, avoid repetition and simplify data collection as much as possible. Response options were considered from the existing literature as well as stakeholder feedback to encompass a broad range of referral systems and scenarios. The tool is intended to be useful for referral systems at all levels of development and to encourage increasing effectiveness. As such, variables within the composite indicator, derived from survey questions, were divided into three tiers to describe increasing complexity of a referral system. These tiers are designated as essential, improved and advanced referral readiness and were determined through extensive consultation and piloting feedback (see steps below). The essential tier captures the inputs that are required for a referral system to function (e.g., access to a vehicle and driver, vehicle minimally equipped for care during transport, some form of communication). Improved referral readiness builds upon the essential inputs by adding those that would enhance referral quality (e.g., dedicated vehicle for emergency referral, regular accompaniment of referred patients, free transport guaranteed). Finally, advanced referral readiness reflects a more complex and robust referral system (e.g., emergency services cadre available, financing mechanisms in place to support the referral system). We developed a full data collection tool that allows users to determine if the health facility meets the criteria for each tier as well as a short data collection tool that focuses only on essential referral readiness, to offer a

practical tool for frequent monitoring. As a companion to the data collection tool, we crafted scoring guidance that describes the responses required to meet criteria for each tier, as well as a full summative scoring protocol to assign a percent score for each dimension.

2.6. Step 5: consultation and feedback

Consultation and feedback were embedded in the entirety of the indicator development process. The SC GTR-CoP maintained ongoing engagement with the EmONC Revisioning Steering Committee to review and provide feedback at each stage of development, with major reviews during meetings in New York, September 2022 and in Istanbul, November 2023. In addition, there were several key events through which stakeholders were engaged.

In May 2023, we presented the concept of the referral indicator and its associated signal function at the International Maternal and Newborn Health Conference through an interactive session, inviting feedback and input from all attendees interested in the topic. The group included about 35 conference attendees with experience in referral systems, measurement development and clinical practice. We captured discussions through notes and collaborative inputs on a flip chart.

In June 2023, we held a virtual workshop in collaboration with UNFPA to present the referral indicator at that stage, seeking validation of the six identified dimensions, prioritization of items to include within dimensions that had many indicator options, and input on dimensions lacking robust options among existing indicators. Country teams working on EmONC referral system monitoring or implementation were invited to participate. The workshop was attended by UNFPA headquarters, regional and country office staff, as well as Ministry of Health personnel, with participants representing 13 countries (Benin, Burundi, Côte d'Ivoire, Guinea, Guinea-Bissau, Jordan, Madagascar, Rwanda, São Tomé e Príncipe, Senegal, Togo, the United Kingdom, and the United States of America). Feedback was documented through participant responses to Mentimeter questions, the meeting chat and notes taken by facilitators during the breakout sessions.

As part of the broader EmONC Revisioning effort, human-centered design workshops were held in Malawi, Senegal and Bangladesh in 2022–2023 to seek detailed input from stakeholders on new EmONC indicators proposed for inclusion in the revised EmONC framework, including the referral indicator. These countries were selected as they had previous experience implementing the EmONC framework and indicators, and represented varying health systems and EmONC service delivery contexts. Participants were purposively selected based on their experience with the use, provision, monitoring or planning of EmONC services. These included health planners and decision-makers, facility managers, health providers, community representatives, and women who had used EmONC services and their male partners. In total, over 300 participants across the three countries were included. Facilitators used a myriad of qualitative methods with participatory, generative design techniques to engage participants to share their experiences at a deeper level, including use of walk throughs, sliders and rankings (Alessandra et al., 2020). Results from this effort, published elsewhere, were reviewed to inform the referral dimensions and content of the data collection tool (Dieng et al., 2023; Chowdhury et al., 2023; Chodzaza et al., 2023; Moreira et al., 2025). The results helped ensure that varied referral system scenarios were accounted for in the referral indicator (e.g., both public and private health systems) and grounded the indicator in the realities of health providers and community members who engage with referral systems across LMICs.

In July 2023 we held an open webinar and discussion session with the broad GTR-CoP membership to present the concept of the indicator of emergency referral readiness and the complementary signal function, seeking feedback through Mentimeter questions. In August 2023, we had a consultation with colleagues from the WHO Emergency Care and Maternal Health teams on the referral signal function and indicator.

2.7. Step 6: piloting the emergency referral readiness data collection tool

The short version of the tool, measuring essential referral readiness, was piloted in Senegal in November 2023 across five public health facilities, some urban and some rural, in different regions. Feedback from the data collection team was used to iterate the tool.

The full tool was piloted in the provinces of Nampula and Zambezia, Mozambique in April–May 2024. FHI 360 staff who were trained on the tool through a one-day workshop administered the questionnaire at 18 public health facilities (16 health centers and two district hospitals). Staff who administered the questionnaire completed a feedback survey following data collection to share insights on implementation of the tool, feedback on specific questions and response options, and overall perceptions on the ease and usefulness of the questionnaire. Responses to the questionnaire were analyzed and discussed with the data collection team to improve question clarity.

2.8. Step 7: consolidating and finalizing the referral readiness indicator and guidance

We reviewed the mapped survey questions and indicators in comparison with the feedback from consultations and piloting described in steps 5–6, adapting, adjusting and adding to the existing prioritized variables. Variables were selected for an initial shortlist and shared with the Revisioning EmONC Steering Committee for review. Final feedback was integrated to create a final data collection tool, scoring guidance and indicator description.

3. Results

We identified 24 source documents for the literature review including 16 indicator lists (World Health Organization, 2023a; Davies et al., 2001; World Health Organization, 2015a, 2016, 2018a, 2020b, 2015b, 2021a, 2021b; M Diana and Hotchkiss, 2017; World Health Organization and UNICEF, 2022; World Health Organization, 2018b; Bae et al., 2018; Hirner et al., 2023; Broccoli et al., 2018; Willis et al., 2012; Brun et al., 2020; Steeve et al., 2019), six survey or assessment tools (The Demographic and Health Surveys Program, 2012; World Health Organization, 2015c, 2023c; NEST360 U and HFA collaborative authorship group, 2023; MEASURE Evaluation, 2013; Averting Maternal Death and Disability, 2015) and two frameworks (World Health Organization, 2018; Prasad and Penn-Kekana, n.d.). Through content analysis, we identified six dimensions of emergency referral systems (Table 1). Each dimension represents a unique and essential component to ensure functionality of the system.

Mapping of existing indicators to the six dimensions revealed a robust pool of items for *Referral efficiency and coordination of care*, occurring in 79 % of documents, and *Transportation readiness*, appearing in 67 % of documents. The remaining four dimensions arose in 38–42 % of sources, suggesting a need to develop additional items for these dimensions.

For the transportation readiness dimension, we tailored questions to be relevant for contexts with onsite, offsite and centrally coordinated emergency vehicles to reflect the variation in referral systems globally. Stakeholders noted the importance of going beyond vehicle availability and functionality to document potential delays in referral more fully. For example, participants in the Malawi workshop shared that “*Ambulances are sometimes assigned to general duties causing a serious jeopardy to referral cases*,” highlighting the need for emergency vehicle exclusivity. Respondents in the Senegal workshop recommended to “*Ask ambulance drivers to be on call like health providers for a quick referral instead of going to wake them up at home*,” noting another typical delay. Survey questions are additionally designed to capture the ability of emergency transport to handle shocks to the system (e.g., fuel shortages, transport barriers), and the conditions of the vehicle (e.g., vehicle maintenance and disinfection practices).

Table 1
Definitions of the six dimensions of emergency referral systems.

Dimension	Definition
Transportation readiness	Describes a facility's ability to quickly and effectively mobilize the necessary transportation for referral, including having ready access to a functional emergency vehicle that is maintained and appropriate for the local geography and climate.
Referral efficiency and coordination of care	Refers to all that is needed to ensure that services for clients are efficiently and thoughtfully planned, communicated and executed across all care providers from first point of contact through definitive care. This includes the availability of explicit criteria for referrals, pre-referral stabilization guidelines and practices.
Care during transport	Encompasses the ability to offer continued quality care during referral, by having an appropriate provider with the skills, support, equipment and supplies needed, to perform interventions addressing maternal and newborn emergencies during transfer.
Financial accessibility of referral	Reflects the burden of costs that are borne by the client and their family related to the referral process or that affect the efficiency of the referral, as well as the health facility mechanisms in place to minimize the financial burden of referral on clients.
Family-centered referral	Comprises the components related to being able to offer thoughtful and respectful communication, inclusion, and consideration of families from the decision-making process to refer, through transfer and handover, with a prioritization on minimizing separation of caregivers and newborns and ensuring birth companionship.
Inter-facility relational dynamics	Captures the interpersonal and organizational relationships, processes and tools across structures (i.e., levels of the health system) that affect the collaboration, coordination and care of referrals.

There was widespread alignment across source documents that availability and use of communication devices were essential elements of referral efficiency and coordination of care, however, consultative efforts underscored the need to inquire broadly about the systems in place to allow for an efficient and systematic approach to referrals, including elements such as referral criteria, referral protocols, and protocols for pre-referral stabilization. Workshop participants in Bangladesh reiterated the importance of strong coordination systems, sharing that in their context, *“newborns may be referred multiple times over and not survive the care-seeking journey.”*

Stakeholders and source documents strongly agreed that provider presence is fundamental to ensuring continued clinical care during referral. A nurse-midwife technician in Malawi explained, *“We fail to escort patients to the referral facility because we are understaffed and that puts the patient at risk of developing further complications during transportation.”* While many previous indicator lists inquire about the presence of a provider during referral, this offers limited insight regarding the care, and particularly the quality of care, that clients receive during transfer. The referral readiness tool further investigates providers' ability to offer care during transport by documenting accompanying providers' training, access to remote clinical support, and availability of supplies and equipment in the emergency vehicle.

The *financial accessibility of referral* dimension centers on the premise that finances should not delay emergency referral. Stakeholders shared many financial barriers to referral, pointing to several components considered in the survey. For example, a nurse-midwife technician in Malawi shared, *“I really want to escort women and babies with complications to the referral facility, but they (the District Health Management Team) are not going to give me transportation for me to come back to my health centre. I will have no meals, no accommodation or care.”* The survey expands in scope to understand the financial sustainability and equity of the referral system including elements such as sufficient budgeting for

referral expenses, transparency of costs to avoid extortion, and the establishment of more nuanced structures such as health insurance mechanisms and funding for low-income clients.

The hallmark of *family-centered referral* is meaningful and respectful engagement with clients and their families during emergency referral and about the referral system. Respondents in Senegal highlighted that the *“place of the husband or companions in the front of the vehicle is badly experienced: it does not reassure them and does not respect their place in a family-centered care system,”* indicating that mere presence of a birth companion is insufficient. As such, this domain builds upon allowing birth companions and minimizing separation of newborns and caregivers to encompass active engagement of companions, supporting caregivers to undertake kangaroo care (KMC) during transport, seeking client feedback on the referral process and preparing families for the possibility of emergency referral and its cost during antenatal care. Respectful and timely communication is central, such that UNFPA workshop participants described the need to *“sensitize”* the family, help them *“prepare”* for the referral, and *“clearly inform them of the situation”* including *“the reason for the referral.”*

The dimension of *inter-facility relational dynamics* comprises essential building blocks such as informative and updated directories and formal agreements between facilities that detail critical referral processes, to respond to the frequent challenge that *“referrals take place on an informal basis with no formal communication between facilities”* (Bangladesh workshop participants). UNFPA workshop attendees highlighted the importance of having *“respect between health workers at different levels”* and finding a balance between *“accountability versus blame when issues arise.”* This was reiterated in the Malawi workshop where participants shared that *“Midwives at the receiving facility show negative attitude towards escorting midwives in respect to how they mismanaged the escorted patients.”* This dimension therefore encompasses working collaborations with receiving facilities, relationships between providers and confidence in the care offered at receiving facilities.

From the pilot test in Mozambique, the data collection team found it took 75–90 min to administer the survey at a health facility. They reported it was fairly easy to identify staff who were well-positioned to answer all survey questions, such that they spoke to 2–3 employees at each health center and five employees at each hospital surveyed. Data collection team members indicated they were highly satisfied with the tool overall, noting its comprehensiveness as a strength, and felt it was very easy to administer. The main challenges were in accessing health facilities due to rainy conditions and providers' availability. The team offered specific feedback to improve the clarity of questions and broaden response options to reflect many possible scenarios. Overall, the team said the tool was *“very reflective”* of the referral system in the Mozambican context and very useful in identifying strengths and weakness of the system. Interestingly, one data collector reported that health providers who responded to the survey told them that *“the questionnaire opened our eyes regarding the referrals and interventions we have not carried out.”*

The final health facility assessment tool includes 123 questions across the six dimensions (to access the full tool see [Supplemental material – Health facility referral readiness assessment form](#)). Health facility responses can be scored by level of readiness (essential, improved or advanced referral readiness) such that a health facility must meet all criteria within a tier to be classified as a facility with that level of readiness (for scoring instructions see [Supplemental material – Health facility referral readiness scoring instructions by tier](#)). The tool can also be scored by dimension, calculating a total score that can be used to identify areas of the referral system in need of strengthening (see [Supplemental material – Health facility referral readiness scoring instructions by dimension](#)). The emergency referral readiness indicator is included in the revised EmONC Framework under *Domain 1: Structure indicators, describing equitably distributed and well-functioning EmONC facilities* (access here: <https://emonc.org/en/framework/indicators/>) ([Averting Maternal Death and Disability, 2024](#)).

4. Discussion

The emergency referral readiness indicator tool put forth in this article offers a standardized approach to assess referral system readiness, accounting for the many dimensions of this system that are often overlooked, filling a gap in global measurement tools previously noted (Broccoli et al., 2018). A high-quality referral entails much more than simply contacting the next facility or transporting a patient to the receiving facility. The results of this multi-stage process reinforce that emergency referral systems are complex, multifaceted systems that require appropriate measurement tools. This is in agreement with existing literature describing the complexity of referral systems (Moresky et al., 2019; Murray and Pearson, 2006; Seyed-Nezhad et al., 2021). The proposed composite indicator encompasses six dimensions that were identified through the consultative process - transportation readiness, referral efficiency and coordination of care, care during transport, financial accessibility of referral, family-centered referral, and inter-facility relational dynamics. This effort confirmed there was no pre-existing indicator to measure referral readiness in its complexity. Stakeholders strongly supported tool development and item inclusion, providing rich feedback to ground the tool in the experiences of referral system providers and users across a variety of health systems.

The referral readiness indicator is best used when assessing multiple health facilities within a health system, which can occur at any geographic scope. The tool should be adapted for the local context where it is being implemented; the dimension definitions and the tool contents can serve as a guide to organize new or differing data points. When the tool is adapted, it should remain constant within a country and over time to allow for comparison between health facilities and to enable progress monitoring going forward. The frequency of use will be setting-specific and based on its intended purpose. For large-scale assessment, annual monitoring may best meet the goals of health planning and resource allocation. For targeted referral system strengthening efforts, more frequent monitoring will better allow for continuous data-informed adaptation.

The referral readiness indicator can be used for national or regional health system tracking as well as for program monitoring and evaluation where referral system strengthening activities are taking place. It can help health planners consider the many components of referral systems to avoid the pitfall of narrowly focusing on transportation. Data generated from the tool will allow health planners to allocate resources appropriately, recognizing there are many elements that must come together to ensure a patient reaches the care they need in time. Transport and communication systems are certainly critical for referral, however, the referral readiness indicator can highlight other lower-cost areas for intervention which are also crucial, allowing health planners to identify areas of referral systems that can be addressed with available resources.

The proposed emergency referral readiness indicator grapples with some systemic challenges however it focuses on the health facility level. The intention is not to hold facilities responsible for systems-level issues that are out of their control but rather to measure how those systems function from the perspective of facilities and to aggregate health facility responses to a larger geographic area for planning purposes. Many of the questions within the tool focus on local-level factors that can provide insight into the actions that can be taken at a health facility or across facilities at a sub-national level. We recommend that the emergency referral readiness indicator be used for quality improvement at the facility level and across referral networks to drive system-level improvements.

We must recognize that this has been a pioneering effort and as such, this indicator should be used while recognizing its limitations. There was little research in the area of referral system measurement to support the development of the emergency referral readiness tool, limiting our ability to build upon preexisting evidence. Further, while the indicator was developed in alignment with content analysis, stakeholder input

and piloting efforts, no statistical analysis was used to validate the measure; additional research is needed to substantiate the multidimensional conceptual model and to refine the composite indicator. At the same time, we believe that our process of reviewing existing sources, including input from a variety of stakeholders with relevant personal and professional experience, and integrating practical feedback from pilot testing, has resulted in a solid foundational tool that can be used by the global health community. We wholeheartedly welcome those who use the tool to share their feedback and publish their findings so that we can collectively iterate and improve upon this measurement strategy. We hope this tool is just the beginning. An entire suite of indicators must be developed to capture referral at different levels of the health system, along different journeys to care, and with different measurement goals. We are keenly aware that what gets measured, gets done, and for far too long, women and newborns have been dying due to broken referral systems. It is time to start examining our referral systems with a health systems lens so we can finally tackle this missing link in emergency obstetric and newborn care.

5. Conclusion

It is imperative to think about emergency referral systems as complex systems. Our emergency referral system monitoring framework offers a roadmap for continued measurement development needed in this field. We call upon researchers and implementers to work on building standardized and validated tools to complete the monitoring framework. We also must begin to collect data to assess health system readiness to perform referrals so that we can effectively identify and address the gaps. The proposed emergency referral readiness indicator, along with its associated data collection tool and scoring guidance, provide a step in this direction. We encourage global partners to begin to use and adapt this tool and share their learnings widely so that the tool can be continuously improved and data on referral systems can begin to grow, allowing for greater understanding of these complex systems and better evaluation of referral system strengthening efforts. The referral system is a critical component of the health system and therefore referral system strengthening should be embedded in all health systems strengthening efforts. A health system is only as strong as its weakest health facility when there is no functional referral system in place, but when there is a robust referral system, a health system can be as strong as its most capable health facility. Effective emergency referral systems are central to resilient health systems that avoid preventable maternal and newborn deaths.

CRedit authorship contribution statement

Megan M Lydon: Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Emily B Keyes:** Writing – original draft, Supervision, Resources, Project administration, Methodology, Investigation, Data curation, Conceptualization. **Loveday Penn-Kekana:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Peter Acker:** Writing – review & editing, Methodology, Investigation. **Prateek Gupta:** Writing – review & editing, Methodology, Investigation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.ssmhs.2025.100137](https://doi.org/10.1016/j.ssmhs.2025.100137).

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