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COLLEGE OF HEALTH SCIENCES

**DEPARTMENT OF EMERGENCY AND CRITICAL CARE
MEDICINE**

Assessment of clinical characteristics and outcomes of obstetric patients admitted to the intensive care unit at two selected public hospitals: A retrospective study

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Addis Ababa, Ethiopia

December, 2025

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Abstract

Background: Obstetric complications remain a leading cause of maternal morbidity and mortality globally, particularly in low-resource settings such as Ethiopia. Despite improvements in antenatal care and delivery services, severe obstetric complications requiring intensive care unit (ICU) admission continue to pose major challenges, causing fetomaternal morbidity and mortality.

Objective: To assess the prevalence, clinical profiles, and outcomes of obstetric complications among ICU admissions and identify factors associated with maternal mortality in ICU settings.

Methods: A retrospective cross-sectional study was conducted on all obstetric patients admitted to the ICUs of ALERT and Zewditu Memorial Hospitals from July 1, 2023, to July 1, 2025. Data were extracted from medical records using a structured questionnaire. Descriptive statistics summarized patient demographics, obstetric complications, and clinical profile. Bivariable and multivariable logistic regression analyses were applied to identify predictors of ICU mortality. Statistical significance was set at $p < 0.05$.

Results: Of the 101 obstetric ICU admissions analyzed, the predominant diagnoses were eclampsia (31.7%), postpartum hemorrhage (29.7%), and preeclampsia (27.7%). System-specific medical emergencies such as respiratory, renal, infectious, hematologic and neurologic system were observed in two-thirds of patients. The overall in-hospital mortality rate was 21.8% (95% CI: 14%-30%). Place of residence emerged as the only significant predictor of ICU mortality, with women residing outside Addis Ababa exhibiting higher odds of death compared to those from in the city (AOR: 6.17; 95%CI: 1.24–30.73).

Conclusion: Eclampsia, post-partum hemorrhage and pre-eclampsia were the leading causes of ICU admission. Strengthening early identification and timely intervention at primary and secondary health care facilities could help reduce the need for ICU admission. Place of residence was the only significant factor associated with in-hospital mortality. It is recommended that strengthening referral and transportation systems for obstetric emergencies might help reduce morbidity and mortality.

Keywords: Obstetric complications, Intensive Care Unit, Maternal mortality, Ethiopia

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Acronyms/Abbreviations

ALERT	All Africa Leprosy Rehabilitation and Training Center
AOR	Adjusted Odds Ratio
CHS	College of Health Sciences
CI	Confidence Interval
EDHS	Ethiopian Demographic and Health Survey
ECCM	Emergency and Critical Care Medicine
HIC	High Income Countries
ICU	Intensive Care Unit
LMICs	Low-Middle Income Countries
LOS	Length of Stay
MNM	Maternal Near Miss
PPH	Postpartum Hemorrhage
SDGs	Sustainable Development Goals
SPSS	Statistical Package for Social Sciences
WHO	World Health Organization
ZMH	Zewditu Memorial hospital

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1. INTRODUCTION

1.1 Background

Obstetric complications represent a range of serious clinical conditions that arise during pregnancy, childbirth, and the postpartum period, often leading to severe maternal morbidity and mortality. These complications are critical drivers of intensive care unit (ICU) admissions among pregnant and postpartum women, reflecting the high acuity and resource-intensive management required on top of their detrimental impact on safe motherhood (1).

The postpartum period, defined as the first six weeks (42 days) following childbirth, remains a vulnerable period for maternal health (2,3). Globally, postpartum complications continue to be among the leading contributors to maternal mortality, with World Health Organization 2025 data indicating peripartum hemorrhage as accountable for more than a quarter (27%) of maternal deaths, and an additional 16% attributed to hypertensive disorders such as preeclampsia (4).

Recent empirical reports demonstrated that ICU admission rates for obstetric patients are disproportionately higher in lower-middle-income countries compared to high-income countries, paralleled by elevated ICU mortality rates in these settings (5,6). Specifically, in Africa, a recent meta-analysis reported a maternal mortality rate of 30.7% among obstetric ICU admissions, while citing hypertensive disorders (42.9%) and obstetric hemorrhage (24.1%) as the predominant culprits (7).

In Ethiopia, although limited data exist, it has been identified that hypertensive disorders of pregnancy and obstetric hemorrhage as the leading indications for obstetric ICU admission in Addis Ababa, Ethiopia (8). The Ethiopian Ministry of Health has made remarkable progress in improving maternal health outcomes through multipronged initiatives to achieve the Sustainable Development Goal (SDG) Target 3.1, which is reducing the global maternal mortality ratio to less than 70 per 100,000 live births by 2030 (9).

Despite these efforts, the need for multidisciplinary intensive care interventions remains critical, as obstetric conditions such as hypertensive disorders and hemorrhage are associated with substantial morbidity and mortality. Maternal mortality rates among obstetric ICU admissions are reported to be as high as 15.5% in some settings (10).

Understanding the patterns, risk factors, and outcomes of obstetric complications requiring ICU admission is essential for designing targeted interventions, optimizing resource allocation in critical care units, and ultimately reducing adverse maternal outcomes. Thus, this study is conducted to assess these patterns and outcomes among obstetric ICU admissions at two selected public hospitals, aiming to contribute valuable data that can inform clinical practice and policy in maternal critical care in Ethiopia.

1.2 Statement of the Problem

Obstetric complications constitute a substantial burden on maternal health globally, disproportionately affecting low- and lower-middle-income countries (LMICs). In 2023, nearly 260,000 women died worldwide during and following pregnancy and childbirth. Approximately 92% of all maternal deaths occurred in LMICs, with most of these deaths being preventable (11). In Ethiopia, the maternal mortality burden among obstetric ICU admissions remains alarmingly high, with studies reporting mortality rates of up to 15.5% or even higher in certain settings, reflecting a significant public health challenge (10).

Specifically, in Ethiopia, it was found that hypertensive disorders (48.7%) and postpartum hemorrhage (12.9%) were the top reasons for ICU admission among obstetric patients, with an unacceptably high maternal mortality rate, standing at 29.9% (8).

Recently, efforts by the Ethiopian Ministry of Health, including the Health Sector Transformation Plan and initiatives such as the Health Extension Program and the 10 million Safer Births Initiative, have pragmatically led to notable improvements in maternal health indicators and reductions in mortality rates. These programs are believed to have expanded access to maternal health services, improved emergency obstetric care, and strengthened the health system infrastructure (9). Nonetheless, the high ICU maternal mortality rates indicate persistent gaps in the management of severe obstetric complications and the availability of adequate critical care facilities.

What remains unaddressed is the lack of comprehensive and updated data on the specific patterns, risk factors, and outcomes of obstetric ICU admissions within Ethiopia's public hospitals, including the major urban centres like Addis Ababa. Existing studies are limited in scope and geographical coverage, leaving a knowledge gap that hinders tailored interventions to optimize

maternal critical care delivery. This study is thus motivated by the urgent need to fill this evidence gap by retrospectively assessing the pattern and outcomes of obstetric complications among ICU admissions at two selected public hospitals.

1.3. Significance of the Study

This study addresses a critical gap in maternal health research by specifically focusing on obstetric patients requiring ICU admission, a subset often underrepresented in Ethiopian literature. While national and international policies emphasize the importance of early antenatal care, there is limited empirical evidence from tertiary centres to guide clinical and policy decision-making. Generating such detailed epidemiologic information will support clinical decision-making, inform policy formulation, and optimize resource allocation, ultimately aiming to reduce maternal morbidity and mortality associated with obstetric critical care admissions in Ethiopia.

2. LITERATURE REVIEW

2.1 Empirical review

Postpartum complications remain a major contributor to maternal morbidity and mortality worldwide. The World Health Organization (WHO) reported in 2023 that over 260,000 maternal deaths occurred globally, with more than 90% in LMICs (11). The 2022 WHO postnatal care guidelines emphasize that nearly half of maternal deaths occur within the first 24 hours postpartum, and two-thirds within the first week a period when complications like haemorrhage, sepsis, and hypertensive crises are most likely to escalate (12).

A 2024 global systematic review by Tripathy et al. analysed data from 111,601 ICU admissions across 71 studies and found that the ICU admission rate was 0.4% in high-income countries versus 2.8% in LMICs, with mortality rates of 1.4% and 12.4%, respectively. This disparity underscores the critical role of ICU access in maternal survival (5).

A five-year retrospective review in China, analyzing 133 obstetric ICU admissions. Most admissions (85.7%) occurred postpartum, with obstetric hemorrhage (24.1%) and hypertensive disorders (18.8%) as leading causes. Non-obstetric conditions particularly cardiac, respiratory, hepatic, and neurologic complications also contributed significantly. Maternal mortality was 8.3%, and fetal mortality reached 10.9%. Non-urban patients had higher illness severity, poorer prenatal care access, and greater risk of complications. The study emphasizes early risk identification, improved antenatal care, and multidisciplinary critical care to reduce disparities (13).

A prospective study analyzed obstetric ICU admissions over two years in a South Indian tertiary hospital. Hemorrhage (38%) and hypertensive disorders (32%) were the leading causes of admission. Most patients were postpartum, and 70% required mechanical ventilation. The maternal mortality rate was 12%, with sepsis and multiorgan dysfunction as major contributors. Delayed referrals and inadequate antenatal care were associated with worse outcomes (14).

In a 2010 Indian study encompassing 16,756 deliveries, there were 79 maternal deaths, corresponding to a maternal mortality rate of 4.7 per 1000 deliveries. Among these, 24 patients required ICU admission; Postpartum admissions predominated significantly (83.33%, n=20), with obstetric complications accounting for 91.66% (n=22) of ICU admissions compared to 8.32%

(n=2) for medical complications. Obstetric hemorrhage (n=15, 62.5%) and hemodynamic instability (n=20, 83.33%) were significant risk factors associated with ICU admission. Inotropic support was required in 91.66% (n=22) of patients, and 70.83% (n=17) required ventilatory support; however, these interventions were not linked to poor outcomes. The mean duration of mechanical ventilation (30.17 ± 21.65 hours) and ICU stay (39.42 ± 33.70 hours) were significantly longer among survivors compared to non-survivors. The observed mortality rate in the ICU was 41.67% (n=10), which was notably higher than the mortality predicted by the MPM II score (26.43%) (15).

In Argentina, Rios et al. analyzed 242 pregnant women admitted to ICU, and the main reasons for admission were hypertensive disorders, followed by postpartum hemorrhage and sepsis. More than a third (39.7%) was in a first pregnancy. The main non-obstetric reason for admission was pneumonia. Mortality was highest among those admitted for non-obstetric reasons (13.3% vs 0.5%; $P=0.05$). The median stay for obstetric or non-obstetric conditions was 2 versus 5 days (range, 2–3 days vs 2–8 days) (16).

A retrospective study that analyzed 91 ICU admissions among 56,865 deliveries (2011–2015), Tel-Aviv Sourasky Medical Center in Tel Aviv-Yafo, Israel Postpartum hemorrhage, hypertensive disorders, and respiratory complications were the leading causes. Distinct diagnostic profiles emerged: hemorrhage cases had lower platelet counts and temperatures; hypertensive disorders showed elevated blood pressure, creatinine, urea, and liver enzymes; and respiratory complications featured reduced oxygen saturation and elevated temperature. These findings underscore the value of diagnosis-specific physiologic and biochemical markers in individualizing obstetric ICU care and improving clinical decision-making (17).

A systematic review, conducted by researchers from Canada, Uganda, and the United States, aimed to identify socio-demographic and clinical risk factors for postpartum mortality and hospital readmission in LMICs. The review included seven studies encompassing 387,786 women who delivered live births. Studies were taken covering data published up to January 2021. Key findings revealed that caesarean delivery, nulliparity, low birthweight, and shock on admission were significant predictors of postpartum mortality. For readmission, caesarean delivery, HIV-positive status, and abnormal body temperature were consistently associated (18).

A systematic review and meta-analysis done in Africa 2024, 11 studies were included in this study with a total of 10,190 mothers admitted to the ICU, the overall obstetric ICU admissions in Africa was 17.22%. This translates to roughly 17 out of every 100 ICU admissions being for obstetric complications. Hypertensive disorders of pregnancy 42.96% (95% CI: 27.3, 58.56) and obstetric hemorrhage 24.15% were the common indications for obstetric admission in the intensive care unit. Maternal mortality among ICU-admitted patients was 30.69 (7).

Over a 10-year period in Saudi Arabia, 75 obstetric patients were admitted to the ICU, with 59 (78.6%) admitted during the antepartum period. Pregnancy-induced hypertension was the leading obstetric cause of ICU admission, affecting 21 patients (28%), while sepsis was the most common non-obstetric indication, occurring in 12 patients (16%). The mean APACHE II score was 19.59 (± 15.05), corresponding to a predicted mortality rate of 21.97%. However, the actual maternal mortality among these ICU obstetric patients was notably lower, with only six deaths (8%) (19).

A prospective cohort observational study done in Mbarara Regional Referral Hospital (MRRH), southwestern Uganda, 2024 shows, 2,930 postpartum women and their newborns discharged after facility-based delivery were followed for six weeks post-discharge, and incidence of readmissions were related to sepsis/infection in 70 (88%) women and 68(63%) newborns. The study found that caesarean delivery, longer travel time to the facility and higher maternal heart rate at discharge were significantly associated with maternal readmission (20).

In Nigeria, 39 obstetric patients admitted to the ICU were analysed. Nearly all admissions occurred during the postpartum period, with 97.4% following caesarean section. The primary indications for ICU admission were sepsis, postpartum haemorrhage, and hypertension. Among the 39 obstetric ICU admissions, there were 19 maternal deaths (48.7%), primarily due to postpartum hemorrhage (6), eclampsia (6), and sepsis (7). Obstetric patients accounted for 4.73% of the overall 125 deaths recorded (21).

A Retrospective review, done in Ghana in Cape Coast Teaching Hospital (CCTH), from January 2010 – December 2019, review was done on 443 obstetric ICU admissions (25.7% of all ICU admissions), The obstetric ICU mortality rate was 26% (115/443) over the review period. Age ≥ 25 years and a need for mechanical ventilation carried increased mortality risks following ICU admission while surgery in the index pregnancy was associated with a reduced risk of death (22).

In Ethiopia, maternal mortality remains a pressing public health issue, with obstetric complications contributing significantly to critical care admissions. However, disaggregated data on obstetric ICU admissions is limited.

A 2022 study at Saint Paul's Hospital Millennium Medical College in Addis Ababa reviewed 154 obstetric ICU admissions over five years. It found that hypertensive disorders (48.7%) and obstetric hemorrhage (12.9%) were the leading causes of ICU admission, with a maternal mortality rate of 29.9%. and nearly 70% of patients required mechanical ventilation, indicating the severity of illness. Notably, 94.2% of these admissions occurred postpartum, underscoring the vulnerability of this period (8).

Complementing this, a 2024 study of the hospital's obstetric high-dependency unit (HDU) found that with HDU care in place, only 0.42% of obstetric patients required ICU admission. Still, hypertensive disorders (48.6%) and hemorrhage (18.9%) remained the top diagnoses. The study emphasized the HDU's role in reducing ICU burden while managing severe postpartum cases (23).

The Ethiopian Public Health Institute's 2022 report on maternal and neonatal mortality drivers highlighted that a significant proportion of maternal deaths occur in the early postpartum period, often due to delays in recognizing complications and limited access to critical care services (24).

A 2022 systematic review by Leta et al. found that postpartum hemorrhage and eclampsia were the most common obstetric emergencies in Ethiopia, frequently requiring ICU-level interventions. The review called for improved emergency obstetric care and better referral systems (25).

A 2021 case-control study done by Tasew et al. across two tertiary hospitals of Addis Ababa found a 27% ICU mortality rate among obstetric patients. Factors significantly associated with death included severe pre-eclampsia, puerperal sepsis, and absence of antenatal care (10).

A cross-sectional analytical study that was conducted in Ethiopia in 2024, in which the data was secondary data, obtained from 2016 (EDHS). The Bayesian Geo-additive regression model was used to identify the major risk factors and spatial effects on maternal death in Ethiopia, and the result showed that Pregnancy-related problems or childbirth were the cause of death for 1.43% of the 10,009 women in the research, whose ages ranged from 15 to 49 ,and results showed that , maternal death is significantly affected by the place of delivery, the number of prenatal care visits,

marital status, wealth index, mother's age and the number of birth orders. The Afar, Somali, Benishangul Gumuz, and Gambela regions have higher rates of maternal death, according to evidence of geographic variation in a model (26).

A systematic review and meta-analysis that was done in 2023 in Ethiopia which covered both published and unpublished studies from different data bases, was conducted by synthesizing data from January 2015 to March 2023 ,21 studies involving 701,997 pregnant or postpartum mothers were included in the final analysis. The national pooled prevalence of maternal near miss in Ethiopia was 140/1000. Lack of formal education, lack of antenatal care, history of caesarean section, anemia, and having chronic medical disorder were among the predictors of maternal near misses from the pooled estimate. Antenatal care is found to be protective against maternal near miss. Avoiding primary caesarean section is recommended unless a clear indication is present (27).

An institution-based cross-sectional study was employed and a total of 366 participants were involved in the study from 1 April to 30 May 2022, among postpartum women attending postnatal care service in the Bale-Robe Town public health facilities. giving us a response rate of 98.6%. The magnitude of postpartum morbidities among mothers was found to be 102 (27.9%). Women who hadn't had antenatal care follow-up instrumental delivery, unskilled birth attendant, rural residence, and current pregnancy related morbidity or abnormality were significantly associated factors (28).

Finally, the WHO Ethiopia Country Profile (2023) reported a maternal mortality ratio of 267 per 100,000 live births, with postpartum care coverage still below optimal levels. The report emphasized the need for expanded critical care capacity and early postpartum surveillance (9).

Despite these findings, there is currently no published data on obstetric ICU admissions from ALERT comprehensive and Zewditu Memorial hospitals, which are two major referral centres in Addis Ababa, Ethiopia.

2.2 Conceptual framework

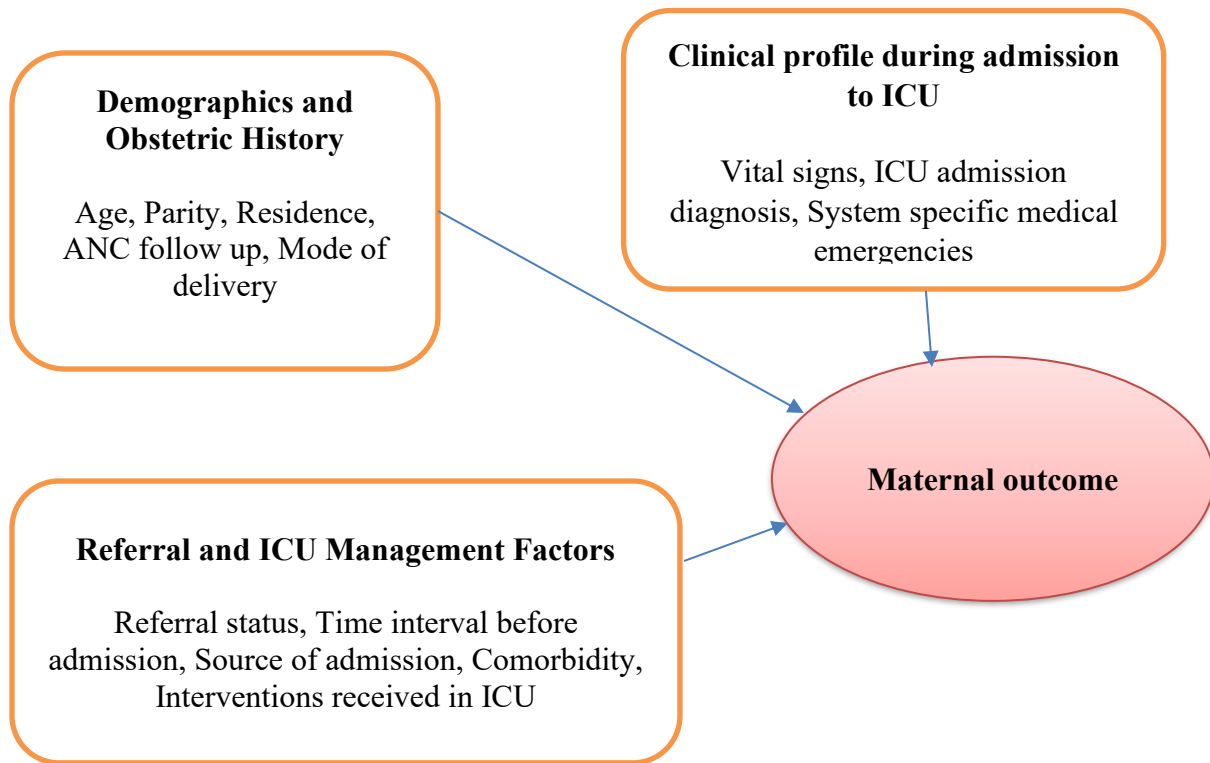


Figure 1; Conceptual frame work

3. OBJECTIVES

3.1 General objective

- To assess the clinical characteristics, management, and outcomes of obstetric patients admitted to the intensive care units of ALERT Comprehensive Specialized and Zewditu Memorial Hospitals in Addis Ababa, Ethiopia.

3.2. Specific objectives

- To describe the demographics of obstetric ICU patients.
- To describe the clinical profiles of obstetric ICU patients.
- To determine the prevalence of obstetric conditions leading to ICU admission.
- To determine the types of obstetric conditions leading to ICU admission.
- To assess in-ICU maternal outcomes among obstetric patients admitted to ICU.
- To identify factors associated with poor maternal outcomes among obstetric patients admitted to ICU.

4. RESEARCH METHODS

4.1 Study area

The study was conducted at ALERT Comprehensive Specialized and Zewditu Memorial Hospitals, both located in Addis Ababa, the capital city of Ethiopia, situated in the central part of the country. ALERT Comprehensive Specialized Hospital is a specialized referral hospital known for its maternal and surgical care services. It hosted a multidisciplinary ICU and received critical obstetric referrals from across the city and surrounding areas.

Zewditu Memorial Hospital, one of the government hospitals located in Addis Ababa, was established in 1976. It was one of the largest referral hospitals under the Addis Ababa Regional Health Bureau, providing a variety of health services including emergency care, ICU, medical and surgical wards. The hospital has one main ICU serving medical, surgical, pediatric, gynecologic, and obstetric patients, equipped with 10 beds and 8 functional mechanical ventilators.

4.2. Study design

A retrospective cross-sectional study design was employed to achieve the stated objectives.

4.3. Sampling technique

A consecutive sampling technique was used. All eligible obstetric women admitted to the ICUs of ALERT Comprehensive Specialized and Zewditu Memorial Hospitals during the defined study period from July 1st, 2023 to July 1st, 2025, were included consecutively until the required sample size was reached. This technique allowed for the inclusion of every case that met the inclusion criteria, in the order they were recorded in the hospital registry.

4.4. Population

4.4.1. Target population

All obstetric women who required ICU admission due to complications at ALERT Comprehensive Specialized and Zewditu Memorial Hospitals.

4.4.2. Source population

All obstetric women admitted to the ICU of ALERT Comprehensive Specialized and Zewditu Memorial Hospitals during the selected study period from July 01/2023 to July 01/2025.

4.4.3. Study population

All obstetric women admitted to the ICU of ALERT Comprehensive Specialized and Zewditu Memorial Hospitals during the selected study period from July 01/2023 to July 01/2025 who met the eligibility criteria.

4.5. Eligibility criteria

4.5.1. Inclusion criteria

- All women with pregnancy beyond first trimester admitted to the ICU at the selected hospitals during the study period.
- Women admitted within 42 days postpartum or post-termination of pregnancy.
- ICU admission primarily for obstetric complications and related medical conditions.

4.5.2. Exclusion criteria

- Women admitted to ICU for other reasons (e.g., trauma, poisoning).

4.6. Sample size and sampling procedure

The sample size for this study was calculated using the single population proportion formula, assuming a 50% proportion of maternal death among obstetric patients admitted to ICU. The parameters for the calculation are:

n = the required sample size

p = the proportion of unfavorable maternal outcome = 0.5

$Z_{\alpha/2}$ = the critical value at 95% confidence level = 1.96

e = precision (margin of error) = 5%

Accordingly,

$$n = \frac{z^2 p(1-p)}{e^2}$$

$$n^0 = \frac{(1.96)^2 * 0.5(1-0.5)}{0.05^2}$$

$$n^0 = \frac{(1.96)^2 * 0.5(0.5)}{0.05^2}$$

$$n^0 = 384$$

Since the total target population from the hospital is less than 10,000 (N=120), a finite population correction formula was applied to adjust the sample size:

$$n = \frac{n^0 N}{n^0 + (N - 1)}$$
$$n = \frac{384 * 120}{384 + (120 - 1)}$$
$$n = \frac{46080}{503} = 92$$

After accounting for a 10% nonresponse rate, the final required sample size is 101. Thus, the principal investigator planned to include all consecutive eligible patients until the required sample size was achieved, using a consecutive sampling technique.

4.7. Study Variables

4.7.1. Dependent variable

- Maternal ICU mortality
- Length of stay

4.7.2. Independent variables

- **Patient Demographics and Obstetric History:** Age, Parity, Residence, Antenatal care, Mode of delivery
- **Clinical Profile during admission to ICU:** Blood pressure, Pulse rate, Respiratory rate, Temperature, Oxygen saturation, Glasgow Coma Scale, ICU admission diagnoses
- **Referral and ICU Management Factors:** Referral status, Timing from referral to ICU admission, Admission location, Mechanical ventilation required at admission, Vasopressor use, Blood transfusion, Pre-existing medical conditions

4.8. Operational definition

- **Source of admission:** patients admitted to ICU either from obstetrics emergency operating room, gynecology/obstetric ward or referral.
- **Length of ICU stays:** the number of days a patient spends in the intensive care unit, determined by adding up all of the days from the time of admission to the time of discharge or death.
- **Admission category:** a category of patients admitted to ICU.

- **Admission outcome:** Discharged alive: Patient improved and left the ICU alive.
- **Non-obstetric conditions:** medical conditions or medical diagnosis leading to admissions.

4.9. Data collection tool and procedure

Data were collected through a retrospective chart review using a structured data extraction form. The form captured key variables including maternal demographics, obstetric history, types of obstetric complications, ICU interventions, and clinical outcomes. The sampling frame included all obstetric women admitted to the ICUs at ALERT Comprehensive Specialized and Zewditu Memorial Hospitals within the defined study period from July 1, 2023, to July 1, 2025. Eligible charts were identified through ICU admission logs and patient registries. This method allowed for efficient and accurate data collection, reducing error and increasing the overall reliability of the collected data.

4.10 Data quality control

The checklist was pretested on 15 randomly selected patient charts to maintain data quality before starting the actual data collection period. Two days of training were provided to data collectors and a supervisor, who worked outside the study area, regarding the data collection process and tools prior to the commencement of data collection. Supervisors and principal investigators monitored the data collection procedure daily to ensure the completeness and consistency of the collected data.

4.11 Data processing and analysis

Data were coded and entered into Excel spreadsheet version 16 and analyzed using SPSS version 26. Descriptive statistics, including means, medians, standard deviations, frequencies, and percentages, were used to summarize socio-demographic data, ICU outcomes, and reasons for ICU admission. Bivariable analysis was conducted to identify associations between binary maternal ICU outcomes and selected independent categorical variables (demographic factors, obstetric factors, reasons for ICU admissions) using chi-square tests. Additionally, binary logistic regression was applied to examine associations between binary maternal ICU outcomes and variables such as age, sociodemographic factors, obstetric factors, and reasons for ICU admission. Variables with a p-value ≤ 0.25 in the bivariable analysis were included in a multivariable logistic regression model to identify independent predictors of ICU outcomes. Model fitness was assessed using the Hosmer-Lemeshow test, and results were reported as Adjusted Odds Ratios (AORs) with

corresponding 95% confidence intervals (CIs). Statistical significance was determined at a p-value < 0.05.

4.12 Ethical consideration

A formal letter was obtained from Addis Ababa University College of Health Sciences, Department of Emergency and Critical Care Medicine, to get approval to conduct this study. The study was conducted after ethical clearance was obtained from the Institutional Review Board (IRB). Data collection commenced after receiving an official letter of permission.

4.13 Dissemination of results

The plan for dissemination of the results involved several strategies to ensure that the findings were widely shared with relevant stakeholders, including the intensive care unit department, emergency department, residents, nurses, and hospital administration. Key dissemination methods included conference presentations, publication in peer-reviewed journals, hospital meetings and morning presentations, and social media platforms.

5. RESULTS

5.1 Demographic and obstetric details of patients

The study included a total of 101 obstetric women admitted to the ICU of ALERT Comprehensive Specialized and Zewditu Memorial Hospitals, Addis Ababa, Ethiopia. Patients' age ranged from 17 to 40, with a median of 26 (interquartile range: 23.5–30) years. The majority of patients (88.1%) were younger than 35 years, with 11.9% aged 35 years or older. Parity was nearly evenly distributed, with 52.5% primiparous and 47.5% multiparous women. Most patients (75.2%) resided in Addis Ababa, while 24.8% dwelled outside the city. A majority (74.3%) had received antenatal care. (Table 1).

Table 1. Demographic and obstetric characteristics of obstetric women admitted to the intensive care unit at ALERT Comprehensive Specialized and Zewditu Memorial Hospitals, Addis Ababa, from July 1, 2023 to July 1, 2025 (n=101)

Variable	Frequency	Percent (%)
Age category		
<35 years	89	88.1
≥35 years	12	11.9
Parity		
Primiparous	53	52.5
Multiparous	48	47.5
Residence		
Addis Ababa	76	75.2
Out of Addis Ababa	25	24.8
Referred from another facility		
No	14	13.9
Yes	87	86.1
Time elapsed before ICU admission		
<24 hours	37	36.6
≥24 hours	64	63.4
Source of ICU admission		
Obstetric emergency	26	25.7
Inpatient ward	18	17.8
Operation theatre	57	56.4
Antenatal care received		
No	26	25.7
Yes	75	74.3
Mode of delivery		
Caesarean section	55	54.5
Spontaneous vaginal	44	43.6
Undelivered	2	2.0

ICU: Intensive care unit

5.2 Clinical profile during admission to ICU

Nearly half of the patients had systolic blood pressure ≥ 130 mmHg (46.5%) and a pulse rate >100 beats per minute (58.4%), while 68.3% exhibited elevated respiratory rates (>20 breaths/min). Most patients had low axillary temperature ($<36.5^{\circ}\text{C}$, 75.2%), with oxygen saturation predominantly $>95\%$ (56.4%). The Glasgow Coma Scale indicated that 63.4% had scores between 13 and 15, suggesting relatively preserved consciousness (Table 2).

Obstetric causes accounted for 87.1% of ICU admissions, with eclampsia (31.7%), postpartum hemorrhage (29.7%) and preeclampsia (27.7%) being the most frequent diagnoses. Non-obstetric causes comprised 12.9% of admissions. Moreover, systemic specific medical emergencies, were common: respiratory system affected in nearly half (46.5%), renal system affected in (14.9%), and infectious disease occurrence (10.9%) and neurologic system affected in (10.9%) of the cases. Hematologic system, cardiovascular system, and anesthesia-related complications were less frequent, observed in 6.9%, 4.0%, and 2.0% of patients, respectively (Table 2).

Table 2. Clinical profile during admission to the intensive care unit at ALERT Comprehensive Specialized and Zewditu Memorial Hospitals, Addis Ababa, from July 1, 2023 to July 1, 2025

Variable	Frequency	Percent (%)
Systolic blood pressure (mmHg)		
<90	8	7.9
90–129	46	45.5
≥130	47	46.5
Pulse rate		
60-100 beats per minute	42	41.6
>100 beats per minute	59	58.4
Respiratory rate		
12-20 breaths per minute	32	31.7
>20 breaths per minute	69	68.3
Axillary temperature (°C)		
<36.5	76	75.2
36.5–37.5	25	24.8
Oxygen saturation (%)		
<90	11	10.9
90–95	33	32.7
>95	57	56.4
GCS		
≤8	8	7.9
9–12	29	28.7
13–15	64	63.4
ICU admission diagnosis		
Obstetric	88	87.1
Non-obstetric	13	12.9
Type of obstetric diagnosis		
Eclampsia	32	31.7
Postpartum hemorrhage	30	29.7
Preeclampsia	28	27.7
Preeclampsia with HELLP syndrome	16	15.8
Antepartum hemorrhage	11	10.9
Eclampsia with HELLP syndrome	10	9.9
Puerperal sepsis	8	7.9
Acute fatty liver of pregnancy	5	5.0
HELLP syndrome	4	4
System-specific medical emergencies		
Respiratory system	47	46.5
Renal system	15	14.9
Infectious disease	11	10.9
Neurologic system	11	10.9
Hematologic system	7	6.9
Cardiovascular system	4	4.0
Anesthesia complications	2	2.0

GCS: Glasgow Coma Scale, ICU: Intensive care unit

5.3 Referral and ICU Management Factors

Most women 86.1% (n=87) were referred from other facilities, while 13.9% (n= 14) were direct intra-facility admissions. The majority experienced a delay of 24 hours or more before ICU admission 63.4% (n=64), compared to 36.6% (n=37) admitted within 24 hours. Regarding comorbidities, few patients had hypertension (4%), diabetes (3%), HIV/AIDS (2%), or other medical conditions (6.9%), while the majority (84.2%) had no any documented comorbidity.

Regarding ventilatory support, one-third (n=34) of patients received nasal cannula oxygen, and nearly one-third required mechanical ventilation. Inotropic support was relatively uncommon, with a vasopressor being administered in 22.8% (n= 23) of cases, whereas blood transfusion was more frequent, given to 62.4% (n=63) of patients (Table 3).

Table 3. Referral and ICU Management details of obstetric women admitted to the intensive care unit at ALERT Comprehensive Specialized and Zewditu Memorial Hospitals, Addis Ababa, from July 1, 2023 to July 1, 2025 (n=101)

Variable	Frequency	Percent (%)
Referred from another facility		
No	14	13.9
Yes	87	86.1
Time elapsed before ICU admission		
<24 hours	37	36.6
≥24 hours	64	63.4
Comorbidity		
None	85	84.2
Diabetes mellitus	3	3.0
Hypertension	4	4.0
HIV/AIDS	2	2.0
Others	7	6.9
Type of ventilatory support		
Room air	14	13.9
Nasal cannula	34	33.7
Simple facemask	20	19.8
Non-invasive positive pressure ventilation	2	2.0
Mechanical ventilation	31	30.7
Vasopressor use		
No	78	77.2
Yes	23	22.8
Blood transfusion		
No	38	37.6
Yes	63	62.4
Length of stay		
Short stay (<3 days)	26	25.7
Moderate stay (3-7 days)	56	55.4
Prolonged stay (>7 days)	19	18.8
Median (interquartile range)	4 (2–6)	-

ICU: Intensive care unit

5.4 In-ICU maternal outcomes

Overall, the percentage of patients who were discharged alive from the ICU were 78.2%, with 79 patients alive and 22 (21.8%; 95% CI: 14%–30%) deceased. Specifically, 80.7% (71/88) of women with obstetric diagnoses survived to ICU discharge, while 19.3% (17/88) died. In contrast, among those with non-obstetric or no obstetric diagnoses, 61.5% (8/13) survived and 38.5% (5/13) died in the ICU. Statistical analysis using Pearson’s Chi-Square test showed no significant association between obstetric diagnosis and ICU survival ($\chi^2 = 2.436$, $p = 0.119$). Length of stay was categorized as short (<3 days), moderate (3–7 days), and prolonged (>7 days), comprising 25.7%,

55.4%, and 18.8% of patients, respectively. The median length of stay was 4 days, with an interquartile range of 2 to 6 days (Figure 2).

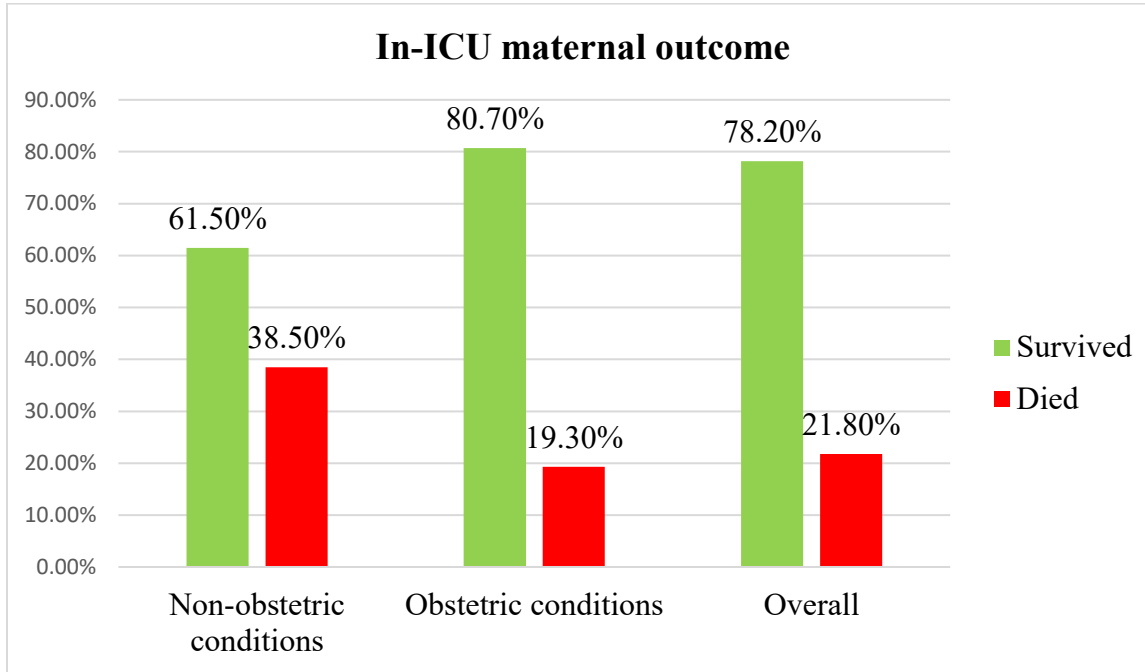


Figure 1. In-ICU maternal outcome of obstetric women admitted to the intensive care unit at ALERT Comprehensive Specialized and Zewditu Memorial Hospitals, Addis Ababa, from July 1, 2023 to July 1, 2025 (n=101) ($\chi^2 = 2.436$, df=1, p=0.119).

5.5 Factors associated with adverse maternal outcomes in the ICU

In this study, the crude association between all independent variables and the dependent variable, in-ICU maternal outcome, was assessed using bivariable logistic regression. Variables with p-values less than 0.25 in the bivariable analysis were included in the multivariable logistic regression model for adjusted analysis. Accordingly, ten variables—residence, antenatal care received, systolic blood pressure, oxygen saturation, GCS, antepartum hemorrhage, non-obstetric cause for admission, comorbidity, type of ventilatory support, and vasopressor use—were considered candidates for the final model.

Among these, upon adjusted analysis, place of residence was the only factor found to be significantly associated with in-ICU mortality in the study population. Specifically, women residing outside Addis Ababa had over six times higher odds of death compared to those from Addis Ababa (AOR: 6.17; 95%CI: 1.24–30.73) (Table 4).

Table 4. Factors associated with maternal outcome among obstetric women admitted to the intensive care unit at ALERT Comprehensive Specialized and Zewditu Memorial Hospitals, Addis Ababa, from July 1, 2023 to July 1, 2025 (n=101)

Variable	Maternal outcome		COR (95%CI)	AOR (95%CI)	P value
	Died (%)	Survived (%)			
Residence					
Addis Ababa	10(13.2)	66(86.8)	1	1	-
Out of Addis Ababa	12(48.0)	13(52.0)	6.09(2.18,17.04)	6.17(1.24,30.73)	0.026
Antenatal care received					
No	3(11.5)	23(88.5)	1	1	-
Yes	19(25.3)	56(74.7)	2.60(0.70,9.65)	5.90(0.79,44.03)	0.084
Systolic blood pressure (mmHg)					
90–129	10(21.7)	36(78.3)	1.59(0.55,4.61)	2.31(0.43,12.56)	0.332
<90	5(62.5)	3(32.5)	9.52(1.84,49.16)	7.09(0.53,95.60)	0.140
≥130	7(14.9)	40(85.1)	1	1	-
Oxygen saturation (%)					
<90	6(54.5)	5(45.5)	7.35(1.81,29.88)	7.14(0.53,95.99)	0.318
90–95	8(24.2)	25(75.8)	1.96(0.66,5.84)	4.60(0.75,28.15)	0.099
>95	8(14.0)	49(86.0)	1	1	-
GCS					
≤12	11(29.7)	26(70.3)	2.04(0.78,5.32)	8.38(0.62,112.51)	0.109
13–15	11(17.2)	53(82.8)	1	1	-
Antepartum hemorrhage					
No	18(20.0)	72(80.0%)	1	1	-
Yes	4(36.4)	7(63.6)	2.29(0.60,8.66)	2.44(0.30,19.94)	0.405
System complication					
No	5(13.5)	32(86.5)	1	1	-
Yes	17(26.6)	47(73.4)	2.32(0.78,6.91)	2.03(0.44,9.29)	0.361
Comorbidity					
No	21(24.7)	64(75.3)	4.92(0.61,39.53)	8.31(0.69,100.71)	0.096
Yes	1(6.3)	15(93.7)	1	1	-
Type of ventilatory support					
Room air	2(14.3)	12(85.3)	0.52(0.10,2.84)	6.19(0.25,152.42)	0.265
Nasal cannula	3(8.8)	31(91.2)	0.30(0.07,1.26)	1.32(0.08,20.67)	0.842
Simple facemask	9(45.0)	11(55.0)	2.56(0.78,8.38)	5.95(0.40,87.83)	0.194

CPAP or MV	8(24.2)	25(75.8)	1	1	-
Vasopressor use					
No	9(11.5)	69(88.5)	1	1	-
Yes	13(56.5)	10(43.5)	9.97(3.39,29.29)	3.89(0.58,26.15)	0.162

Only variables with p value <0.25 in the bivariable regression are depicted here.

CPAP: Continuous Positive Airway Pressure; MV: Mechanical Ventilation

1: Reference category

6. DISCUSSION

This study aimed to assess the types and outcomes of obstetric complications requiring ICU admission at two selected tertiary public hospitals in Addis Ababa, Ethiopia. The predominant obstetric causes of ICU admission were eclampsia, postpartum hemorrhage, and preeclampsia. System specific medical emergencies, including respiratory system, renal system, infectious disease, and neurologic system, collectively were observed in two-thirds (63.4%) of the cases. The overall in-ICU mortality rate was 21.8%. Among the studied factors, place of residence was the only variable significantly associated with in-ICU mortality.

In this study, the main obstetric reasons for ICU admission were eclampsia, postpartum hemorrhage, and preeclampsia. Comparatively, the predominance of these conditions in ICU admissions aligns with regional and global literature, reinforcing their significance as focal points for improving maternal critical care (16,30,31). This aligns with a study conducted among the Argentine population, where the predominant obstetric causes for ICU admission were hypertensive disorders of pregnancy, followed by postpartum hemorrhage (16). Similarly, studies from Nigeria and India independently reported that obstetric hemorrhage was among the major indications for ICU admission (15,21), but in contrast to our study, the study that was done in India Gupta et al. showed a lower percentage of obstetric ICU admissions from hypertensive disorders of pregnancy (15).

Our study also aligns with the 2022 study that was done at Saint Paul's Hospital Millennium Medical College that shows the most common causes for ICU obstetric admissions were hypertensive disorders of pregnancy followed by obstetric hemorrhage, and it also showed that not having follow up at the saint Paul's hospital and short ICU stay were found to be significantly associated with death of mothers admitted to ICU (8), but in contrast our study shows that women residing outside Addis Ababa had over 6x higher odds of death compared to those living in the city.

Eclampsia and preeclampsia are hypertensive disorders of pregnancy that often lead to multi-organ dysfunction, including neurological, hepatic, hematological, respiratory and renal involvement, which necessitates intensive monitoring and advanced interventions in the ICU. Their presence

reflects a high-risk maternal population with increased potential for adverse maternal as well as neonatal outcomes (31,32). Similarly in our study we also found that System specific medical emergencies, including respiratory system, renal system, neurologic system and infectious disease, collectively were observed in two-thirds (63.4%) of the cases.

As observed in this study, PPH remains a foremost obstetric emergency and a leading cause of maternal morbidity. Its prominence as a cause of ICU admission in this study reinforces the urgent need for timely identification, effective hemorrhage control, and supportive care such as blood transfusions and hemodynamic stabilization to save both fetal and maternal lives while reducing ICU length of stay and morbidity risk, and also PPH is largely preventable with early risk identifications, Antenatal screening and proper intrapartum care (30,33).

The overall in-ICU mortality rate among obstetric women admitted with obstetric complications was 21.8% (95% CI: 14%-30%). The observed overall in-ICU mortality rate in this study aligns with reported mortality rates from similar tertiary care settings in Ethiopia, where mortality rates have been reported around 27% (10). The present mortality rate is notably lower than rates reported in some Nigerian tertiary hospital ICUs and in India, where the corresponding rates of 48.7% and 41.7% (10/24) have been documented, respectively (15,21). In contrast, this figure was higher than the observation in Saudi Arabia and Argentina, where death rates recorded ranged from 8% to 13.3% (16,19).

This observed variation can be attributed to differences in healthcare infrastructure, patient mix, and referral patterns influencing in-ICU outcomes. High-income countries are likely to benefit from advanced critical care resources, early referral systems, and timely management alongside comprehensive maternal care programs. The persistence of elevated mortality in settings like the present study likely reflects ongoing challenges such as delayed presentation, limited ICU bed availability, constrained access to specialized interventions, and a high prevalence of life-threatening obstetric conditions including eclampsia, postpartum hemorrhage, and sepsis (34).

Interestingly, this study found that women residing outside Addis Ababa had more than six times higher odds of death compared to those living in the city. This striking difference is supported by findings from multiple studies, where it showed similarly that women living in rural areas experienced significantly higher rates of severe maternal morbidity and mortality compared to urban (35,36). Potential explanations include variations in illness severity at presentation, differential access to or utilization of healthcare services, longer referral time and other social determinants influencing health outcomes between urban and non-urban populations. Although Addis Ababa generally has better healthcare coverage and higher facility delivery rates compared to other regions in Ethiopia, as reflected in previous reports, these advantages may coincide with a concentration of less critically ill referrals in urban centers, contributing to lower observed mortality (37,38).

7. STRENGTHS AND LIMITATIONS

7.1 Strengths

- The study addresses a critical gap by focusing on obstetric ICU admissions in Ethiopia, where data are scarce, thereby providing valuable local evidence. It also contributes to national strategic initiatives aimed at reducing maternal mortality and achieving the SDG targets.
- The multicenter design of the study may enhance the generalizability of findings to other hospitals or regions with similar patient demographics or healthcare conditions.

7.2 Limitations

- The retrospective nature of the study, relying on secondary data, constrained the ability to investigate potential confounding factors such as Acute Physiology and Chronic Health Evaluation II (APACHE II) score and Sepsis-related Organ Failure Assessment (SOFA) scoring index.
- The sample size was relatively small, limiting power especially for subgroup analyses and detection of less common predictors.
- The single city setting may limit broader national representativeness beyond similar urban tertiary hospitals.

8. CONCLUSION AND RECOMMENDATION

8.1 Conclusion

Eclampsia, post-partum hemorrhage and pre-eclampsia were the leading causes of ICU admission. Strengthening early identification and timely intervention at primary and secondary health care facilities could help reduce the need for ICU admission. Place of residence was the only significant factor associated with in ICU mortality. It is recommended that strengthening referral and transportation systems for obstetric emergencies might help reduce morbidity and mortality.

8.2 Recommendations

Based on the findings of the study, the following recommendations can be tailored:

For Healthcare Professionals:

- Strengthening early identification and timely intervention of leading obstetric emergencies at primary and secondary health care facilities to reduce ICU admissions and improve outcomes.
- Implement protocols for timely hemorrhage control, fluid and hemodynamic management.
- Enhance training on recognizing severity indicators.

For Local Healthcare Administrators:

- As residence outside Addis Abeba was the only significant factor associated with mortality, strengthening referral and transportation systems for obstetric emergencies might help reduce morbidity and mortality.
- Improve quality of health education, ANC service utilization and facility level readiness.
- Strengthen ICU and high-dependency unit infrastructure with adequate staffing, equipment, and blood product availability to support management of obstetric critical illnesses.

For Researchers:

- Conduct prospective multicenter studies to further explore additional risk factors influencing ICU mortality.
- Explore long-term maternal and neonatal outcomes following ICU admissions to form comprehensive care pathways.

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DATA COLLECTION TOOL

Section 1: sociodemographic data	
1.1. Participant ID:	
1.2. Age	
1.3. parity	Primiparous/Multiparous
1.4. Residence	Addis Ababa/Out of Addis Ababa

Section 2: source of admission	
2.1. referral status	
2.2. timing from referral to ICU admission	
2.3. obstetric emergency/ward/operating room	

Section 3: obstetric history	
3.1. Antenatal care	Yes/No
3.2. Mode of delivery	C/S/SVD

Section 4: vital signs at admission	
4.1. BP	
4.2. PR	
4.3. RR	
4.4. Oxygen saturation	
4.5. Temperature	
4.6. GCS	

Section 5: ICU admission diagnosis
5.1. Eclampsia
5.2. Post partum hemorrhage
5.3. Preeclampsia
5.4. Preeclampsia with HELLP syndrome
5.5. Eclampsia with HELLP syndrome
5.6. Antepartum hemorrhage
5.7. Puerperal sepsis
5.8. Acute fatty liver of pregnancy
5.9. HELLP syndrome
5.10. Non- obstetric conditions (cardiac, respiratory, hepatic, neurologic conditions)

Section 6: system specific medical emergencies
6.1. Respiratory system
6.2. Renal system
6.3. Infectious disease
6.4. Neurologic system
6.5. Hematologic system
6.6. Cardiovascular system
6.7. Anesthesia complications

Section 7: Previous medical history	
7.1. Diabetes	Yes/No
7.2. Hypertension	Yes/No
7.3. HIV Status	Positive/Negative
7.4. Other conditions	

Section 8: Interventions received in ICU	
8.1. Mechanical ventilation Required at admission	Yes/No
8.2. Vasopressor use	Yes/No
8.3. Blood transfusion	Yes/No

Section 9: Outcomes in ICU	
9.1. Survival status	Alive/Dead
9.2. Length of stay	