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Characteristics of referral process and outcomes of women referred for obstetric care to three urban hospitals in Guinea: A longitudinal facility-based study

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Title: **Characteristics of referral process and outcomes of women referred for obstetric care to three urban hospitals in Guinea: A longitudinal facility-based study**

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Competing interests

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.

CRediT authorship contribution statement

Fassou Mathias Grovogui: Conceptualization, Methodology, Supervision, Data curation, Formal analysis, Visualization, Writing – original draft. **Pépé Kpogomou:** Investigation, Data curation, Validation, Writing – review & editing. **Hadja Fatoumata Souaré:** Investigation, Data curation, Validation, Writing – review & editing. **Aline Semaan:** Conceptualization, Methodology, Validation, Visualization, Writing – review & editing. **Peter M. Macharia:** Supervision, Validation, Visualization, Writing – review & editing. **Elie Béavogui:** Investigation, Data curation, Validation, Writing – review & editing. **Hawa Manet:** Conceptualization, Methodology, Investigation, Writing – review & editing, Validation. **Nafissatou Dioubate:** Validation, Writing – review & editing. **Rehema Ouko:** Validation, Writing – review & editing. **Aly Badara Touré:** Validation, Writing – review & editing. **Mamadou Saliou 3 Souaré:** Investigation, Validation, Writing – review & editing. **Mohamed Lamine Maria Camara:** Investigation, Validation, Writing – review & editing. **Ibrahima Sory Conté:** Validation, Writing – review & editing. **Tamba Mina Millimouno:** Validation, Writing – review & editing. **Lenka Beňová:** Supervision, Conceptualization, Methodology, Validation, Visualization, Writing – review & editing. **Alexandre Delamou:** Supervision, Conceptualization, Methodology, Validation, Visualization, Writing – review & editing.

Abstract

Despite global efforts, sub-Saharan Africa continues to bear a disproportionate share of the global burden of maternal deaths and stillbirths, with referral inefficiencies among the major drivers. This study describes the characteristics, referral process, and maternal and perinatal outcomes of women admitted following referral to the maternity wards of three urban referral hospitals in Guinea, at the district (Forécariah), regional (Mamou), and national (Ignace Deen) levels of the health pyramid. In this prospective longitudinal study, all women admitted as a result of referral were identified on admission and followed until discharge, with recruitment over five months in 2025. Among the total of 3,771 admissions recorded, 1,178 women were referred: 63% of admissions at HNID, 8% at HRM, and 16% at HPF. Intrapartum complications were the leading reason for referral. Only 17% of referred women at HNID, and almost none at HRM or HPF, arrived by ambulance; most used taxis or motorcycles. At HNID, severe complications were concentrated at night, when hospital capacity is lowest. In-facility maternal mortality ratios among referred women were 564 per 100,000 live births at HNID and 5,970 per 100,000 at HRM, and stillbirth rates ranged from 129 to 212 per 1,000 births, with 46–70% fresh stillbirths, suggesting many foetal deaths occurred around the time of arrival. These findings reveal potential weaknesses across the entire referral pathway, from bypassed primary care to transport without trained staff and limited emergency capacity, requiring system-wide strengthening rather than facility-level fixes.

Keywords: Obstetric referral, Maternal mortality, Stillbirth, Health system, Emergency obstetric care, Guinea

Background

Despite substantial reductions in maternal and newborn mortality between 2000 and 2023, sub-Saharan Africa (SSA) continues to bear a disproportionate share of the global burden [1–4], with approximately 70% of global maternal deaths, 47% of stillbirths, and 46% of neonatal deaths occurring in the region [1,5,6]. Most maternal deaths result from haemorrhage, hypertensive disorders, or sepsis; most neonatal deaths stem from intrapartum events or preterm complications [7]. All these are complications largely preventable with timely access to high-quality Emergency Obstetric and Newborn Care (EmONC) [8]. However, this knowledge alone has not translated into sustained progress toward mortality reduction targets. Despite evidence of EmONC's potential, most SSA countries will not achieve the Sustainable Development Goal target of fewer than 140 maternal deaths per 100,000 livebirths by 2030 [1]. This stalled progress reveals that structural and contextual barriers, beyond clinical knowledge or facility capacity, are limiting the effectiveness of existing interventions. Understanding these barriers requires granular, context-specific data including on delays, quality of care, referral pathways, patient characteristics, and outcomes at referral facilities [9].

Guinea illustrates these challenges well. The national maternal mortality ratio (MMR) has halved from 971 to 494 maternal deaths per 100,000 livebirths between 2000 and 2023 [1], a trajectory coinciding with efforts to expand skilled birth attendance and strengthen maternal health services, including the introduction of a fee removal policy for EmONC since 2010 [10]. Despite this progress, the current MMR remains more than three times the SDG national target of 140, and substantial gaps persist along the continuum of care. Nearly 88% of pregnant women initiate antenatal care, yet only 53% of births happen in a health facility, and postnatal care coverage remains low [11,12]. These national averages, however, hide large inequalities; the coverage of these essential interventions is much higher in urban settings, for example in Conakry, ANC coverage is near universal (96%) while nine in 10 women give birth in a health facility [13].

Despite this high service use, there is concern about the quality of care women receive during childbirth; for example, a 2025 census of health facilities in Conakry found that only 5% (16 out of 331) of facilities provide Comprehensive Emergency Obstetric and Newborn Care (CEmONC) [14]. This means that referral hospitals (as the apex referral facilities) receive referral cases which require advanced/specialised care, while at the same time providing care for often large volumes of routine childbirth cases among women seeking hospital care in search for high-quality care [15]. As a result of being under-resourced to provide both these functions at high volume and delays in referral processes, such hospitals have poor maternal and perinatal outcomes [16].

Timely obstetric referral, defined by the WHO as ‘a dynamic process in which a health professional at one level of the health system, lacking the resources or power to manage a patient's condition, seeks help at the same or higher level’ [17], is widely recognised as a critical determinant of maternal and perinatal survival. A systematic review estimated that improving referral efficiency can reduce maternal mortality by 50%, stillbirths by 27%, and neonatal deaths by 18% [18].

Conceptually, the “three delays” model-delays in seeking, reaching, and receiving care-has provided the dominant analytical framework for understanding maternal death pathways in low-resource settings for decades [19]. A recent “six-delays” extension of this model, grounded in evidence from Madagascar, demonstrates how referral within pyramidal health systems compounds delays at each transition between facilities [20]. These dynamics take a distinct form in cities, where referral pathways are rarely linear. Intermediate levels are frequently bypassed, with peripheral facilities referring women directly to referral hospitals that cannot decline admission [15]. Such bypassing makes referral journeys longer across congested cities and concentrates demand on a single overburdened facility. Beyond these factors, financial constraints, lack of trust, and structural barriers including inter-facility communication gaps, ambulance availability, and geographic inaccessibility shape referral timeliness and quality of care [21–25].

To understand how women navigate these barriers and what outcomes result, facility-based studies across low- and middle-income settings have documented the clinical profile and outcomes of women arriving through emergency obstetric referral [21]. In urban India, a study of over 25,000 referrals identified health-system capacity gaps (non-availability of an operating theatre (47%) and neonatal intensive care unit (45%)) as the primary drivers of referral [22]. A prospective cohort in Uganda documented adverse neonatal outcomes in 40% of emergency obstetric referrals, including neonatal intensive care admission, and fresh stillbirth [23]. In West Africa specifically, a prospective study at Korle Bu Teaching Hospital in Ghana reported labour progress complications and hypertensive disorders as the leading referral indications, while 73% of patients arrived by public transport and over half were unaccompanied by health staff [24]. A multicentre study in Nigeria documented an MMR of 2,085 per 100,000 livebirths among referred women, with absence of antenatal care and referral from non-hospital sources as independent risk factors [25]. In Guinea, referral status, lack of prenatal care, and delays in management have been identified as significant risk indicators for maternal mortality. This is particularly when at least 30% of deliveries at the national referral hospital arrive as referrals from peripheral health facilities [26].

Despite this evidence, comprehensive data on the characteristics, pathways, and health outcomes of women admitted for obstetric care as a result of referral in Guinea remain scarce. Existing studies are predominantly retrospective and single-site, focusing on specific complications rather than the full referral population due to incomplete patient records [16]. Prospective longitudinal data capturing the full trajectory-from demographic and obstetric profile through the referral process to maternal and newborn outcomes at discharge-are notably absent, and no multi-site study has simultaneously examined referral dynamics across hospitals serving distinct urban populations in Guinea. This study of maternity wards of three referral hospitals in urban Guinea aimed to describe the demographic, obstetric, and clinical characteristics of women admitted as a result of referral, characterise the referral process from the last health facility visited, and assess maternal and newborn health outcomes.

Methods

Study design and period

This was a prospective longitudinal study of referred women from point of admission until discharge in the maternity wards of three urban referral hospitals in Guinea. Primary data were collected through face-to-face interviews with respondents (either the women themselves or other informants reporting on women's behalf) and the extraction of clinical data from individual patient records. Enrolment took place between 3 April and 3 September 2025 at HRM, from 7 April to 7 September at HNID, and from 11 April to 4 September at HPF.

Study setting

General setting

Guinea is a West African country with an estimated population of nearly 17.6 million in 2025, 52% of whom are women [27]. The country is subdivided into seven administrative regions, comprising 33 prefectures (districts) and the capital, Conakry, which is organised into nine urban communes [28].

The Guinean healthcare system is organised into public and private sectors. The public sector, aligned with the country's administrative divisions and structured hierarchically, is responsible for providing sexual, reproductive, maternal, neonatal, child, and adolescent health services across three levels. At the peripheral level, which encompasses the 33 inland prefectures and the capital, Conakry, service delivery is ensured through community health workers, 2,308 health posts, and 413 health centres, of which 91 (22%) provide Basic Emergency Obstetric and Newborn Care (BEmONC). The intermediate level comprises six communal medical centres (CMCs), 26 prefectural hospitals, and eight regional hospitals, all providing CEmONC. At the national level, there are three national hospitals-Hôpital de l'Amitié Sino-Guinéenne, Hôpital National Donka, and Hôpital National Ignace Deen-which together form the teaching hospital of Conakry [28]; however, only Hôpital National Ignace Deen was providing CEmONC at the time of data collection.

The private sector accounts for an important share of health facilities providing childbirth care, particularly in Grand Conakry. However, it is not formally organised into a hierarchical framework. Among these facilities, only two provide BEmONC (Dispensaire Saint Gabriel and Berney Fotoba), and none is designated as CEmONC, even though some provide caesarean section (CS) [14].

Study sites

Data collection activities were carried out in the maternity wards of three urban hospitals representing different levels of the healthcare system pyramid: the prefectural or district level (Forécariah Prefectural Hospital, HPF); the regional level (Mamou Regional Hospital, HRM); and the national level (Ignace Deen National Hospital, HNID) in Conakry [29].

The HPF maternity ward is at the first level of referral within the Guinean health system, receiving patients referred primary health facilities, and private clinics in the prefecture of

Forécariah. The HRM maternity ward serves as both the primary referral centre for Mamou prefecture and the intermediate referral service for the three prefectures that make up the Mamou administrative region: Mamou, Dalaba, and Pita. HPF does not refer to HRM as they are not nested in the same geographic unit. The HNID maternity ward in Conakry is a national tertiary referral unit and is currently the largest and highest-level maternity ward in the country (**Figure 1**). All three hospitals offered the full range of CEmONC functions at the time of the study. Further details on the characteristics of these hospitals are presented elsewhere [16].

Study population

Our study population included all women arriving at the three hospitals as a result of referral during the study period. Inclusion criteria involved being alive at admission, providing consent for participation (women or other informants reporting on women's behalf), and admission to the maternity wards of any the three hospitals for maternal care services, defined as antenatal, intrapartum, postpartum, and postabortion care (Full questionnaire is available online [29]).

What is an obstetric referral?

The World Health Organization defines referral as a process in which a health worker at one level of the health system, having insufficient resources to manage a clinical condition, seeks the assistance of a better or differently resourced facility at the same or higher level to assist in, or take over, the management of the case [17].

In this study, a woman was classified as referred if she arrived for the purpose of receiving antenatal, intrapartum, postpartum, or postabortion care to any of the three maternity wards, having been sent by any skilled care provider (medical doctor, midwife, or nurse) as long as that provider is not working at the destination facility. Women were considered referred if they arrived from any health facility or from community settings.

As the study was descriptive, we did not calculate a formal sample size but enrolled all eligible women admitted as a result of referral during the study period. Based on care providers' estimates of the average monthly number of referrals before the study, we anticipated about 1,500 women at Ignace Deen, 450 at Mamou, and 300 at Forécariah.

Data collection procedures

This study used primary data from respondents (the referred women or companion(s) such as partner, other relative, or a neighbour), and secondary data from individual patient records.

A structured questionnaire was developed to monitor data completeness and quality, organised into four sections [29]. The admission section collected informed consent, admission time, and referral screening questions at hospital admission (section1). The referral pathway section, administered shortly after admission, captured information on the referral process and the previous facility visited (section 2). The labour and birth section, completed during admission, included details on the reason for admission, labour complications, and newborn outcomes (section 3). Finally, the discharge section, completed at discharge, recorded postpartum complications, blood transfusions, and maternal and newborn outcomes (section 4).

The four sections were integrated into Kobocollect and linked using a unique identification code generated at admission (More details are available here [29]).

The questionnaire was developed through an iterative process and aimed to close the gap in incomplete patient records reported in our previous study in the same maternity hospitals [16]. To ensure that we are not missing any women admitted, data collection was conducted 24-hours a day/7-days a week by nine medical doctors and midwives under the supervision of FMG, HFS, and PK over the study period (4 in HNID, 3 in HRM, 2 in HPF). To ensure data quality, data collectors underwent three days of training, and the tools were piloted for two days in each hospital prior to full implementation. Standard operating procedures and data collector guidelines were developed to support the process. In addition, a WhatsApp group was created with all data collectors and supervisors to ensure common understanding, identify challenges, and agree on solutions across the three hospitals.

Variables

We collected a wide range of socio-demographic, clinical, and referral-related variables. The table below shows these variables by domain, variable name, and variable category. Detailed information was collected on the reasons women were admitted. This information was then grouped under broader items (e.g., labour progress complications capture conditions such as cephalopelvic disproportion (CPD) and foetal macrosomia, which were recorded under numerous spellings and local abbreviations in the clinical registers). This process was carried out in consultation with the co-authors, some of whom are gynaecologists practicing at the three referral hospitals. All variables, with their domains, names, and categories, are presented in **Table SI1**.

The time of day was categorized into four periods, following the approach used by Birabwa et al. in their study of referral pathways in Kampala : morning (05:00–11:59), afternoon (12:00–16:59), evening (17:00–20:59), and night (21:00–04:59). This categorization was intended to account for potential differences in the availability of care providers and transportation services across different times of the day.

Indicators

Three primary indicators were defined in this study: referral rate, in-facility maternal mortality ratio, and stillbirth rate.

Referral rate: the number of women who were admitted as result of a referral over the total number of women admitted in the maternity ward during the corresponding period.

In-facility maternal mortality ratio (IMMR): the number of in-facility maternal deaths per 100,000 livebirths [30] and per 100,000 deliveries among women admitted as a result of referral.

Stillbirth rate: was defined as the number of stillbirths per 1,000 births among women admitted as a result of referral.

Data analysis

The data were extracted from the KoboToolbox platform, cleaned, merged, and analysed using R software (version 4.5.2). All estimates were stratified by hospital because each facility occupies a distinct level of the referral system serving structurally different populations, such that a pooled rate would be a volume-weighted average dominated by the largest facility and would correspond to no real population. First, for each hospital, we described the characteristics of the study population using absolute numbers and percentages for categorical variables and medians with interquartile range (IQR) for quantitative variables. Second, we described the referral process (women origins, mean of transportation and barriers). We also described complications by time of day. Finally, we estimated three primary indicators (referral rate, IMMR and stillbirth rate). The preliminary results were presented at a results dissemination and validation workshop held on 4 February 2026 at the University Gamal Abdel Nasser of Conakry, attended by three providers from each of the three maternity wards including one senior obstetrician and one midwife, data collectors, a representative from the National Directorate of Family Health and Nutrition, and the research team. Participants' comments and reflections were used to contextualise and interpret the results.

Results

Study population characteristics

Overall, among the 3,771 women admitted to the three maternity wards, 1,178 arrived as results of referral. At HNID, 1,509 women were admitted and 944 were referred (62.8%). At HRM, 1,680 women were admitted and 141 were referred (8.4%). At HPF, 583 women were admitted and 93 were referred (16%) (**Figure SI1**).

Table 1 presents the demographic and clinical characteristics of women admitted following referral, by hospital. The median age was 25 years at HNID, 26 years at HRM, and 22 years at HPF. Women aged 15-24 years represented 48% of admissions at HNID, 43% at HRM, and 58%. At HNID, 57% of women were admitted during the evening or night, compared to 34% at HRM and 16% at HPF. The majority of women came from the region in which the referral

hospital is located, representing approximately 89% for HNID and HRM, and 100% for HPF. Nulliparous women accounted for 34% of referrals at HNID, 23% at HRM, and 26% at HPF.

Maternal and perinatal outcomes

Over the study period of five months, HNID and HRM recorded four maternal deaths each among referred cases, corresponding to an IMMR of 564 and 5,970 maternal deaths per 100,000 livebirths, respectively. No maternal deaths were reported among referred women at HPF over the study period. Haemorrhage was the leading cause of death at HNID (3 out of 4), while hypertensive disorders/eclampsia predominated at HRM (3 out of 4). Obstructed/prolonged labour (2 of 4), uterine rupture (1 of 4), and anaemia (1 of 4) were additional contributing causes at HNID, whereas sepsis (1 out of 4) was reported only at HRM (**Table 2**).

Among the 834 births at HNID, 125 were stillbirths, meaning a stillbirth rate of 150 per 1,000 births, of which 70% were fresh stillbirths. At HRM, 18 of 85 births were stillbirths (212 per 1,000 births; 61% fresh stillbirths), while at HPF, 11 of 85 births were stillbirths (129 per 1,000 births; 67% fresh stillbirths) (**Table 2**).

Regarding referrals out of the three maternity wards for newborns who needed advanced care, 18% of the 709 newborns at HNID were transferred to another unit or service, of which 77% were sent to the Institute of Child Nutrition and Health (INSE at Donka Hospital). At HRM, 30% of 67 newborns, and 18% of 74 newborns at HPF were transferred to the neonatal unit within the same hospital (**Table 2**).

Referral process: facility, notification, and transport

Table 3 presents the characteristics of the referral process. Almost all of the 944 referred women admitted to HNID were referred by a health facility (99%). The referring facilities were mainly district hospitals/CMCs (46%), followed by primary health facilities, including both public health centres and faith-based facilities (27%). Private health facilities accounted for nearly 16% of referrals. The percentage of women referred from a health facility was 72% of the 141 women at HRM and 43% of the 93 women at HPF. The remaining women (28% at HRM and 57% at HPF) were referred from the community by skilled care providers. At HRM, all women referred by a health facility came from primary-level facilities and a similar pattern observed at HPF, where 39 of 40 came from primary health facilities and one from a clinic.

About half (48%) of referred women admitted at HNID had either a referral document (39%) or were preceded by a phone call to notify of their arrival (9%). This percentage was considerably higher at HRM, where 90% of referred women were with prior notification (89% with a referral document and 1% via phone call), and at HPF, where 86% of women were referred with prior notification (82% with a referral document and 4% via phone call).

Nearly 17% of referred women reaching HNID arrived by ambulance, compared with 0% at HRM and 2% at HPF. Taxis and motorcycles were the primary transportation modes used by women to travel to referral hospitals. More than half of referred women admitted to each

facility arrived by taxi (58% at HNID, 74% at HRM, and 55% at HPF). At HNID, taxis were followed by private cars (19%) and motorcycles (4%). At HRM, women commonly arrived by motorcycle (23%) or taxi (73%). At HPF, 54% of referred women used taxis, followed by motorcycles (39%) (**Figure 2-A**).

In terms of challenges in reaching hospitals, traffic congestion was the most frequently reported barrier among referred women admitted to HNID (85%). In contrast, referred women reaching HRM and HPF more commonly reported poor road conditions (52% and 67%, respectively) and heavy rains (25% and 33%, respectively) (**Figure 2-B**).

Obstetric complications

Among the 1,178 women admitted following referral, intrapartum complications were the main reason for referral (85% at HNID, 57% at HRM, and 86% HPF). Postpartum admissions were twice as frequent at HRM (13%) as at HNID (6%) and HPF (5%) **Table 4**).

Analysis of specific types of complications showed that labour-related complications were the most common across hospitals, accounting for 34% of referrals at HNID, 36% at HRM, and 46% at HPF. At HNID, hypertensive disorders (24%), antepartum or intrapartum haemorrhage (16%), and foetal complications (7%) followed. At HRM, hypertensive disorders (11%), antepartum or intrapartum haemorrhage and malaria (9% each), and postpartum haemorrhage (8%) were most frequent. At HPF, antepartum or intrapartum haemorrhage (15%), foetal complications (9%), and hypertensive disorders (8%) predominated. Postabortion complications represented up to 5% of referrals at HRM and less than 2% at the other two hospitals, while at HNID nearly 1% (n=8) of women were referred because they disagree with the proposed care plan during childbirth (**Table 3**). Further details are available in **Table SI2** and **SI3**.

Mode of delivery and caesarean section indications

Among the 960 intrapartum cases (799 at HNID, 81 at HRM and 80 at HPF), the proportion of CS was 52% at HNID, 57% at HRM, and 63% at HPF. The proportion of episiotomies ranged from 9% at HPF to nearly 14% at HNID. At HRM, vacuum extraction was performed in approximately 3% of cases (**Table SI4**).

Postpartum complications and blood transfusion

Table 5 presents postpartum complications along with blood transfusion. Among the 12 women admitted for intrapartum complication who developed postpartum complications, three cases were recorded at HNID, seven at HRM, and two at HPF. At HNID, postpartum haemorrhage accounted for 0.3%. At HRM, postpartum haemorrhage occurred in 5% of women who gave birth and only 1% involved retained placenta. At HPF, one operation-site infection and one severe malaria were documented among women who gave birth (1%).

Blood transfusion was required for 7%, 15%, and 8% of all referred cases at HNID (n = 944), HRM (n = 141), and HPF (n = 93), respectively. Transfusion was successfully performed in

95% of indicated cases at HNID and in all indicated cases at HRM and HPF. At HNID, 61% of transfusions used blood supplied by the National Blood Transfusion Centre and 15% from family and friends; at HRM, one-third of transfusions originated from donors, compared to 14% at HPF, with the remainder sourced from hospital blood banks.

Types of complications by admission time categories

Figure 3 shows the distribution of referral complications by time of admission across the three hospitals. Overall, the night period accounted for a large share of severe complications admissions across several complication types at HNID. Most intrapartum complications were admitted at night (45%) and in the morning (28%). Ante- and intrapartum haemorrhagic complications and hypertensive disorders followed a similar pattern, with higher proportions during night hours (37% each). More than half of postabortion complications (56%) were also admitted at night.

At HRM, the distribution of complications showed a concentration during the night and morning hours. Ante- and intrapartum complications were more frequent in the morning (39%) and at night (31%). Postpartum haemorrhages were more common at night (46%) and less frequent in the morning (9%). Similarly, postpartum infections and postabortion complications were mainly reported at night (40% and 43%, respectively) compared with the morning (20% and 14%).

At HPF, referrals displayed a predominantly afternoon pattern compared with HNID and HRM. Almost all types of complications followed this afternoon trend. Labor-related complications were concentrated in the afternoon (65%) and morning (26%), as were ante- and intrapartum haemorrhages (79%). Postpartum haemorrhage and foetal complications were evenly distributed between the afternoon and evening (50% each). Hypertensive disorders were more frequent in the afternoon (43%) and at night (29%), while postabortion complications occurred exclusively in the afternoon (100%).

Discussion

Prospective descriptions of obstetric referral in sub-Saharan African maternity settings remain scarce; most evidence relies on routine or retrospective data, and referral itself is inconsistently defined across studies [31–33]. This study addresses that gap by using a clear operational definition of referral and prospective data to characterise referred women, their pathways, and outcomes across three urban hospitals in Guinea. It builds on our earlier routine-data work in the same facilities [16], extending it by deepening our understanding of referred women cases specifically.

In this study, referred women accounted for 63% of admissions at HNID, 8% at HRM and 16% at HPF. Among these women, maternal mortality was high at HNID (564 per 100,000 livebirths) and HRM (5,970 per 100,000 livebirths). Stillbirth rates ranged from 129 per 1,000 births at HPF to 212 at HRM, with at least 45% being fresh stillbirths. Intrapartum

complications were the leading reason for referral and haemorrhage the leading cause of maternal death at HNID while hypertensive disorders were reported as leading cause of maternal at HRM. Ambulances were rarely used, carrying 17% of referred women at HNID and almost none at HRM or HPF. These findings point to failures across the referral pathways, affecting primary care, referral organisation, and quality of care at each level.

At HNID, women admitted following a referral represented nearly two-thirds of admissions. This confirms and quantifies an observation left open by our previous study at the same facility, which lacked clear evidence on the proportion of referrals among admissions due to incomplete patient records [16], and is consistent with the profile of a tertiary hospital. Referred women came from all levels of the system, including district hospitals/CMCs, regional hospitals and private facilities, some over 500 km away: the national hospital's catchment extends well beyond its administrative area, as women and care providers often bypass the nearest district or regional hospital to seek care or refer women at the national level [15], which may increase workload and strain already scarce resources. This pressure has grown over time, with annual admissions rising from around 4,000 in 2015 [34] to nearly 7,000 in 2021–2023 [16,26].

At HRM and HPF the pattern reversed. HRM recorded more admissions yet only 8.4% were referred. HPF's referral share was about twice that (16%). Similar direct admission pattern has been described in Kampala [15]. In Guinea, women should attend their nearest primary facility first, where staff manage the birth or refer upward when the case exceeds their capacity. The low referral share indicates that the primary level is frequently bypassed. We lack routine data to support that claim here, but stakeholders reported bypassing even where a primary facility exists; in Mamou and Forécariah for instance, health centres sit opposite the referral hospital, yet women prefer to give birth at the hospital directly. This has also been reported elsewhere in SSA [15,35]. This pattern likely reflects deficiencies in primary-level care quality, whether perceived or real [31].

Poor outcomes among referred women are best read through the six-delays model, which splits the traditional three delays framework into initial-care and referral-care stages [20]. Referred women have already passed the first three delays and are navigating the second set. Therefore, poorer outcomes reflect dysfunction across the pathway and at admission, rather than care at HNID, HRM, or HPF alone [15,36].

At HNID, the IMMR among referred women (564 per 100,000 livebirths; 4 deaths per 709 registered livebirths) was lower than the rate of 1,264 per 100,000 livebirths among all women (referred and not) reported in our previous study (151 deaths per 11,943 registered livebirths). This likely reflects the shorter observation period (5 versus 24 months) rather than better outcomes; the true toll may also be understated, since women who died before admission were not counted, and more such deaths were recorded here. At HRM, the IMMR (5,970 per 100,000 livebirths; 4 deaths per 67 registered livebirths) far exceeded the rate of 245 per 100,000 reported in our study (19 deaths per 7,748 livebirths), although it was based on a very small number of referred cases. Comparable excess risk has been reported in Harare [37] and Nigeria [38]. No maternal death was recorded at HPF, probably because it lacks obstetricians and transfers its most severe cases onward to HNID [16].

Stillbirth rates were also high (150/1,000 births at HNID, 212 at HRM, 129 at HPF), with 70%, 61% and 46% fresh stillbirths respectively. Fresh stillbirths are a proxy for intrapartum foetal death. This indicates that many foetuses may have been alive when the woman started her journey to seek care. These deaths are therefore more likely linked to delays along the pathway and to care at the receiving hospital than to antenatal factors [39]. With timely and adequate care, some of these stillbirths could have been prevented [40]. Stakeholders offered concrete explanations for the high number of stillbirths at HNID, including the absence of an ultrasound and a cardiotocograph in the delivery room and limited means for monitoring the foetus before, during and after delivery, and, at times, insufficient promptness of monitoring by staff. Conakry's road congestion may have also compound this by delaying transfer [41].

Maternal and perinatal risk are thus concentrated among referred women, consistent with our earlier findings [16] and COVID-period surveillance across the same hospitals [42]. Stakeholders described women arriving already critical after long journeys, sometimes dying before or shortly after arrival; such cases did not meet our admission-alive criterion and are excluded from the ratios above, still the pattern fits the observed risk concentration. These results reinforce our call to reconsider the hierarchical referral model in this congested urban setting [16,43]. The system needs strengthening at both ends: relieving the national hospital, while rebuilding primary- and secondary-level capacity to identify, manage, and where necessary refer complications upward in a timely way. , and rebuilding women’s trust in their nearest facilities. Rebuilding women’s trust is important as well.

In this study, we also observed that intrapartum complications were the main reason for referral everywhere (85% HNID, 86% HPF, 57% HRM). Labour-related complications were commonest (34–46%), followed by hypertensive disorders and haemorrhage, with higher percentages at HNID (24% and 16%). These conditions were also involved in maternal deaths: haemorrhage at HNID (3 out of 4), eclampsia at HRM (3 out of 4), in line with our earlier work [16] and global evidence that haemorrhage and hypertensive disorders are among the leading causes of maternal death [44].

Time of admission also matters. At HNID, 45% of labour-related complications, haemorrhage and hypertensive disorders (37% each) and postabortion complications (56%) arrived at night. Night (roughly 9pm–5am) covers about a third of the day, so some concentration is expected, but it is also when the hospital can least respond, with fewer staff and senior obstetricians and the theatre, laboratory and blood bank hardest to mobilise. Even in high-income settings, night-time deliveries requiring obstetric intervention carry higher perinatal risk than daytime ones [45].

This pattern also points upstream. District hospitals, CMCs and regional hospitals should manage many of these complications, including caesarean section, but their capacity is limited: most have a single operating theatre, cannot handle simultaneous CS, and cannot assemble a senior clinician after hours. Night-time clustering of severe referrals is therefore a sign of limited emergency obstetric capacity along the whole chain, not only at the receiving hospital.

Our findings also showed that ambulances were rarely used for referred women: 17% at HNID, almost none at HRM or HPF; most arrived by taxi or motorbike. We assessed use, not availability. Ambulances are not especially scarce, so the problem lies less in their number than in how they are managed and dispatched and, above all, their cost. Because families pay themselves and shared taxis are cheaper, the ambulance is often the option they decline. We did not measure this directly, so it remains providers' assessment rather than a confirmed result, but it fits the pattern better than any account based on vehicle numbers alone.

What an ambulance offers also matters [46]. A vehicle marked as an ambulance with a siren does little for a woman or newborn with complications if it carries no trained staff and no basic equipment, and in Guinea many carry neither. In Kampala, drivers reported vehicles lacking oxygen, stretchers and other essentials [43]. A study in eastern Ethiopian also described the same, with poor ambulance services (no trained staff, no equipment, ambulances misused) as a central referral-chain weakness [47]. The neonatal end makes this concrete: at INSE, Conakry's only neonatal intensive care unit, most referred newborns arrived by taxi (71%) not ambulance (2.3%), the taxi being more available in a peninsular city where dense traffic on a poor road network delays ambulance. Even ambulance-transported newborns travelled with no oxygen, incubator or monitoring, showing an ambulance on paper does not mean better care [48].

Timely ambulance availability at the primary level for carrying women to the referral hospital is also uncertain: ambulances are often based at the hospital, while some primary facilities lie tens of kilometres away, and every minute of waiting increases the risk to the woman and her newborn.

If ambulances are used so little, the question is how to organise services around them, not replace them. Several sub-Saharan initiatives recruit and train local taxi and motorcycle drivers in advance. Tanzania's m-mama programme routes each referral to an ambulance or a registered community driver, paid afterwards at a pre-agreed rate. In Shinyanga, community drivers handled most referrals (69.9%) at nearly a third the cost per completed trip of ambulances alone (USD 170.4 vs 472) [49]. In Mozambique, a neighbourhood-cofinanced transport fund worked without outside vehicles [50].

Implications

Our findings suggest weaknesses at more than one level of the referral system. Referral shares were low at the district and regional hospitals, indicating that many women reach these facilities without passing through the primary level, while the national hospital drew referrals from every level, including cases lower levels might have managed. Stakeholders linked some of the upward referrals to limited capacity, such as facilities having a single operating theatre. Although we did not measure capacity or triage directly, this pattern suggests that strengthening any single level in isolation is unlikely to be enough: adding capacity at the national hospital will not ease its overload if lower levels continue to be bypassed, and strengthening primary care would achieve little if referral links between levels

remain weak. The system may therefore need to be addressed as a whole. Three priorities follow.

First, emergency obstetric and newborn care needs to be available at all hours at district and regional hospitals, not only at the national one. In our data, severe cases arrived mostly at night, when these hospitals are least able to respond, and stakeholders described referrals that happened simply because no night team, blood, or working theatre was available. Such referrals reflect gaps in capacity rather than clinical need. Closing them would require more skilled staff, including the ability to perform more than one caesarean at once, and reliable after-hours cover. Given the shortage of specialists, this is likely to depend on better deployment and retention of staff across the country, alongside task-sharing so that trained non-specialists can manage emergencies [51].

Second, transport needs to be run as a coordinated service, not just a set of ambulances. In our study, ambulances were rarely used, and stakeholders attributed this to their cost, poor call-out management, and the lack of care during the trip, rather than to a shortage of vehicles. If so, adding ambulances would not cut delays. A better approach would be to make transport affordable or free, equip it to provide care during transport, coordinate it centrally, and build on what women already use, taxis and motorbikes, rather than replace it. Similar community-driver models elsewhere have moved most referrals at a fraction of the cost of ambulances, which suggests this is feasible. It matters most for referrals from facilities far from the hospital, where an ambulance has furthest to travel.

Third, primary care needs to become the first place women go, and this depends as much on women's trust in it as on its facilities and equipment. Women in our setting bypassed primary facilities even when one sat next to a referral hospital, which suggests distance is not the main barrier. We did not measure why women chose as they did, but low confidence in primary-level care is a plausible explanation, consistent with reports from other cities. If so, equipment and staff alone will achieve little: women also need reason to believe the nearest facility can safely manage their birth. Rebuilding this level therefore means improving care and making that improvement visible to the communities that use it.

Strengths and limitations

This study has several strengths. First, referred women were identified and included by enumerators present around the clock throughout the study in all three hospitals, improving case identification and data quality and addressing a limitation of our earlier study [16]. Second, once identified, we followed each woman's record through her stay and captured key outcomes rather than relying on secondary data. By recording origin, the last facility visited, mode of transport, prior notification, arrival time and subsequent events, this study fills gaps that secondary-data studies, including our own, could not [16]. We also held a dissemination workshop with stakeholders from the three maternity wards to interpret and validate the results, grounding our explanations in each facility's reality.

Limitations should be acknowledged. First, we included only women who reached the maternity wards and met our inclusion criteria. Those were referred but never arrived, or

died before admission, are not captured. Second, we may have underestimated the percentage of women arriving as a referral due to excluding women who ‘s sending and receiving skilled care providers was the same person. Third, we cannot compare referred with non-referred women, who were outside this study's scope. Fourth, although the perinatal burden was very high, fresh/macerated stillbirths may have been misclassified, possibly from staff reluctance to register fresh stillbirths. Future studies linking care-pathway data with hospital-preparedness assessments, and reaching women who never arrived, would contextualise these findings and strengthen the case for the changes we propose. Finally, we would have liked to have the babies’ survival, but we were unable to track babies referred to NICUs/externally

Conclusion

In these three urban hospitals in Guinea, the obstetric referral system did not function as a clear hierarchy. Demand concentrated at the national hospital, while the regional hospital admitted the most women yet received the fewest through formal referral, suggesting that lower levels were often bypassed rather than used as intended. Women frequently arrived late, unannounced, by informal transport, and at night, when hospitals were least able to respond. Their maternal and perinatal outcomes were poor, and the high proportion of fresh stillbirths suggests that many of these deaths occurred around the time of arrival, pointing to problems along the pathway rather than at any single facility.

Because these weaknesses appear to span the whole system, reducing these deaths is likely to require change at every level and in the links between them: emergency obstetric care available at all hours, coordinated and affordable transport, and primary care that women trust enough to use first. These findings come from three urban hospitals over five months, yet they show what a referral system looks like from the receiving end. The women this study could not capture, those referred who never arrived and those who bypassed primary care, hold the missing part of the picture.

Declarations

Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

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Declaration of generative AI use

During the preparation of this work, the author(s) used Claude AI for coding/R script and text Editing. The author(s) reviewed and edited the output as needed and take full responsibility for the content of the published article.

References

1. WHO, UNICEF, UNFPA, World Bank Group, UNDESA/Population Division. Trends in maternal mortality 2000 to 2023 [Internet]. 2025 [cited 2026 Jun 26]. Available from: https://www.who.int/publications/i/item/9789240108462
2. WHO Regional Office for Africa. African region's maternal and newborn mortality declining, but progress still slow [Internet]. 2025 [cited 2026 Jun 26]. Available from: https://www.afro.who.int/news/african-regions-maternal-and-newborn-mortality-declining-progress-still-slow
3. UNICEF DATA. Delivery care [Internet]. 2024 [cited 2026 Jun 26]. Available from: https://data.unicef.org/topic/maternal-health/delivery-care/
4. Boerma T, Campbell OMR, Amouzou A, Blumenberg C, Blencowe H, Moran A, et al. Maternal mortality, stillbirths, and neonatal mortality: a transition model based on analyses of 151 countries. Lancet Glob Health. 2023 Jul 1;11(7):e1024–31. doi:10.1016/S2214-109X(23)00195-X PubMed PMID: 37349032.
5. United Nations Inter-Agency Group for Child Mortality Estimation (UN IGME). Levels and trends in child mortality 2024 [Internet]. 2024 [cited 2026 Jun 26]. Available from: https://data.unicef.org/resources/levels-and-trends-in-child-mortality-2024/
6. UNICEF DATA. Standing Up for Stillbirth: Current estimates and key interventions [Internet]. 2025 [cited 2026 Jun 26]. Available from: https://data.unicef.org/resources/standing-up-for-stillbirth-report/
7. Asefa YA, Gemeda AT, Blencowe H, Assefa N, Persson LÅ, Seale AC. Perinatal mortality in eastern Africa: A systematic review and meta-analysis. International Journal of Gynecology and Obstetrics. 2026 Jun 1;173(3):1207–22. doi:10.1002/IJGO.70717;ISSUE:ISSUE:DOI PubMed PMID: 41574390.
8. Cresswell JA, Alexander M, Chong MYC, Link HM, Pejchinovska M, Gazeley U, et al. Global and regional causes of maternal deaths 2009–20: a WHO systematic analysis. Lancet Glob Health. 2025 Apr 1;13(4):e626–34. doi:10.1016/S2214-109X(24)00560-6 PubMed PMID: 40064189.
9. Molenaar J, Beňová L, Abimbola S, Owolabi O, Lurton G, Macharia PM. The richness of urban health realities lost in measurement monocultures. BMJ Glob Health. 2026 Mar 26;11(3):e023241. doi:10.1136/BMJGH-2025-023241 PubMed PMID: 41887664.
10. Delamou A, Dubourg D, Beavogui AH, Delvaux T, Kolié JS, Barry TH, et al. How Has the Free Obstetric Care Policy Impacted Unmet Obstetric Need in a Rural Health District in Guinea? PLoS One. 2015 Jun 5;10(6):e0129162. doi:10.1371/JOURNAL.PONE.0129162 PubMed PMID: 26047472.
11. The DHS Program. Guinea: DHS, 2018 - Final Report (French) [Internet]. 2018 [cited 2021 Mar 21]. Available from: https://www.dhsprogram.com/publications/publication-FR353-DHS-Final-Reports.cfm
12. Semaan A, Grovogui FM, Delvaux T, Housseine N, Van Den Akker T, Delamou A, et al. Correction: Length-of-stay and factors associated with early discharge after birth in health facilities in Guinea by mode of birth: Secondary analysis of Demographic and

Health Survey 2018. PLOS global public health. 2025 Aug 1;5(8). doi:10.1371/JOURNAL.PGPH.0005019 PubMed PMID: 40768495.
13. Macharia P, Semaan A, GROVOGUI FM, Manet H, Dioubate N, Libertini L, et al. Not all cities are the same: different tales of maternal health indicators in 62 sub-Saharan African conurbations [Internet]. 2025 Oct 15. doi:10.21203/RS.3.RS-7851216/V1
14. Dioubate N, Semaan A, Ouko R, Djidonou GJ, Keita MK, Kpogomou P, et al. The profile of urban healthcare service provision with a focus on maternal and newborn health in Grand Conakry, Guinea: Results of a 2025 health facility census. medRxiv. 2026 Aug 21;2026.08.19.26360676. doi:10.64898/2026.08.19.26360676
15. Birabwa C, Benová L, Olmen J van, Semaan A, Waiswa P, Banke-Thomas A. Emergency Obstetric Care Access Dynamics in Kampala City, Uganda: Analysis of Women's Self-Reported Care-Seeking Pathways. Glob Health Sci Pract. 2024 Dec 1;12(6). doi:10.9745/GHSP-D-24-00242 PubMed PMID: 39662976.
16. Grovogui FM, Semaan A, Manet H, Kourouma K, Delvaux T, Macharia PM, et al. Levels of in-facility maternal mortality, obstetric complications and stillbirths in three urban referral hospitals in Guinea: analysis of routine data from May 2021 to April 2023. BMJ Glob Health. 2026 May 14;11(5):20317. doi:10.1136/BMJGH-2025-020317 PubMed PMID: 10.1136/bmjgh-2025-020317.
17. WHO. High-value referrals: learning from challenges and opportunities of the COVID-19 pandemic: concept paper [Internet]. 2023 [cited 2026 Jun 26]. Available from: https://www.who.int/europe/publications/i/item/WHO-EURO-2023-7452-47219-69202
18. Hussein J, Kanguru L, Astin M, Munjanja S. The Effectiveness of Emergency Obstetric Referral Interventions in Developing Country Settings: A Systematic Review. PLoS Med. 2012 Jul;9(7):e1001264. doi:10.1371/JOURNAL.PMED.1001264 PubMed PMID: 22807658.
19. Maternity Worldwide. The Three Delays Model and our Integrated Approach [Internet]. [cited 2026 Jun 26]. Available from: https://www.maternityworldwide.org/what-we-do/three-delays-model/
20. Franke MA, Iata Pasteur G. The Six Delays Model: expanding the three delays model with evidence from Madagascar for maternal referrals in LMICs. BMJ Glob Health. 2026 Feb 17;11(2). doi:10.1136/BMJGH-2025-020936 PubMed PMID: 10.1136/bmjgh-2025-020936.
21. Cresswell JA, Alexander M, Chong MYC, Link HM, Pejchinovska M, Gazeley U, et al. Global and regional causes of maternal deaths 2009–20: a WHO systematic analysis. Lancet Glob Health. 2025 Apr 1;13(4):e626–34. doi:10.1016/S2214-109X(24)00560-6 PubMed PMID: 40064189.
22. Das S, Patil S, Pathak S, Chakravarthy S, Fernandez A, Pantvaidya S, et al. Emergency obstetric referrals in public health facilities: A descriptive study from urban Maharashtra, India. Frontiers in health services. 2023;3. doi:10.3389/FRHS.2023.1168277 PubMed PMID: 37138953.
23. Okot G, Omara S, Kasujja M, Pebalo FP, Baruti P, Ubarnel NA. Incidence and factors associated with immediate adverse neonatal outcomes among emergency obstetric referrals in labor at a tertiary hospital in Uganda: a prospective cohort study. BMC

Pregnancy Childbirth. 2024 Dec 1;24(1). doi:10.1186/S12884-024-06900-6 PubMed PMID: 39478452.
24. Nkyekyer K. Peripartum referrals to Korle Bu teaching hospital, Ghana - A descriptive study. Tropical Medicine and International Health. 2000 Nov 1;5(11):811–7. doi:10.1046/J.1365-3156.2000.00640.X;CTYPE:STRING:JOURNAL PubMed PMID: 11123830.
25. Ntoimo LF, Okonofua FE, Ogu RN, Galadanci HS, Gana M, Okike ON, et al. Prevalence and risk factors for maternal mortality in referral hospitals in Nigeria: a multicenter study. Int J Womens Health. 2018;10:69. doi:10.2147/IJWH.S151784 PubMed PMID: 29440934.
26. Diallo A, Michalek IM, Bah IK, Diallo IA, Sy T, Roth-Kleiner M, et al. Maternal mortality risk indicators: Case-control study at a referral hospital in Guinea. European Journal of Obstetrics and Gynecology and Reproductive Biology. 2020 Aug 1;251:254–7. doi:10.1016/j.ejogrb.2020.05.066 PubMed PMID: 32554328.
27. Institut National de la Statistique|Guinea. Recensement Général de la population et de l'habitation (RGPH-4) 2025:Résultats préliminaires [Internet]. 2026 [cited 2026 Jul 1]. Available from: https://www.stat-guinee.org/
28. Institut National de statistique|Guinea. Annuaire statistique 2022 [Internet]. 2023 [cited 2023 Sep 16]. p. 50. Available from: https://www.stat-guinee.org/index.php/publications-ins/89-publications-annuelles
29. Grovogui FM, Semaan A, Benova L, Macharia PM, Delvaux T, Bangoura C, et al. Analyse de la qualité des soins et de son effet sur la morbidité et la mortalité maternelles et périnatales chez les femmes référées dans trois (03) maternités urbaines en Guinée [Internet]. doi:10.5281/ZENODO.15393278
30. WHO | The global health observatory. Maternal mortality ratio (per 100 000 live births) [Internet]. [cited 2026 Jul 3]. Available from: https://www.who.int/data/gho/indicator-metadata-registry/imr-details/26
31. Kyei-Nimakoh M, Carolan-Olah M, McCann T V. Access barriers to obstetric care at health facilities in sub-Saharan Africa—a systematic review. Systematic Reviews 2017 6:1. 2017 Jun 6;6(1):110-. doi:10.1186/S13643-017-0503-X PubMed PMID: 28587676.
32. Ameyaw EK, Njue C, Tran NT, Dawson A. Quality and women's satisfaction with maternal referral practices in sub-Saharan African low and lower-middle income countries: a systematic review. BMC Pregnancy and Childbirth 2020 20:1. 2020 Nov 11;20(1):682-. doi:10.1186/S12884-020-03339-3 PubMed PMID: 33176732.
33. Avoka CK, McArthur E, Banke-Thomas A. Interventions to improve obstetric emergency referral decision making, communication and feedback between health facilities in sub-Saharan Africa: A systematic review. Tropical Medicine & International Health. 2022 May 1;27(5):494. doi:10.1111/TMI.13747 PubMed PMID: 35322914.
34. Diallo BS, Diallo MH, Balde O, Sylla I, Conte I, Diallo A, et al. The Maternal Deaths at the Obstetrics and Gynaecology Department of the Ignace Deen National Hospital, University Teaching Hospital (CHU) Conakry, Guinea. Open J Obstet Gynecol. 2019 May 13;9(5):597–603. doi:10.4236/OJOG.2019.95058

35. Jung M, Son J, Lee S, Yoon S. Bypassing primary healthcare facilities for maternal and child health services in low- and middle-income countries: a scoping review. Reproductive Health 2026 23:1. 2026 May 11;23(1):133-. doi:10.1186/S12978-026-02351-8 PubMed PMID: 42116056.
36. Straneo M, Beňová L, van den Akker T, Abeid MS, Ayebare E, Dossou JP, et al. Mixed vulnerabilities: the biological risk of high parity is aggravated by emergency referral in Benin, Malawi, Tanzania and Uganda. Int J Equity Health. 2025 Dec 1;24(1). doi:10.1186/S12939-025-02379-5 PubMed PMID: 39833887.
37. Busumani W, Mundagowa PT. Outcomes of pregnancy-related referrals from rural health facilities to two central hospitals in Harare, Zimbabwe: a prospective descriptive study. BMC Health Serv Res. 2021 Dec 1;21(1). doi:10.1186/S12913-021-06289-4 PubMed PMID: 33766018.
38. Akaba GO, Ekele BA. Maternal and fetal outcomes of emergency obstetric referrals to a Nigerian teaching hospital. Trop Doct. 2018 Apr 1;48(2):132–5. doi:10.1177/0049475517735474 PubMed PMID: 29108472.
39. Arega BN, Feleke LA, Tilahun HA, Ahmed DM, Hailu FG. Proportion of stillbirth and associated factors among women who deliver at public hospitals in Bahir Dar city, north-West Ethiopia. BMC Womens Health. 2024 Dec 1;24(1):122. doi:10.1186/S12905-024-02920-8 PubMed PMID: 38365779.
40. Christou A, Mbishi J, Matsui M, Beňová L, Kim R, Numazawa A, et al. Stillbirth rates and their determinants in a national maternity hospital in Phnom Penh, Cambodia in 2017-2020: a cross-sectional assessment with a nested case-control study. Reprod Health. 2023 Dec 1;20(1). doi:10.1186/S12978-023-01703-Y PubMed PMID: 37865789.
41. Grovogui FM, Dioubate N, Manet H, Kpogomou P, Millimouno TM, Semaan A, et al. Inequities in spatial access to childbirth care in the Grand Conakry conurbation, Guinea. Nature Cities 2025 2:5. 2025 Apr 23;2(5):422–33. doi:10.1038/s44284-025-00220-2
42. Millimouno TM, Dioubaté N, Niane H, Diallo MC, Maomou C, Sy T, et al. Effect of the COVID-19 pandemic on maternal and neonatal health services in three referral hospitals in Guinea: an interrupted time-series analysis. Reproductive Health 2023 20:1. 2023 Mar 25;20(1):50-. doi:10.1186/S12978-023-01599-8 PubMed PMID: 36966343.
43. Ononge S, Magunda A, Balaba D, Waiswa P, Okello D, Kaula H, et al. Strengthening Kampala's Urban Referral System for Maternal and Newborn Care Through Establishment of an Emergency Call and Dispatch Center. Glob Health Sci Pract. 2023 Jun 1;11(3). doi:10.9745/GHSP-D-22-00332 PubMed PMID: 37348939.
44. Cresswell JA, Alexander M, Chong MYC, Link HM, Pejchinovska M, Gazeley U, et al. Global and regional causes of maternal deaths 2009–20: a WHO systematic analysis. Lancet Glob Health. 2025 Apr 1;13(4):e626–34. doi:10.1016/S2214-109X(24)00560-6 PubMed PMID: 40064189.
45. Gijsen R, Hukkelhoven CWPM, Schipper CMA, Ogbu UC, de Bruin-Kooistra M, Westert GP. Effects of hospital delivery during off-hours on perinatal outcome in several

subgroups: a retrospective cohort study. BMC Pregnancy Childbirth. 2012 Sep 8;12. doi:10.1186/1471-2393-12-92 PubMed PMID: 22958736.
46. EmONC Digital Guinde. The revised EmONC Framework [Internet]. [cited 2026 Sep 4]. Available from: https://emonc.org/en/framework/signal-functions/
47. Mengist B, Semahegn A, Yibabie S, Amsalu B, Tura AK. Barriers to proper maternal referral system in selected health facilities in Eastern Ethiopia: a qualitative study. BMC Health Serv Res. 2024 Dec 1;24(1):376. doi:10.1186/S12913-024-10825-3 PubMed PMID: 38532445.
48. Alves MBM, Conté Nf, Diallo B, Mamadou M, Delamou A, John O, et al. "Assessing Today for a Better Tomorrow": An observational cohort study about quality of care, mortality and morbidity among newborn infants admitted to neonatal intensive care in Guinea. PLoS One. 2021 Aug 1;16(8):e0254938. doi:10.1371/JOURNAL.PONE.0254938 PubMed PMID: 34460846.
49. Munishi C, Mateshi G, Mlunde LB, Njiro BJ, Ngowi JE, Kengia JT, et al. Community-based transport system in Shinyanga, Tanzania: A local innovation averting delays to access health care for maternal emergencies. PLOS global public health. 2023 Aug 1;3(8). doi:10.1371/JOURNAL.PGPH.0001487 PubMed PMID: 37531348.
50. Amosse F, Kinshella MLW, Boene H, Sharma S, Nhamirre Z, Tchavana C, et al. The development and implementation of a community engagement strategy to improve maternal health in southern Mozambique. PLOS Global Public Health. 2023 Jan 1;3(1):e0001106. doi:10.1371/JOURNAL.PGPH.0001106
51. Van De Pas R, Kolie D, Delamou A, Van Damme W. Health workforce development and retention in Guinea: a policy analysis post-Ebola. Hum Resour Health. 2019 Aug 5;17(1). doi:10.1186/S12960-019-0400-6 PubMed PMID: 31382972.

Tables and figures

Table 1. Characteristics of women admitted as result of referral to the maternity wards of HNID, HRM, and HPF in Guinea, April–August 2025, n= 1,178

	HNID		HRM		HPF	
Characteristics	n = 944	%	n = 141	%	n = 93	%
Age group in years						
15-19	170	18.0	35	24.8	25	26.9
20-24	282	29.9	26	18.4	29	31.2
25-29	265	28.1	30	21.3	19	20.4
30-34	128	13.6	25	17.7	12	12.9
≥35	99	10.5	25	17.7	8	8.6
Median age in years (IQR)	25 (20, 29)		26 (20, 30)		22 (19, 29)	
Day of admission						
Weekday	679	71.9	107	75.9	79	84.9
Weekend	265	28.1	34	24.1	14	15.1
Period of admission						
Morning (05:00–11:59)	238	25.2	40	28.4	21	22.6
Afternoon (12:00–16:59)	171	18.1	53	37.6	57	61.3
Evening (17:00–20:59)	154	16.3	18	12.8	7	7.5
Night (21:00–04:59)	381	40.4	30	21.3	8	8.6
Originated from the same region						
Yes	848	89.3	125	88.7	93	100.0
No	96	10.7	19	11.3	-	-
Residence zone						
Urban	848	89.8	4	2.8	2	2.2
Rural	96	10.2	137	97.2	91	97.8
Parity (n=1,099)	n = 888		n = 123		n = 88	
No previous birth	302	34.0	28	22.8	23	26.1
1–2 previous births	330	37.2	29	23.6	24	27.3
≥3 previous births	256	28.8	66	53.7	41	46.6
Gestational age categories (n=1,096)	n=886		n=123		n=87	
<28 weeks	48	5.4	21	17.1	5	5.7
28-36 weeks	259	29.2	24	19.5	14	16.1
37-41 weeks	572	64.6	78	63.4	67	77.0
>41 weeks	7	0.8	-	-	1	1.1

Table 2. Distribution of maternal and perinatal outcomes among women admitted as a result of referral to the maternity wards of HNID, HRM, and HPF in Guinea, April–August 2025

Characteristics	HNID n (%)	HRM n (%)	HPF n (%)
In-facility maternal mortality ratio			
Number of maternal deaths (per 100,000 livebirths)	4 (564)	4 (5,970)	0
Number of maternal deaths (per 100,000 deliveries)	4 (480)	4 (4,706)	0
Causes of maternal deaths (n=8)			
Haemorrhage	3(75.0)	1(25.0)	-
Hypertensive disorders / Eclampsia	1(25.0)	3(75.0)	-
Obstructed / prolonged labour	2(50.0)	-	-
Uterine rupture	1(25.0)	-	-
Sepsis / infection	-	1(25.0)	-
Anaemia	1(25.0)	-	-
Stillbirth rates, (n=1,004)	**834**	**85**	**85**
Number of stillbirths (rate per 1,000 births)	125 (150)	18 (212)	11 (129)
% Fresh stillbirth	87 (69.6)	11 (61.1)	5 (45.5)
% Macerated stillbirth	38 (39.4)	7 (38.9)	6 (54.5)
Newborn referred/transferred among live births	124 (17.5)	20 (16.4)	11 (14.9)
Facility/service the newborn was referred to			
Neonatology unit (same facility)	28 (22.6)	20 (100.0)	11 (100.0)
Institute of Child Nutrition and Health (INSE Donka)	96 (77.4)	-	-

Table 3. Characteristics of the referral process-origin of referral, documentation and notification, and women's knowledge of referral timing among women admitted as result of referral to the maternity wards of HNID, HRM, and HPF in Guinea, April–August 2025, n= 1,178

	HNID		HRM		HPF	
Characteristics	n = 944	%	n = 141	%	n = 93	%
Last place visited before arrival						
Community setting	9	1.0	39	27.7	53	57.0
Health facility	935	99.0	102	72.3	40	43.0
Level of last health facility visited (n=1,077)	n=935		n=102		n=40	
Primary	253	27.1	102	100.0	39	97.5
*District hospital/CMC**	432	46.2	-	-	-	-
Regional hospital	103	11.0	-	-	-	-
Clinic	147	15.7	-	-	1	2.5
Ownership of last health facility						
Public	688	73.6	102	100.0	39	97.5
Private	147	15.7	-	-	1	2.5
Faith-based	100	10.7	-	-	-	-
Respondent knew the date of referral						
Yes	934	98.9	140	99.3	90	96.8
No	7	0.7	1	0.7	3	3.2
Don't know / No response	3	0.3	-	-	-	-
Respondent knew the time of referral?						
Yes	730	77.3	93	66.0	78 ()	83.9
No	150	15.9	26	18.4	15 ()	16.1
Don't know / No response	64	6.8	22	15.6	-	-
Time of referral departure categories	n=730		n=93		n=78	
Morning (05–11:59)	157	21.5	50	53.8	27	34.6
Afternoon (12–16:59)	148	20.3	23	24.7	24	30.8
Evening (17–20:59)	128	17.5	9	9.7	10	12.8
Night (21–04:59)	297	40.7	11	11.8	17	21.8
Type of referral document						
Written document	369	39.1	125	88.7	76	81.7
Phone call	82	8.7	2	1.4	4	4.3
None	493	52.2	14	9.9	13	14.0
Information on the referral document	n=369		n=125		n=76	
Date of referral	367	99.5	124	99.2	75	98.7
Time of referral	196	53.1	115	92.0	69	90.8

* Communal Medical Centres.

Table 4. Reasons of admission and types of complications among women admitted as result of referral to the maternity wards of HNID, HRM, and HPF in Guinea, April–August 2025, n=1,178

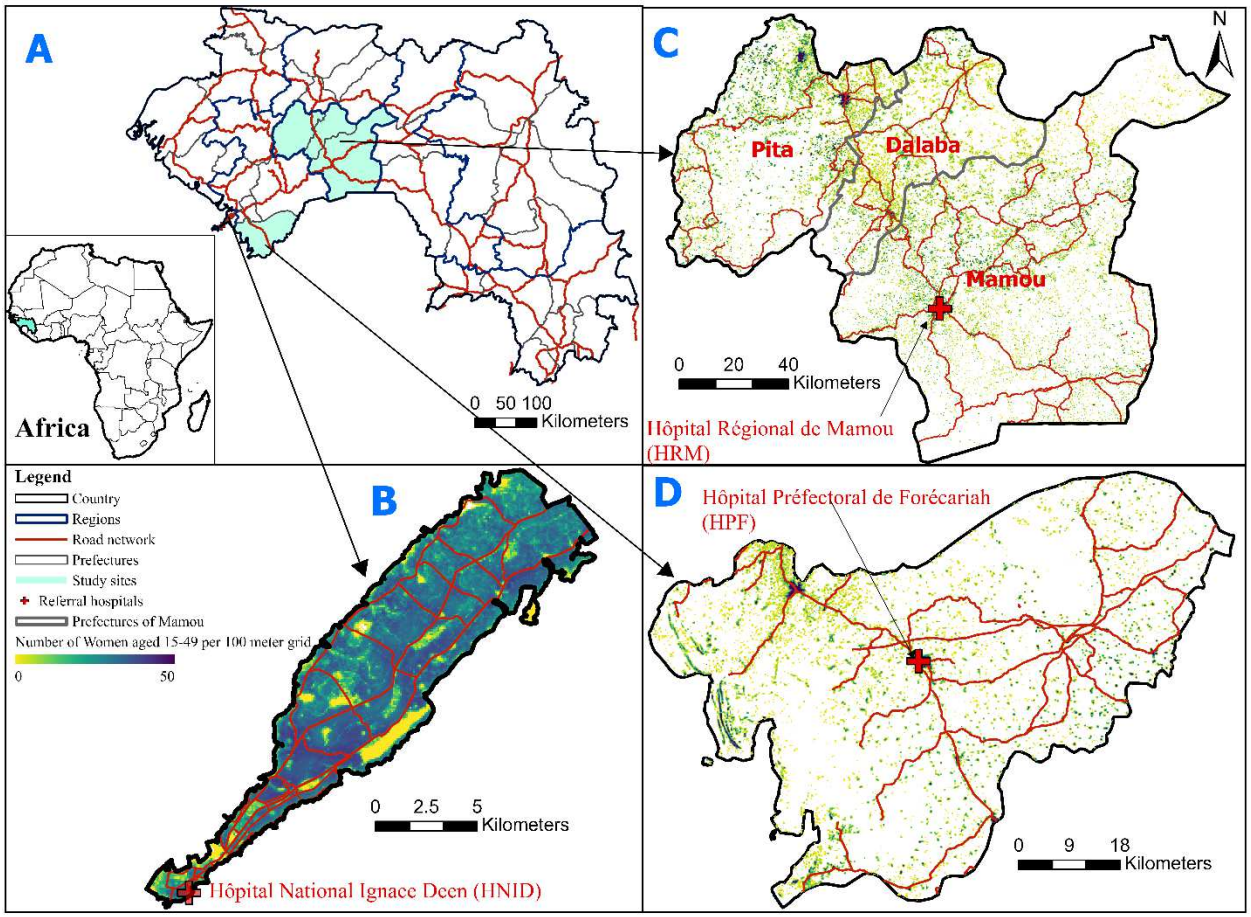
Characteristic	HNID n= 944	%	HRM n = 141	%	HPF n = 93	%
Reasons for admission						
Antepartum complications	82	8.7	35	24.8	7	7.5
Intrapartum complications	799	84.6	81	57.4	80	86.0
Postpartum complications	56	5.9	18	12.8	5	5.4
Postabortion care	7	0.7	7	5.0	1	1.1
Complications on admission*						
Progress of labour complications	323	34.2	50	35.5	43	46.2
Hypertensive disorders	229	24.3	15	10.6	7	7.5
Ante/intrapartum haemorrhage	150	15.9	13	9.2	14	15.1
Postpartum haemorrhage	33	3.5	11	7.8	2	2.2
Foetal complications	66	7.0	8	5.7	8	8.6
Prelabour rupture of membrane	31	3.3	1	0.7	3	3.2
Postpartum infections	14	1.5	5	3.5	-	-
Threatened abortions	17	1.8	3	2.1	-	-
Postabortion complications	9	1.0	7	5.0	1	1.1
Other obstetric complications	19	2.0	7	5.0	4	4.3
Previous caesarean section	25	2.6	6	4.3	6	6.5
Malaria	6	0.6	12	8.5	1	1.1
*Disagreement with the care plan***	8	0.8	-	-	-	-
Other reason/complications	9	1.0	2	1.4	1	1.1
Missing/Illegible	5	0.5	1	0.7	3	3.2

*These categories are not mutually exclusive; column percentage can exceed 100%

**This reason was reported by the referring facility as follows : the woman in labour disagreed with the care plan, and care providers, wanting to avoid complications, referred her.

Table 5. Distribution of postpartum complications, blood transfusion practices, and maternal and perinatal outcomes among women admitted as result of referral to the maternity wards of HNID, HRM, and HPF in Guinea, April–August 2025

Characteristics	HNID n (%)	HRM n (%)	HPF n (%)
Postpartum complications among women who gave birth, n=36	**n=799**	**n=81**	**n=80**
Multiple	-	1 (1.2)	-
Surgical site infection	-	-	1 (1.3)
Septicaemia	-	-	-
Retained placenta	-	1 (1.2)	-
Postpartum haemorrhage	2 (0.3)	4 (4.9)	-
Severe malaria	1 (0.1)	-	1 (1.3)
Postpartum eclampsia	-	1 (1.2)	-
Blood transfusion	**n=944**	**n=141**	**n=93**
Blood transfusion required	62 (6.6)	21 (14.9)	7 (7.5)
Blood transfusion performed	59 (95.2)	21 (100.0)	7 (100.0)
Blood source among women who need transfusion			
Family/friends	9 (15.3)	7 (33.3)	1 (14.3)
Hospital blood bank	14 (23.7)	14 (66.7)	6 (85.7)
National blood transfusion centre	36 (61.0)	-	-
In-facility maternal mortality ratio			
Number of maternal deaths (per 100,000 livebirths)	4 (564)	4 (5,970)	0
Number of maternal deaths (per 100,000 deliveries)	4 (480)	4 (4,706)	0
Causes of maternal deaths (n=8)			
Haemorrhage	3(75.0)	1(25.0)	-
Hypertensive disorders / Eclampsia	1(25.0)	3(75.0)	-
Obstructed / prolonged labour	2(50.0)	-	-
Uterine rupture	1(25.0)	-	-
Sepsis / infection	-	1(25.0)	-
Anaemia	1(25.0)	-	-
Stillbirth rates, (n=1,004)	**834**	**85**	**85**
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Neonatology unit (same facility)	28 (22.6)	20 (100.0)	11 (100.0)
Institute of Child Nutrition and Health (INSE Donka)	96 (77.4)	-	-



848

849 **Figure 1.** Maps of the study area. Map A shows Guinea with the locations of all three study
850 areas. *Map B displays Conakry, including its road network and the HN, whose actual*
851 *catchment area covers the entire country. Map C presents Forécariah Prefecture, the*
852 *catchment area of HD, and the road network. Map D illustrates the Mamou region,*
853 *highlighting HR and the three prefectures which together form HR's catchment area.*

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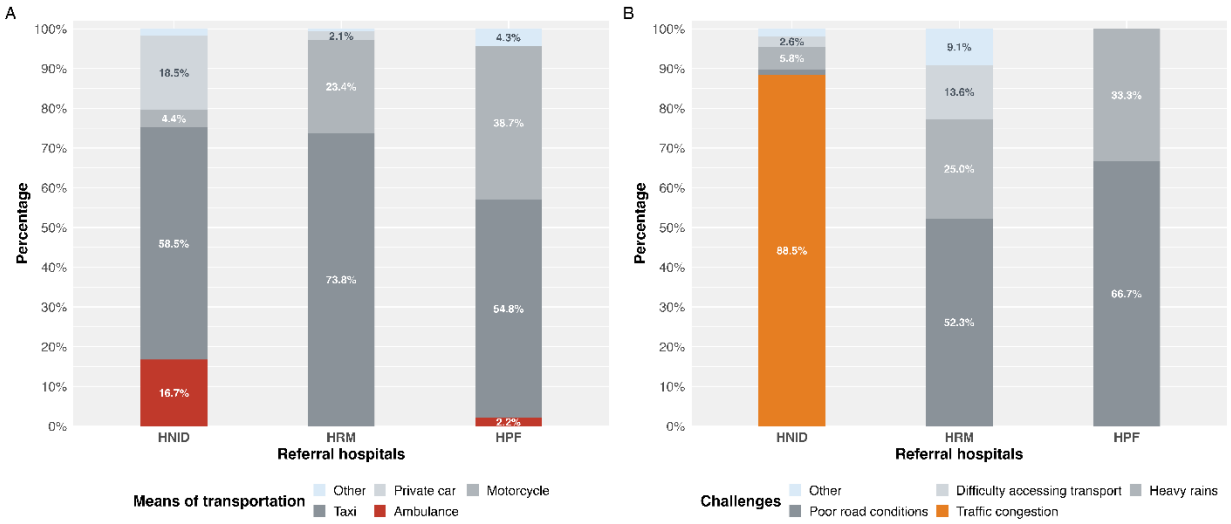


Figure 2. Distribution of transportation modes used by referred women to reach the maternity wards of HNID, HRM, and HPF (A), and challenges faced during transportation (B), April–August 2025, Guinea, n= 1,178

Each stacked bar represents the percentage of referred women admitted by mode of transportation or type of challenge, by hospital. Percentages are shown for segments representing ≥ 2% of the total.

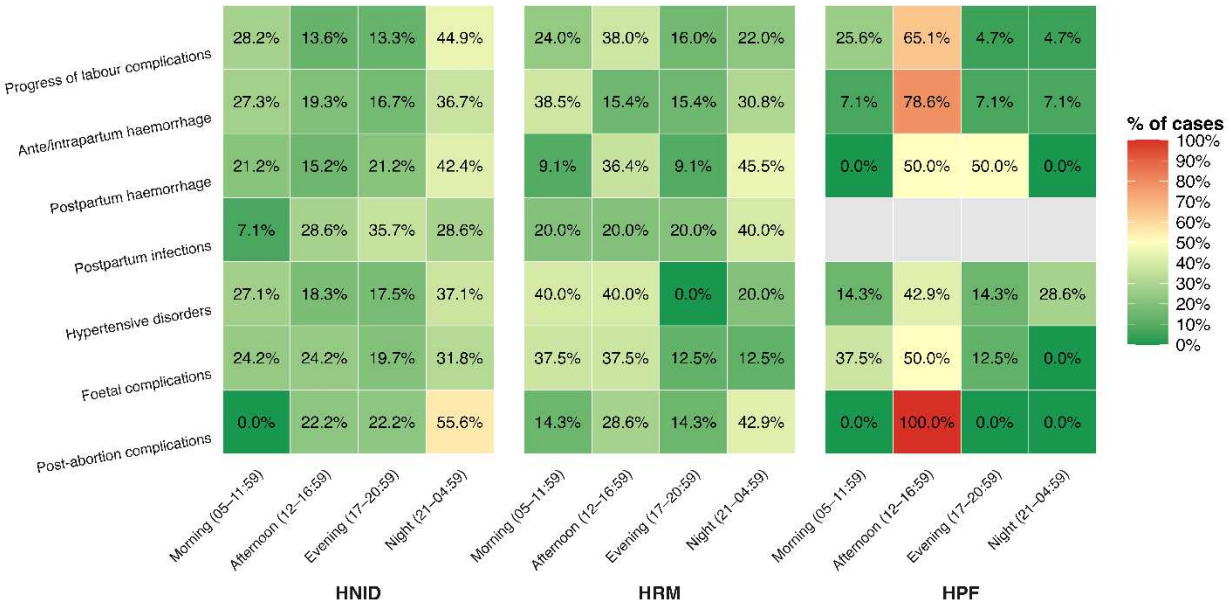


Figure 3. Distribution of obstetric complications by time of admission and hospital among referral cases admitted to the maternity wards of HNID, HRM, and HPF in Guinea, April–August 2025 (n=1018)

Each cell represents the percentage of cases within a hospital–complication combination distributed across four-time categories: morning (05–11:59), afternoon (12–16:59), evening (17–20:59), and night (21–04:59). Percentages are row-normalised within hospitals.

Supplementary Files

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