BMJ Open

Post-discharge mortality, readmission and care seeking among postpartum women and their newborns following facility-based delivery in Uganda: a prospective observational study

Yashodani Pillay ,[1,2] Vuong Nguyen ,[1] Clare Komugisha,[3] Pascal M Lavoie ,[4] Lisa M Bebell,[5] Marianne Vidler ,[6] Beth A Payne,[7] Jessica Trawin,[1] Astrid Christofferson-Deb,[6] Douglas Mwesigwa,[3] Happy Annet Twinomujuni,[3] Stefanie K Novakowski,[1,2] Dustin Dunsmuir,[1,2] J. Mark Ansermino,[1,2] Abner Tagoola,[8] Niranjan Kissoon,[1,4] Nathan Kenya-Mugisha,[3] Angella Namala,[8] Joseph Ngonzi,[6] Matthew O Wiens[1,2,3]

To cite: Pillay Y, Nguyen V, Komugisha C, *et al*. Post-discharge mortality, readmission and care seeking among postpartum women and their newborns following facility-based delivery in Uganda: a prospective observational study. *BMJ Open* 2026;**16**:e108734. doi:10.1136/bmjopen-2025-108734

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (https://doi.org/10.1136/bmjopen-2025-108734).

Received 04 August 2025
Accepted 06 May 2026

Check for updates

© Author(s) (or their employer(s)) 2026. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ Group.

For numbered affiliations see end of article.

Correspondence to
Dr Matthew O Wiens;
matthew.wiens@bcchr.ca

ABSTRACT

Introduction Maternal and newborn morbidity and mortality are a global concern. Understanding the epidemiology of post-discharge complications could identify opportunities for interventions. We aimed to quantify mortality, care-seeking events and readmission among mothers and newborns in Uganda following facility-based delivery.

Methods This prospective observational study (Apr 2022-Sep 2023) enrolled women presenting for delivery at two regional referral hospitals in Uganda. Data were collected during admission and 6 weeks after delivery by phone.

Results Overall, 7131 women delivered 7359 newborns, of whom 7129 (99%) women and 6968 (94%) newborns were discharged alive. The newborn mortality rate was 2.7% and 32% of deaths occurred post-discharge. Following discharge, 230 (3%) women and 287 (4%) newborns were readmitted. Suspected sepsis and infections were the most common reasons for readmission among mothers (62.2%) and newborns (89.9%). Caesarean delivery (OR:2·26 (1·75-2·93)) and perinatal death (OR:3·18 (2·09-4·69)) were associated with post-discharge maternal readmission. Both maternal and newborn readmission were associated with household food insecurity during pregnancy (maternal OR:1·56 (1·15-2·08); newborn OR: 1·73 (1·31-2·25)). Newborn resuscitation with oxygen was associated with maternal readmission (OR:2.24 (1.24–3·78)), newborn readmission (OR: 2·74 (1·54-4·56)) and newborn death (OR: 4·01 (1·73-8·21)). Although >99% of women had ≥1 antenatal care visit, only 511 (7%) had ≥1 routine postnatal care visit. There were no routine postnatal care visits among 211 (91·7%) readmitted mothers, 276 (96·2%) newborns and 57 (91·9%) newborns who died.

Conclusion Post-discharge complications occur in a context of low routine postnatal care use. Risk-informed discharge planning, postnatal care and health education strategies may improve outcomes in mothers, newborns and their families.

STRENGTHS AND LIMITATIONS SUMMARY

⇒ The study provides robust, granular facility-based and follow-up data collected at two sites, providing a comprehensive picture of care-seeking pathways and adverse outcomes from admission through post-discharge.
⇒ By including detailed data across different care domains and describing pathways to adverse outcomes rather than testing specific hypotheses, the study offers valuable exploratory insights that can inform the direction of future confirmatory research.
⇒ Findings represent two regional referral facilities in semi-rural Uganda, restricting generalisability to urban settings.
⇒ Post-discharge outcomes relied on maternal and proxy self-reports, introducing potential recall and reporting bias; outcomes were classified broadly as mortality and readmission.
⇒ Key populations including home births, deliveries at lower-level facilities, critically ill women unable to consent, potentially underestimating the burden of adverse outcomes.

INTRODUCTION

The largest global burden of maternal and newborn deaths occurs in Sub-Saharan Africa where mortality rates remain static despite an increase in facility-based births.[1–3] Efforts to reduce preventable deaths are undermined by gaps in robust epidemiological data on maternal and newborn mortality, morbidity and care seeking to guide resource allocation, interventions and policy decisions.[4]

Maternal and newborn health are closely linked.[5 6] Interventions throughout antenatal, intrapartum and postnatal care are

BMJ Open: first published as 10.1136/bmjopen-2025-108734 on 2 June 2026. Downloaded from http://bmjopen.bmj.com/ on September 14, 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

therefore essential to improving both maternal and newborn survival and health.[7] Facility-based births are an opportunity to identify high-risk mothers and newborns early, prevent intrapartum deaths and safely manage facility-to-community transitions.[8] It is essential to address risk factors and gaps in care during these heightened periods of vulnerability to accelerate reductions in maternal and newborn mortality and morbidity.[3]

The WHO recommends one immediate postnatal check within 24 hours of delivery and three additional visits within the first 6 weeks.[9–11] However, in low-resourced settings, postpartum women and their newborns are often discharged within the first 24 hours of birth, before the first postnatal check due to a lack of resources, including bed and staff availability.[11–13] Lower maternal age, parity and socioeconomic status; poor awareness of need, high cost and distance have previously been identified as risk factors for suboptimal postnatal care use and coverage in Uganda.[14 15] Additionally, routine postnatal care delivery varies widely in sub-Saharan Africa, making it difficult to distinguish routine postnatal care from other care seeking events to assess uptake and effectiveness.[16]

Despite the WHO's emphasis on postnatal care, research has largely focused on in-hospital outcomes and neglected the post-discharge period.[17] Surveillance and national demographic data suggest approximately 30% of maternal and 50% of newborn deaths in the first 6 weeks after delivery and most occur more than 24 hours after birth, emphasising the importance of postnatal care in the post-discharge period.[4 9 18 19] There is a paucity of recent, granular data in sub-Saharan Africa, capturing maternal and newborn mortality, morbidity and care seeking events following hospitalisation for delivery. Improving our understanding of the pathways to adverse outcomes following facility-based delivery could identify opportunities early in the care continuum to prevent severe illness after discharge. Therefore, the aim of this study was to describe the epidemiology of post-discharge morbidity, mortality and care seeking events among postpartum women and newborns in Uganda from facility-based delivery to the end of the 6 week postnatal period.

METHODS

Study design and setting

This prospective observational study was conducted between April 2022 and September 2023, including recruitment and a 6 week post-discharge follow-up period. Mothers and newborns were enrolled from two regional referral facilities in Uganda: Mbarara Regional Referral Hospital in southwestern Uganda and Jinja Regional Referral Hospital in eastern Uganda. Together, these facilities cover two districts and serve a population of approximately 973 000 people, providing an acceptable representation of the population outside of the capital city of Kampala.

This study was approved by the Makerere University School of Public Health (MakSPH) Institutional Review Board (SPH-2021-177) in Uganda and the Uganda National Council of Science and Technology (UNCST) (HS2174ES), and the University of British Columbia in Canada (H21-03709). This study has been registered at clinicaltrials.gov (NCT05730387). This manuscript is reported using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.[20]

Patient and public involvement

Neither the patients nor the public were involved in the design of the study. Health workers at the study sites provided feedback during the development of study tools.

Participants

All women and adolescent girls admitted for delivery, over the age of 12 years and living within the catchment districts were considered eligible. Those who refused or who were unable to provide consent, were not admitted for delivery, had a language barrier, resided in a refugee settlement (due to language barriers) or did not have access to a phone were ineligible. Since census sampling was not feasible, a quasi-random sampling strategy was implemented to allow for enrolment of 7–10 participants per site per day (Supplementary Information page 2).[21] In cases where the mother was between 12 and 17 years of age, parent and/or guardian consent was obtained along with individual assent.

Procedures

This study was part of a larger project. Data collection tools and study procedures have been published[21] and are available through the Smart Discharges Study Dataverse.[22] All participants received routine care at the discretion of their medical teams. In cases where study nurses noted concerning signs or symptoms, these were reported to the medical team.

Following delivery and informed written consent, trained study nurses collected data grouped according to three periods of care: admission, delivery and discharge. Data from admission, delivery, and discharge were captured from the hospital medical record where possible and by direct observation, measurement or patient interview when not (eg, when not documented). At discharge, study nurses measured maternal haematocrit using the HemataSTAT Hematocrit Centrifuge (EKF Diagnostics, Cardiff, UK), maternal blood pressure using the Microlife Cradle VSA semi-automated blood pressure monitor (Microlife Corporation, Widnau, Switzerland), maternal and neonate oxygen saturation (SpO_2) using the Masimo $iSpO_2$ (Masimo Corporation, California, USA) and Nellcor iSpO2 (Medtronic Minneapolis, Minnesota, USA) with the Phone Ox Application,[23] maternal and newborn respiratory rate using the RRate Application,[24] and maternal and newborn temperature using Exergen Temporal Scanners (Exergen, Massachusetts, USA). 6 weeks after delivery, field officers who were nurses or clinical officers by training contacted every mother and/or caregiver of newborns who survived to discharge by

BMJ Open: first published as 10.1136/bmjopen-2025-108734 on 2 June 2026. Downloaded from http://bmjopen.bmj.com/ on September 14, 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

phone to determine vital status, all-cause readmission and care-seeking events and routine post-discharge postnatal care. Where participants could not be reached by phone, in-person visits were completed by field officers. All post-discharge data was maternal self- or proxy-report. Reported diagnoses were not mutually exclusive. Suspected sepsis and infections were reported in the results as a composite of women who reported at least one of: malaria, surgical site infections, puerperal sepsis or other infection and caregivers of newborns reporting at least one of: sepsis, respiratory illness or other infection.

To describe socioeconomic status, we used the Global Network Socioeconomic Status Index score from 0 to 10. This was developed using the multidimensional poverty index (MPI) and validated in previous studies.[25–27] Items deemed significant to our study sites in the MPI that were excluded from the Global Network Socioeconomic Status Index were described separately (online supplementary table S1 and S2).

All data were collected using a custom-built application installed on Android tablets with an encrypted database and uploaded daily to a Research Electronic Capture (REDCap) database hosted at the BC Children's Hospital Research Institute in Vancouver, Canada.[28]

The primary outcomes were post-discharge mortality and readmission (at any facility) for either the mother or newborn. Secondary outcomes included the timing and frequency of routine post-discharge postnatal care and care-seeking events.

Statistical analysis

The sample size was determined a priori and was specifically centred around building a clinical prediction model of post-discharge readmission and/or mortality based on the objectives of the larger study.[21] We estimated that a target sample size of 6700 would be sufficient assuming an expected readmission rate of 2·7% for mothers and 4·4% for newborns. Based on this sample size and expected outcome rates, we can estimate readmission and mortality rates within a 1% margin of error.

We described the population using medians with interquartile ranges (IQRs) for continuous variables and counts with percentages for categorical variables. We did simple tabulations to describe in-hospital and post-discharge morbidity and mortality. Stillbirth, maternal and neonatal mortality rates were calculated using total and live births in the study population (online supplementary table S3). We used Kaplan-Meier survival curves to assess the time from discharge to post-discharge mortality, readmission and care-seeking for an illness alongside routine postnatal care. We evaluated variables related to admission, delivery and discharge as potential risk factors for post-discharge readmission and mortality. Univariable logistic regression was used to explore associations between each variable and readmission and mortality. All analyses were completed using R statistical software (version 4·2·1). A p value <0·05 was considered statistically significant.

RESULTS

A total of 9497 women presented to the maternity ward for care. Of these, 2366 (25%) were excluded: 701 (30%) did not meet eligibility criteria and 1665 (70%) were not selected due to the sampling strategy (figure 1).

In total, 7131 women were enrolled and delivered 7359 newborns. The median maternal age and parity were 26 (IQR 22–30) and 2 (IQR 1–3), respectively (table 1). The median household socioeconomic index score was 3 (IQR 2–4) out of 10. A total of 2567 (36·2%) women had caesarean deliveries. Overall, 601 (8·4%) total births were reported to be preterm (<37 weeks) and 1038 (14·1%) had a low birth weight (<2500 g). In total, during both hospitalisation for delivery and the 6 week postnatal period, we observed three maternal deaths, (maternal mortality ratio was 27·2 per 100 000 births), 262 stillbirths (stillbirth rate was 35·6 per 1000 births) and 191 (26·9 per 1000 live births) additional newborn deaths. Among newborns, we observed early (0–7 days) and late (8–28 days) mortality rates of 20 and 3·5 per 1000 live births, respectively (online supplementary table S3). During hospitalisation for delivery, 570 (8%) women were transferred to a higher level of care (online supplementary table S4) and 812 (11%) newborns were admitted to the neonatal intensive care unit (NICU), of which 44 (5·4%) died. The median NICU length of stay was 6 (IQR 4–9) days. Prematurity (31%), suspected sepsis (27·3%) and birth asphyxia (26·2%) were the major reported causes of NICU admission (online supplementary table S5).

Discharge characteristics

A total of 7060 (99%) women and 6123 (99%) newborns were routinely discharged and reached by phone or in-person visit to capture 6-week post-delivery outcomes (figure 1, online supplementary table S6). The median length of stay from admission to discharge was 22.75 (IQR 15.3 – 29.5) hours for vaginal births and 74.15 (IQR 63.3 – 94.6) hours for caesareans and 623 (8.5%) were discharged within 24 hours of delivery. The median length of stay from delivery to discharge was 15.7 (IQR 9.6 – 22.1) hours for vaginal births and 65.2 (IQR 53.4 – 80.5) for caesareans. At discharge, 56 (0.8%) had a respiratory rate >30 breaths per minute, 6 (0.1%) had a fever (>38 °C) and 37 (0.5%) had a haemoglobin <7 g/dL (online supplementary table S7, figure S1). Most women (75.8%) were discharged to their own homes. Among the 6123 newborns who were discharged alive without a NICU admission, 172 (2.8%) were observed to be hypothermic (<36 °C) and 1175 (19.2%) were hypoxaemic (SpO_2<92%) at discharge (online supplementary table S6, figure S1).

Post-discharge readmission and mortality

Of the 7060 women who completed follow-up, the median time from discharge to readmission was 14 (IQR 7–21) days for those who delivered vaginally and 8 (IQR 4 to 15) days for those who had a caesarean (figure 2). Following discharge, one woman (<0.1%) died and

BMJ Open: first published as 10.1136/bmjopen-2025-108734 on 2 June 2026. Downloaded from http://bmjopen.bmj.com/ on September 14, 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

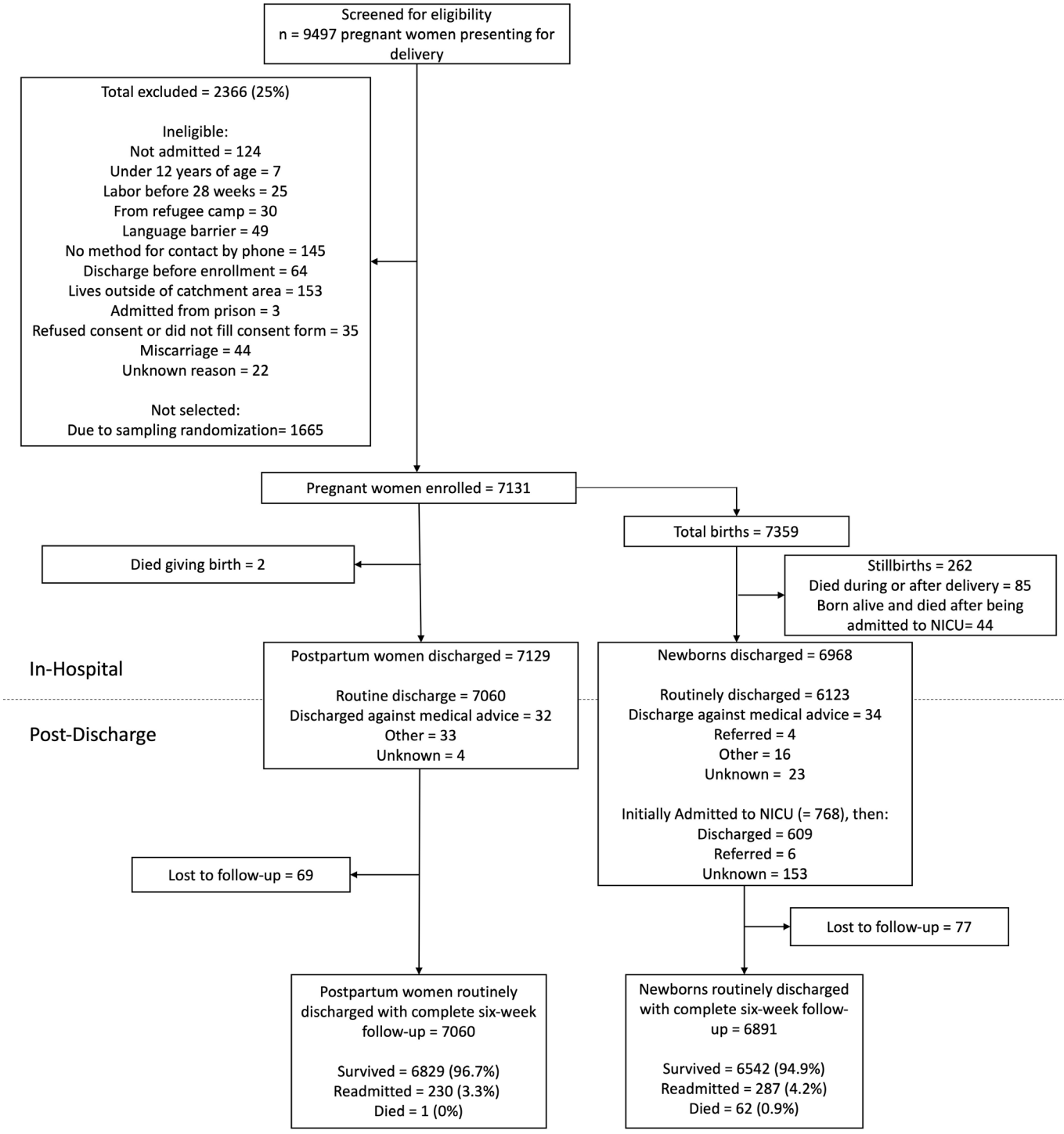


Figure 1 Flow chart including selection criteria of mothers enrolled in our study and pathways to in-hospital and post-discharge outcomes. NICU, neonatal intensive care unit.

230 (3%) were readmitted. Of the 6968 newborns who completed follow-up, 287 (4.2%) were readmitted, and 62 (0.9%) died. Readmissions and deaths occurred a median of 21 (IQR 7–24.5) and 17.5 (IQR 7.8 - 30) days post-discharge respectively (figure 2). Newborn deaths occurred at home (50%), in transit (12.9%), during readmission (32.3%) or unknown location (4.8%; online supplementary table S8).

Most maternal and newborn readmissions were self-referrals, with patients presenting to facilities with complaints (99.6% and 98.3%, respectively; table 2). Suspected sepsis and infections were the most common reasons for both maternal (62.2%) and newborn readmissions (89.9%) (online supplementary table S9 and S10). Specifically, puerperal sepsis and surgical site infections accounted for 34.8% and 28.3% of maternal readmissions,

BMJ Open: first published as 10.1136/bmjopen-2025-108734 on 2 June 2026. Downloaded from http://bmjopen.bmj.com/ on September 14, 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Table 1 Demographics of all participants enrolled in the study (mothers n=7131, total births n=7359), including two mothers who died giving birth and 391 newborns that were stillbirths or otherwise died before being discharged. Continuous variables are summarised as the median (IQR) while categorical variables are summarised as n (%)

Characteristics	All enrolled mothers and total births	N (%) Missing
Maternal and household demographics		
Maternal age (years)	26 (22, 30)	2 (0.03%)
<18 years	157 (2.2%)	
18-35 years	6311 (88.5%)	
>35 years	661 (9.3%)	
Lives with the father of the baby	6439 (90.3%)	5 (0.07%)
Maternal education level		5 (0.07%)
≤P3	263 (3.7%)	
P4-P7	2263 (31.7%)	
S1-S6	3200 (44.9%)	
Post-secondary	1400 (19.6%)	
Transport time		3 (0.04%)
Less than 30 min	3414 (47.9%)	
30 min to 1 hour	2713 (38.0%)	
>1 hour	1001 (14.0%)	
Had any children who have died	854 (12.0%)	4 (0.06%)
Socioeconomic Index Score *	3 (2, 4)	4 (0.06%)
Food insecurity	1243 (17.4%)	5 (0.07%)
Pregnancy and Health History		
Woman had vitals taken on admission	7020 (98.4%)	5 (0.07%)
Parity	2 (1, 3)	5 (0.07%)
Pregnancy loss	0 (0, 0)	5 (0.07%)
Diagnosed with illness before pregnancy †	865 (12.1%)	2 (0.03%)
Referral, n (%)	3163 (44.4%)	3 (0.04%)
Admitted to hospital during pregnancy	1002 (14.1%)	4 (0.06%)
Number of antenatal care visits	4 (3, 5)	4 (0.06%)
At least one visit	7110 (99.7%)	
<4	1862 (26.1%)	
4-8	5140 (72.1%)	
>8	125 (1.8%)	
Diagnosed with illness during pregnancy ‡	4291 (60.2%)	0 (%)
Delivery		
Mode of delivery		3 (0.04%)
Vaginal	4546 (63.7%)	
Assisted vaginal	15 (0.2%)	
Caesarean with labour	1995 (28.0%)	
Caesarean without labour	572 (8.0%)	
Surgical urgency, n (%) of caesarean births		14 (0.55%)
Immediate threat to life of woman or fetus	1246 (48.5%)	
Maternal/fetal compromise but not immediately life threatening	877 (34.2%)	
Needs early delivery but no maternal/fetal compromise	30 (1.2%)	
Elective	400 (15.6%)	
Resuscitation at birth		429 (6.02%)
None	4560 (63.9%)	
Resuscitation with oxygen	265 (3.7%)	
Resuscitation without oxygen	1877 (26.3%)	
Delivery at<37 weeks	601 (8.4%)	2 (0.03%)
Number of babies delivered		2 (0.03%)
Singleton	6907 (96.9%)	
Twin	217 (3.0%)	
Triplet	5 (0.1%)	
Mother transferred to higher level of care following delivery	570 (8.0%)	4 (0.06%)
Neonate demographics and birth characteristics §		
Male sex	3763 (51.1%)	173 (2.35%)
Birth weight (kg)	3.1 (2.8, 3.5)	444 (6.03%)
Low birth weight (<2500 g)	1038 (14.1%)	444 (6.03%)
Length (cm)	49.5 (48.2, 50.3)	538 (7.31%)
Apgar at 1 min	9 (8, 9)	441 (5.99%)
Apgar at 5 min	10 (10, 10)	441 (5.99%)

*Calculated using the Global Network Socioeconomic Status Index score from 0 to 10 online supplementary table 2.
†Includes HIV, high blood pressure, prior infertility, diabetes, kidney disease, sickle cell, hepatitis B/C, tuberculosis and chronic mental illness.
‡Includes gestational diabetes, eclampsia, gestational hypertension, antepartum haemorrhage, PPROM, preterm labour, malaria, HIV, urinary tract infection, tuberculosis, anaemia, COVID-19, hepatitis B/C, mental health illness or other infections.
§Missing neonate demographics include stillbirths and newborns who died in-hospital.
PPROM, Pre-term premature rupture of membranes; Q1, first quartile; Q3, Third quartile.

BMJ Open: first published as 10.1136/bmjopen-2025-108734 on 2 June 2026. Downloaded from http://bmjopen.bmj.com/ on September 14, 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

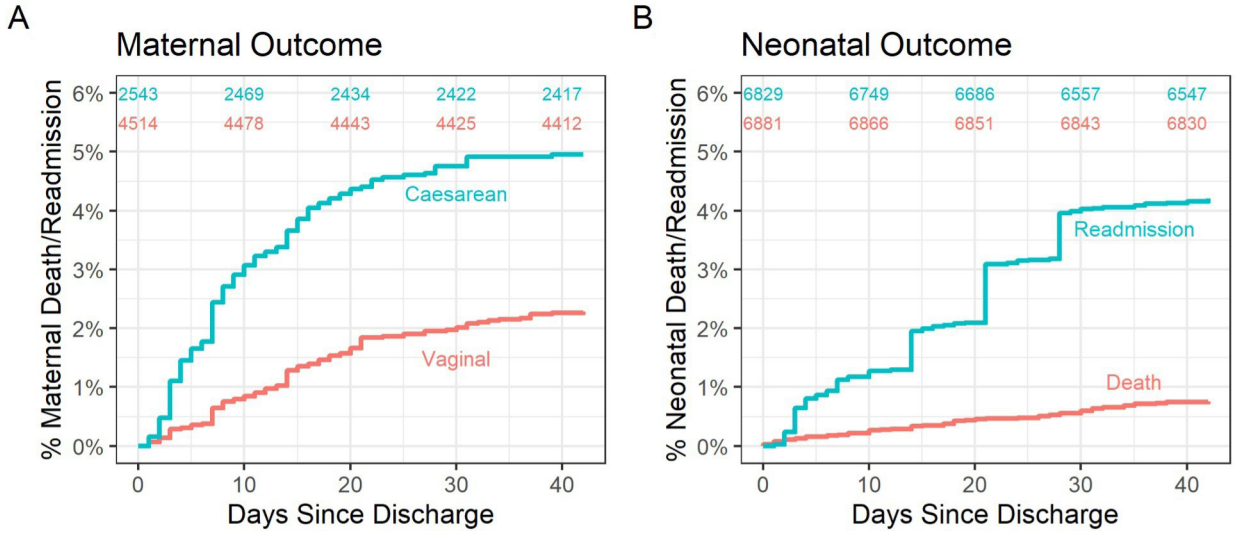


Figure 2 Kaplan Meier curves showing time until A) combined readmission or death among women stratified by delivery mode and B) readmission or death among newborns. The numbers at risk for each event are displayed at the top of each plot.

respectively, and suspected sepsis 74.6% of neonate readmissions (online supplementary table S9 and S10).

Women who delivered by caesarean experienced more readmissions (OR: 2.26; 95% CI (1.75 to 2.93)) (online supplementary table S11). Diagnosis with an illness during pregnancy (maternal OR:1.74; 95% CI (1.32 to 2.33); newborn OR: 3.09; 95% CI (2.3 to 4.22)) and household food insecurity (maternal OR: 1.56; 95% CI (1.15 to 2.08); newborn OR:1.73; 95% CI (1.31 to 2.25)) were associated with higher maternal and newborn readmission. The most significant risk factor for maternal readmission was perinatal mortality (OR: 2.97; 95% CI (1.97 to 4.33)).

Newborn death was associated with indicators of maternal inexperience and social vulnerability. Higher maternal age (OR:0.93; 95% CI (0.89 to 0.98), per year) and parity (OR:0.81; 95% CI (0.66 to 0.97), per child) were both associated with lower newborn death, while reliance on friends for home support (OR:3.59; 95% CI (1.24 to 8.24)) and maternal HIV diagnosis during pregnancy (OR: 7.76; 95% CI (2.3 to 19.7))—indicators of poor social and healthcare resources—were predictors of newborn mortality. Newborn readmission but not mortality was suggestive of resources for health seeking behaviour, including partner support at home (OR:1.85; 95% CI (1.31 to 2.25)) and the absence of delays and

Table 2 Care seeking pathways among discharged women who had no adverse outcome (n=6829) or were readmitted (n=230), and discharged neonates who had no adverse outcome (n=6542), were readmitted (n=287), or who died (n=62) following discharge

	Maternal		Newborn		
	No outcome	**Readmitted**	**No outcome**	**Readmitted**	**Died**
Completed Routine PNC					
0	6398 (93.7%)	211 (91.7%)	6357 (97.2%)	276 (96.2%)	57 (91.9%)
1	398 (5.8%)	18 (7.8%)	161 (2.5%)	10 (3.5%)	0 (0%)
2	28 (0.4%)	1 (0.4%)	17 (0.3%)	0 (%)	0 (0%)
3	1 (0%)	0 (0%)	1 (0%)	0 (%)	0 (0%)
Missing	4 (0.1%)	0 (0%)	6 (0.1%)	1 (0.4%)	5 (8.1%)
Care seeking events, n (%) *	1129 (16.5%)	19 (8.3%)	2614 (40%)	15 (5.2%)	8 (12.9%)
Care seeking pathway, n (% sought care)					
Routine PNC	58 (5.1%)	1 (5.3%)	38 (1.5%)	1 (6.7%)	0 (0%)
Self-referral	1067 (94.5%)	18 (94.7%)	2571 (98.4%)	14 (93.3%)	8 (100%)
Admissions pathway, n (% readmitted/died)					
Routine PNC	–	0 (0%)		2 (0.7%)	0 (0%)
Self-referral	–	229 (99.6%)	–	282 (98.3%)	9 (14.5%)

*Refers to any care seeking events not related to postnatal care, including care sought for an illness that did not result in hospital admission.
PNC, postnatal care visit.

BMJ Open: first published as 10.1136/bmjopen-2025-108734 on 2 June 2026. Downloaded from http://bmjopen.bmj.com/ on September 14, 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

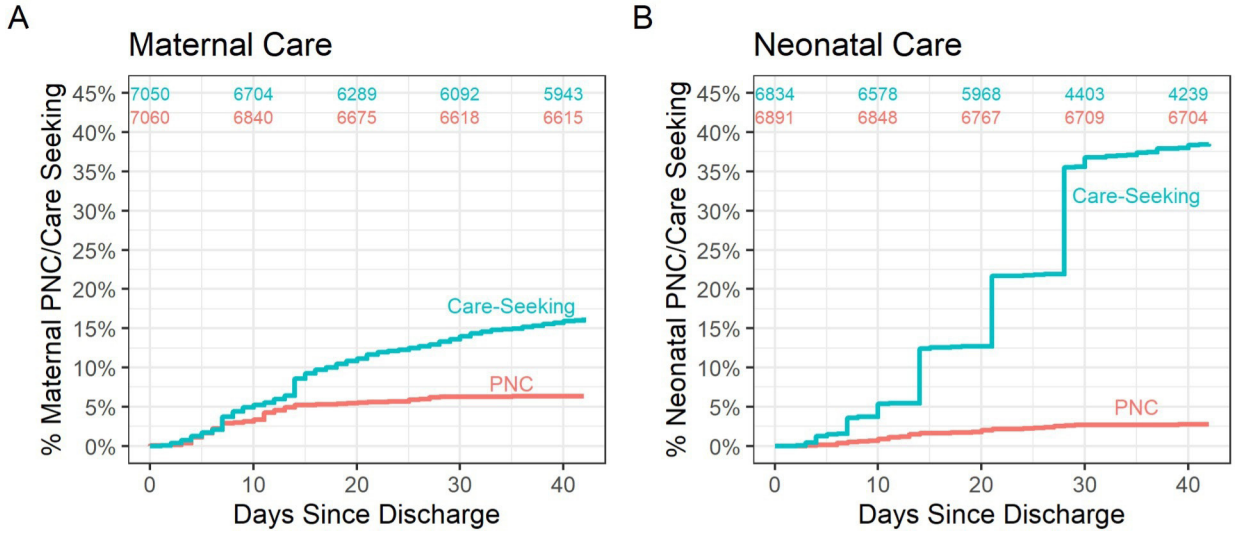


Figure 3 Kaplan Meier curves showing time from discharge to first routine postnatal care visit (PNC) and time from discharge to first care seeking event for an illness that did not result in a readmission among A) women and B) newborns. The numbers at risk for each event are displayed at the top of each plot.

barriers to reaching the delivery facility (OR:1.86; 95% CI (1.23 to 2.97)).

Maternal readmission was directly associated with maternal symptoms at discharge (OR:2.16; 95% CI (1.13, 3.78)) (online supplementary table S7). Newborns hypoxaemic (SpO2 < 92%) at discharge (OR:2.1; 95% CI (1.59 to 2.76)) had higher risk for readmission.

Postnatal care

By 6 weeks, 513 (7.3%) patients had completed one or more routine maternal or newborn postnatal care visits (figure 3). Only two (0.02%) completed the recommended three postnatal care visits following discharge. Of those who used routine postnatal care services, the median time from discharge to the first postnatal care visit was 14 (IQR 7–14) days for mothers and 14 (IQR 10–21 days) for newborns. There were no postnatal care visits among 211 (91.7%) readmitted mothers, 276 (96.2%) newborns and 57 (91.9%) newborns who died (table 2). Among the 1148 (16.3%) mothers and 2629 (42.9%) newborns who sought care for an illness that did not result in admission, the majority were self-referred, with only 39 (3.4%) maternal and 14 (0.5%) newborn visits referred via routine postnatal care (table 2). Care seeking for illnesses did not have an impact on the timing and use of routine postnatal care in mothers or newborns (online supplementary figure S2). Only two (0.7%) readmitted newborns and none of the readmitted women were referred via routine postnatal care. Factors that increased routine maternal and newborn postnatal care included higher socioeconomic status index scores, partner support, pregnancy-related illnesses, admission during pregnancy, preterm premature rupture of membranes (PPROM), newborn resuscitation and newborn hypoxemia at discharge (online supplementary table S12). Routine maternal postnatal care use was associated with attending more than eight antenatal care visits and caesarean delivery, while prematurity and multiple gestation pregnancy were associated with increased newborn postnatal care (online supplementary table S12).

DISCUSSION

This study provides detailed primary data on post-discharge outcomes among women and newborns in Uganda following facility delivery. We observed high rates of post-discharge maternal readmissions and newborn mortality, alongside low rates of routine postnatal care. Most post-discharge newborn deaths occurred at home (50%) or in transit (12.9%) indicating poor care seeking practices. This suggests only using readmission rates likely underestimates the true burden of illness and morbidity in the community both in national data and our study. Most post-discharge readmissions were related to suspected sepsis or infections (62.2% maternal and 89.9% newborn). Furthermore, discharge characteristics including the presence of maternal symptoms and newborn hypoxemia suggest a link between poor discharge readiness and risk of subsequent readmission. While the causes of post-discharge death and morbidity are multifactorial, these findings clearly signal the need to improve facility-to-community transitions following hospital delivery. This study had several strengths, such as rigorous data collection in a large facility-based study with a high follow-up rate and inclusion of the maternal and caregiver perspective via self-report of care seeking and severe illness during follow-up which is often underreported.

Perinatal mortality had a strong association with maternal readmission. Perinatal deaths and stillbirths are often caused by birth asphyxia and preterm birth, which are related to maternal complications like infections, hypertensive disorders and placental complications

BMJ Open: first published as 10.1136/bmjopen-2025-108734 on 2 June 2026. Downloaded from http://bmjopen.bmj.com/ on September 14, 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

during pregnancy as well as intrapartum complications.[3 4] This underscores the strong connection between maternal and newborn health and the need to strengthen antenatal, intrapartum and newborn care to reduce preventable deaths and morbidity.[4 29] Our findings reinforce that preterm births, intrapartum complications and infections remain leading causes of newborn mortality even among facility-based births, highlighting the critical role of quality facility care in improving outcomes.[4 29–31]

Our study found caesarean deliveries were an important risk factor for maternal readmission, with over one quarter of all readmissions secondary to surgical site infections. Caesarean delivery is well-documented as an independent risk factor for maternal morbidity,[32 33] and while the WHO recommends caesarean rates of 10–15%, many who need caesareans lack access, and unnecessary caesareans are also rising in LMICs.[30 34] Together, these findings point towards an urgent need for improved infection prevention and control practices in facilities,[35] health education and guidelines for wound care and timely access to postnatal care during the post-discharge period, alongside efforts to ensure appropriate use of caesareans.

Approximately 26% of mothers and 50% of newborns in our study had abnormal vital signs or were discharged before meeting criteria (online supplementary table S7), emphasising the importance of early postnatal care within 24 hours to guide discharge readiness and reduce early maternal and newborn morbidity.[13] This is supported by others who have observed that over 50% of women and up to 75% of newborns do not receive recommended postnatal care in facilities following delivery likely due to premature discharge and failure to recognise known warning signs.[13 29] Addressing this preventable gap in early detection of illness requires context-appropriate strategies to strengthen early postnatal checks to detect warning signs and provide care and escalate management prior to discharge. Given significant resource constraints including bed and staff availability, alternate strategies could also include extended length of stay for high-risk cases, down-referral to lower-level facilities for observation for moderate risk or cases that have recovered to a point of not needing regional referral level care, home visits for routine and early discharges, or implementing family integrated care that is appropriately adapted to low-resourced contexts.[36]

Prior studies suggest maternal and newborn care in Uganda is hampered by rurality, age, stigmatised conditions (eg, HIV), poor health education and high out-of-pocket costs.[11 17 37 38] Though intended as a surrogate for illness severity, the readmissions observed in our context are likely a complex interplay of features related to both illness and sociodemographic factors related to care-seeking behaviour. This presents difficulty in identifying the specific risk factors for this outcome. We observed that over half of newborn deaths occurred in the community, suggesting that socially vulnerable families face significant barriers to care seeking and extended admissions.[39 40] This study, and others, have reported an inverse relationship across measures of vulnerability between post-discharge mortality and readmission.[40 41] Given that household poverty and women's social autonomy are strong predictors of health coverage and child survival, there may be additional unobserved morbidity events within community settings that are unaccounted for through readmission and care seeking events.[3 40 41] This further reinforces the need for improved community-based services to facilitate the facility-to-community transition following birth, especially for newborns at risk of death.

Postnatal care provides continuity of care to detect complications and promote good health and practice following discharge. However, studies across sub-Saharan Africa indicate there is significant variability in definition and use.[9 16 29] Only 7% of mothers and newborns in our study sought any routine postnatal care post-discharge. Crucially, most readmitted mothers, newborns and newborns who died post-discharge in our study did not receive any postnatal care, emphasising the importance of this intervention for high-risk patients. We observed, largely in line with other studies, that knowledge of risk and social support improve postnatal care use.[14 15 38 42] Leveraging high-risk features, possibly using a risk-differentiated care approach, is a potential strategy to develop efficient, effective, sustainable and contextually appropriate postnatal care.[41 43] While three in-person follow-up visits at a local health facility within the postnatal period for every mother and newborn may not be feasible in this setting, risk-informed health education and counselling at discharge and follow-up visits, calls or SMS reminders after discharge could improve knowledge of risk and strengthen connections to care for those most at-risk.[17 44–47]

Limitations

This study aimed to describe pathways to adverse outcomes and care seeking events rather than testing specific hypotheses. As such, further research is needed to confirm findings. Post-discharge newborn deaths were rare (1%) so related risk factors should be interpreted with caution. Though only 7·4% of those screened were excluded, this group may share overlapping risk factors particularly linked to social determinants of health that require further study. While there was heterogeneity between sites (online supplementary table S2), data were collected from two regional referral facilities in semi-rural Uganda, limiting generalisability. Urban settings in Uganda face different contextual issues, and recent studies suggest there is lower care coverage and higher rates of stillbirths, maternal and newborn complications in poorer urban communities compared with rural communities.[48] Home-based births, deliveries at lower-level facilities, and pregnancy-related deaths earlier in the care continuum and critically ill women who were unable to provide consent were not included in our study.

BMJ Open: first published as 10.1136/bmjopen-2025-108734 on 2 June 2026. Downloaded from http://bmjopen.bmj.com/ on September 14, 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Additionally, despite robust facility-based and follow-up data, post-discharge outcomes were broadly classified under maternal and newborn readmission and mortality, relying on maternal and proxy reports which may be biased or misreported.

In summary, our cohort study identified that caesarean deliveries, perinatal death, clinical vital signs and discharge before meeting criteria were associated with postnatal maternal and neonatal readmissions or deaths, confirming the synergy and overlap in areas to improve maternal and newborn health. Inconsistent early postnatal checks are unreliable in identifying vulnerable mothers and newborns who face greater risks for severe illness and death as they transition home from the facility. Reducing mortality and morbidity among mothers and newborns requires a multipronged approach that addresses underlying clinical and social vulnerabilities of the mother and newborn and strengthens connections between facility and community-based care.

Author affiliations
[1]Institute for Global Health, BC Children's Hospital, Vancouver, British Columbia, Canada
[2]The University of British Columbia Department of Anesthesiology Pharmacology & Therapeutics, Vancouver, British Columbia, Canada
[3]Walimu, Kampala, Uganda
[4]Department of Paediatrics, BC Children's Hospital, The University of British Columbia, Vancouver, British Columbia, Canada
[5]Medical Practice Evaluation Centre, Centre for Global Health, Department of Medicine and Division of 22 Infectious Diseases, Massachusetts General Hospital, Boston, Massachusetts, USA
[6]Obstetrics & Gynaecology, The University of British Columbia, Vancouver, British Columbia, Canada
[7]BC Children's Hospital Research Institute, Vancouver, British Columbia, Canada
[8]Jinja Regional Referral Hospital, Jinja, Eastern Region, Uganda

Acknowledgements We would like to thank individuals from the Smart Discharges Research Program (at Walimu, Kampala, Uganda and the Institute for Global Health at BC Women's and Children's Hospital, Vancouver, Canada) for their efforts in data collection, administration, logistics and study support including but not limited to: Annet Mary Nabweteme, Bosco Busense, Miria Kantono, Nakasolo Moreen, Olivia Kamusiime, Jonan Nuwagaba, Kasande Clemensia, Turatemba Phionah, Fredson Tusingwire, Agaston Nuwarsasira, Christine Ankwatse, Livingstone Katsigaire, Haneen Amhaz, Obed Twinamatsiko, Peter Lewis, Charly Huxford, Bella Hwang.

Contributors Contributed to funding applications: MOW, JN, SKN, NK, JMA, NK-M. Designed the study: MOW, NK-M, JMA, NK, BAP, MV, AC-D, AT and JN. Coordinated study implementation: YP, AT, AN, JN, CK, AHT, DM. Supervised data collection: CK, AHT, YP, DM. Managed the data: YP, MOW, DD, CK, AHT, DM, VN, JT. Analysed the data: VN. Interpreted the data: YP, MOW, VN, NK-M, JMA, PL, LMB, NK, BAP, MV, AT, AN, JN, AC-D, CK, AHT, DM, JT Drafted the manuscript: YP, MOW, VN. Critically reviewed the manuscript: YP, MOW, VN, NK-M, JMA, PL, LMB, NK, DD, SKN, BAP, MV, AT, AN, JN, AC-D, CK, DM. All authors had full access to all the data in the study and accept responsibility to submit for publication. MOW is the guarantor.

Funding This study was funded by the Canadian Institutes for Health Research (CIHR) (AWD-019909) through the University of British Columbia (UBC) in Canada. YP and MW have received salary support through the Michael Smith Health Research BC (MSHR BC) (RT-2022-2583; SCH-2021-1581) through UBC. The funders had no role in study design, data collection and analysis, decision to publish or preparation of the manuscript.

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

Patient consent for publication Consent obtained directly from patient(s)

Ethics approval This study involves human participants and was approved by This study was approved by Makerere University School of Public Health (MakSPH) Institutional Review Board (SPH-2021-177) in Uganda and the Uganda National Council of Science and Technology (UNCST) (HS2174ES) and the University of British Columbia in Canada (H21-03709). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Study materials (including de-identified data, protocol, data collection tools and analysis code) are available upon reasonable request to the corresponding author or through the Paediatric Sepsis CoLab}.[22] The University of British Columbia Dataverse Collection: Paediatric Sepsis CoLab. Smart Discharges Dataverse. Borealis. 2022. https://borealisdata.ca/dataverse/smart_discharge

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: https://creativecommons.org/licenses/by-nc/4.0/.

ORCID iDs
Yashodani Pillay https://orcid.org/0000-0002-5814-7975
Vuong Nguyen https://orcid.org/0000-0001-9070-9803
Pascal M Lavoie https://orcid.org/0000-0002-2205-0362
Marianne Vidler https://orcid.org/0000-0002-7633-8812

REFERENCES

1 Souza JP, Day LT, Rezende-Gomes AC, *et al*. A global analysis of the determinants of maternal health and transitions in maternal mortality. *Lancet Glob Health* 2024;12:e306–16.
2 Sharrow D, Hug L, You D, *et al*. Global, regional, and national trends in under-5 mortality between 1990 and 2019 with scenario-based projections until 2030: a systematic analysis by the UN Inter-agency Group for Child Mortality Estimation. *Lancet Glob Health* 2022;10:e195–206.
3 Amouzou A, Barros AJD, Requejo J, *et al*. The 2025 report of the Lancet Countdown to 2030 for women's, children's, and adolescents' health: tracking progress on health and nutrition. *The Lancet* 2025;405:1505–54.
4 Ahmed I, Ali SM, Amenga-Etego S, *et al*. Population-based rates, timing, and causes of maternal deaths, stillbirths, and neonatal deaths in south Asia and sub-Saharan Africa: a multi-country prospective cohort study. *Lancet Glob Health* 2018;6:e1297–308.
5 Moucheraud C, Worku A, Molla M, *et al*. Consequences of maternal mortality on infant and child survival: a 25-year longitudinal analysis in Butajira Ethiopia (1987-2011). *Reprod Health* 2015;12 Suppl 1:S4.
6 Chikhungu LC, Newell ML, Rollins N. Under-five mortality according to maternal survival: a systematic review and meta-analysis. *Bull World Health Organ* 2017;95:281–7.
7 Gülmezoglu AM, Lawrie TA, Hezelgrave N, *et al*. Interventions to reduce maternal and newborn morbidity and mortality. *Reprod Matern Newborn Child Health* 2016;2:115–36.
8 Amouzou A, Ziqi M, Carvajal-Aguirre L, *et al*. Skilled attendant at birth and newborn survival in Sub-Saharan Africa. *J Glob Health* 2017;7:020504.
9 World Health Organization. WHO recommendations on maternal and newborn care for a positive postnatal experience. World Health Organization; 2022.
10 Wojcieszek AM, Bonet M, Portela A, *et al*. WHO recommendations on maternal and newborn care for a positive postnatal experience: strengthening the maternal and newborn care continuum. *BMJ Glob Health* 2023;8:e010992.
11 Habte A, Tamene A, Tesfaye L. Towards a positive postnatal experience in Sub-Saharan African countries: the receipt of adequate services during the immediate postpartum period: a multilevel analysis. *Front Public Health* 2023;11:1272888.
12 Campbell OMR, Cegolon L, Macleod D, *et al*. Length of Stay After Childbirth in 92 Countries and Associated Factors in 30 Low- and Middle-Income Countries: Compilation of Reported Data and a Cross-sectional Analysis from Nationally Representative Surveys. *PLoS Med* 2016;13:e1001972.
13 Dey T, Ononge S, Weeks A, *et al*. Immediate postnatal care following childbirth in Ugandan health facilities: an analysis of Demographic

BMJ Open: first published as 10.1136/bmjopen-2025-108734 on 2 June 2026. Downloaded from http://bmjopen.bmj.com/ on September 14, 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

and Health Surveys between 2001 and 2016. *BMJ Glob Health* 2021;6:e004230.
14 Sacks E, Masvawure TB, Atuyambe LM, *et al*. Postnatal Care Experiences and Barriers to Care Utilization for Home- and Facility-Delivered Newborns in Uganda and Zambia. *Matern Child Health J* 2017;21:599–606.
15 Towongo MF, Ngome E, Navaneetham K, *et al*. Individual and community-level factors associated with women's utilization of postnatal care services in Uganda, 2016: a multilevel and spatial analysis. *BMC Health Serv Res* 2024;24:185.
16 Tessema ZT, Yazachew L, Tesema GA, *et al*. Determinants of postnatal care utilization in sub-Saharan Africa: a meta and multilevel analysis of data from 36 sub-Saharan countries. *Ital J Pediatr* 2020;46:175.
17 Rababeh A, Paton C, Grewal G, *et al*. Postdischarge health information tools and information needs for mothers of vulnerable newborns in low- and middle-income countries: a scoping review. *BMJ Open* 2025;15:e082824.
18 World Health Organization. Maternal mortality. 2023.
19 World Health Organization. Newborn Mortality; 2022.
20 Elm E von, Altman DG, Egger M, *et al*. Strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *BMJ* 2007;335:806–8.
21 Wiens MO, Trawin J, Pillay Y, *et al*. Prognostic algorithms for post-discharge readmission and mortality among mother-infant dyads: an observational study protocol. *Front Epidemiol* 2023;3:1233323.
22 Wiens MO, Kenya-Mugisha N, Namala A, *et al*. Smart discharges for mom & baby 2.0: a cohort study to develop prognostic algorithms for post-discharge readmission and mortality among mother-infant dyads. 2023.
23 Gan H, Karlen W, Dunsmuir D, *et al*. The Performance of a Mobile Phone Respiratory Rate Counter Compared to the WHO ARI Timer. *J Healthc Eng* 2015;6:691–703.
24 Dunsmuir D, Karlen W, Gan H, *et al*. A mobile application for measuring respiratory rate.
25 Patel AB, Bann CM, Garces AL, *et al*. Development of the Global Network for Women's and Children's Health Research's socioeconomic status index for use in the network's sites in low and lower middle-income countries. *Reprod Health* 2020;17:1–10.
26 Patel AB, Bann CM, Kolhe CS, *et al*. The Global Network Socioeconomic Status Index as a predictor of stillbirths, perinatal mortality, and neonatal mortality in rural communities in low and lower middle income country sites of the Global Network for Women's and Children's Health Research. *PLoS ONE* 2022;17:e0272712.
27 Alkire S, Santos ME. Acute Multidimensional Poverty: A New Index for Developing Countries. *SSRN Journal* 2010.
28 Harris PA, Taylor R, Thielke R, *et al*. Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform* 2009;42:377–81.
29 Kruk ME, Gage AD, Arsenault C, *et al*. High-quality health systems in the Sustainable Development Goals era: time for a revolution. *Lancet Glob Health* 2018;6:e1196–252.
30 Roder-DeWan S, Nimako K, Twum-Danso NAY, *et al*. Health system redesign for maternal and newborn survival: rethinking care models to close the global equity gap. *BMJ Glob Health* 2020;5:e002539.
31 Mahtab S, Madhi SA, Baillie VL, *et al*. Causes of death identified in neonates enrolled through Child Health and Mortality Prevention Surveillance (CHAMPS), December 2016 –December 2021. *PLOS Glob Public Health* 2016;3:e0001612.
32 Bauserman M, Lokangaka A, Thorsten V, *et al*. Risk factors for maternal death and trends in maternal mortality in low- and middle-income countries: a prospective longitudinal cohort analysis. *Reprod Health* 2015;12:S5.
33 Symonds NE, Vidler M, Wiens MO, *et al*. Risk factors for postpartum maternal mortality and hospital readmission in low- and middle-income countries: a systematic review. *BMC Pregnancy Childbirth* 2023;23:303.
34 Betran AP, Torloni MR, Zhang J, *et al*. What is the optimal rate of caesarean section at population level? A systematic review of ecologic studies. *Reprod Health* 2015;12:57.
35 Tomczyk S, Twyman A, de Kraker MEA, *et al*. The first WHO global survey on infection prevention and control in health-care facilities. *Lancet Infect Dis* 2022;22:845–56.
36 Jones E, Stewart F, Taylor B, *et al*. Early postnatal discharge from hospital for healthy mothers and term infants. *Cochrane Database Syst Rev* 2021;6:CD002958.
37 Faye CM, Wehrmeister FC, Melesse DY, *et al*. Large and persistent subnational inequalities in reproductive, maternal, newborn and child health intervention coverage in sub-Saharan Africa. *BMJ Glob Health* 2020;5:e002232.
38 Arunda MO, Agardh A, Asamoah BO. Determinants of continued maternal care seeking during pregnancy, birth and postnatal and associated neonatal survival outcomes in Kenya and Uganda: analysis of cross-sectional, demographic and health surveys data. *BMJ Open* 2021;11:e054136.
39 Nemetchek BR, Liang LD, Kissoon N, *et al*. Predictor variables for post-discharge mortality modelling in infants: a protocol development project. *Afr Health Sci* 2018;18:1214–25.
40 Wiens MO, Bone JN, Kumbakumba E, *et al*. Mortality after hospital discharge among children younger than 5 years admitted with suspected sepsis in Uganda: a prospective, multisite, observational cohort study. *Lancet Child Adolesc Health* 2023;7:555–66.
41 Hama Diallo A, Shahid ASMSB, Khan AF, *et al*. Hospital readmission following acute illness among children 2–23 months old in sub-Saharan Africa and South Asia: a secondary analysis of CHAIN cohort. *eClinicalMedicine* 2024;73:102676.
42 Atuhaire R, Atuhaire LK, Wamala R, *et al*. Interrelationships between early antenatal care, health facility delivery and early postnatal care among women in Uganda: a structural equation analysis. *Glob Health Action* 2020;13:1830463.
43 Batani J, Maharaj MS. Towards data-driven models for diverging emerging technologies for maternal, neonatal and child health services in Sub-Saharan Africa: a systematic review. *Global Health Journal* 2022;6:183–91.
44 Nkurunziza T, Riviello R, Kateera F, *et al*. Enablers and barriers to post-discharge follow-up among women who have undergone a caesarean section: experiences from a prospective cohort in rural Rwanda. *BMC Health Serv Res* 2022;22:733.
45 Ming DK, Merriel A, Freeman DME, *et al*. Advancing the management of maternal, fetal, and neonatal infection through harnessing digital health innovations. *Lancet Digit Health* 2024;6:e926–33.
46 Barron P, Peter J, LeFevre AE, *et al*. Mobile health messaging service and helpdesk for South African mothers (MomConnect): history, successes and challenges. *BMJ Glob Health* 2018;3:e000559.
47 Till S, Mkhize M, Farao J, *et al*. Digital Health Technologies for Maternal and Child Health in Africa and Other Low- and Middle-Income Countries: Cross-disciplinary Scoping Review With Stakeholder Consultation. *J Med Internet Res* 2023;25:e42161.
48 Magunda A, Ononge S, Balaba D, *et al*. Maternal and newborn healthcare utilization in Kampala urban slums: perspectives of women, their spouses, and healthcare providers. *BMC Pregnancy Childbirth* 2023;23:321.

BMJ Open: first published as 10.1136/bmjopen-2025-108734 on 2 June 2026. Downloaded from http://bmjopen.bmj.com/ on September 14, 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.