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Delays in Emergency Obstetrics referrals in Addis Abeba hospitals

Endalkachew Mekonnen Assefa¹, Yemane Berhane²

Abstract

Background: Preventing severe maternal outcomes or deaths requires timely and appropriate referrals to facilities capable of providing adequate and appropriate treatment. In the city of Addis Abeba the geographic access to health facilities that provide obstetric emergency services is universal. However, timely referral to obstetric facilities when needed is often delayed leading to unnecessary maternal complications due to many factors. This study tries to assess where the delays occur in the referral chain.

Methods: A facility based cross sectional study was conducted in two public hospitals, Zewditu and Gandhi Memorial Hospitals, in Addis Abeba, the capital city of Ethiopia. The study was conducted between December 2018 and February 2019. Data were collected using a pretested and structured questionnaire. All mothers referral to the two hospitals during the study period were included in the study.

Results: A total of 403 pregnant women referred for delivery to the study hospitals were included in the study. Three-fourth (301, 74.7%) of referred pregnant mothers had the third delay (delayed care at the receiving hospital); (211, 52.4%) had first delay (delay in making decision to seek care). Overall 366(90.8%) mothers had experienced at least one of the three delays and 71(17.6%) had all the three delays. Twenty-nine (7.2%) referred mothers had severe maternal outcomes (SMO). The most leading causes/diagnosis of SMO were blood transfusion 17 (58.6%) followed by post partum hemorrhage 15 (52%) then eclampsia 9 (31%). In addition, mothers who experienced severe maternal outcomes were 2.9 times more to have at least one of the three delays.

Conclusion & recommendation: The majority of the mothers in this study had serious delays in both making decision to seek care for birthing and in actually receiving care once at a hospital. Strengthening the guidelines to reduce delays in maternity care is critical to prevent severe maternal outcomes.

Key words: Addis Abeba, Severe maternal outcomes, Three-delay model

Introduction

The majority of maternal deaths are clustered around labour, delivery and the 24 hours postpartum (1),(2). It is estimated that just five conditions (postpartum hemorrhage; puerperal sepsis; preeclampsia and eclampsia; obstructed or prolonged labour, and complications of unsafe abortion), account for at least 60% of all maternal mortality (3). Life-threatening situations may develop rapidly and without warning, often in previously uncomplicated pregnancies(4).

Globally, it is recognized that significant inroads in maternal mortality cannot be made without dramatically increasing access to emergency obstetrical care (EmOC). The World Health Organization estimates that at least 88–98% of maternal deaths can be averted with timely access to existing, emergency obstetric interventions (5). This produces a triple return on investment, saving mothers and newborns and preventing stillbirths(6).

A number of factors can influence a woman's ability to access effective interventions to treat complications in the event of an obstetric emergency. Thaddeus and Maine (1994) group these into three broad categories using a classic, pathways-based framework known as the 'three delays model'(7). The 'three delays model' attempts to explain delays in women accessing emergency obstetric care as the result of: 1) decision-making, 2) accessing services and 3) receipt of appropriate care once a health facility is reached.

Referral is often associated with the second delay of the three delays model– associated with reaching the appropriate level of care. But in fact, a referral system can reduce all three delays. If a population knows that a system is reliable and affordable, families may make the decision to seek care more quickly (the first delay(8)).

The major obstacles that affect the referral system reported by both the health workers and mothers were: 1) financial barriers (for transportation and service payments at health facilities), 2) lack of means of transportation, 3) distance, and 4) lack of awareness of services and the importance of services (9).

Factors associated with health seeking behavior are multidimensional. Socio-cultural and economic problems, lack of awareness, the quality of health services, and infrastructure such as transport services all affect whether and where a woman will seek care, how long it will take to reach care, and whether she receives the appropriate care in a timely fashion(10).

Studies showed referrals in pregnancy and childbirth can be (1) institutional or self-referral, depending on the involvement of first line services; (2) antenatal, delivery or postnatal referral; and (3) elective or emergency referral. Pregnant mothers may be referred due to demographic risks, obstetric historical risks, prenatal complications and delivery and immediate postnatal complications(11). On the other hand, studies show that high risk prediction may not necessarily mean that the woman will have a complication and many women identified as being at risk go on to have normal deliveries(12).

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3 Defining a framework and process for obstetric referrals may lead to reduction of maternal mortality
4 and morbidity. Referral should be broadly defined to include not only transport, but it should be timely
5 referral to minimize or prevent the delay for transportation (called second delay), and ensure pre-
6 hospital care while transporting a patient to the referral facility(13), (14).
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9 It is widely accepted that substantial reductions in maternal mortality and severe morbidity are
10 impossible to achieve without an effective referral system for complicated cases(9), (15). There is a
11 paucity of evidence from Ethiopia on the proportion of complicated and emergency
12 obstetric cases that are detected and referred to appropriate higher level health institutions.
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15 **Objectives**

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17 The objectives of this study were to identify indications of emergency obstetrics referral and, types of
18 delay and maternal health outcomes based on the three delay model among mothers who referred for
19 childbirth.
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21

22 **Methods**

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24 We used the STROBE cross sectional reporting guidelines (42).
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26

27 **Study design and setting**

28 A facility based cross-sectional study was conducted between December 10/2018-February 28/2019 in
29 two government hospitals Zewditu Memorial Hospital (ZMH) and Gandhi Memorial Hospitals (GMH).
30 Both hospitals are under Addis Abeba Health Bureau and affiliated with Addis Abeba University College
31 of Health Sciences. Gandhi Memorial Hospital is a referral maternity hospital and Zewditu Memorial
32 Hospital is also a comprehensive referral hospital. Both hospitals have 40 (forty) health centers under
33 them allocated by Ministry of Health and other health facilities which can refer to them after contact.
34 Both hospitals are giving Comprehensive emergency obstetrics care (CEmoc) and attending more than
35 17,000 deliveries per a year.
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38

39 The referral system for obstetric emergency in Addis Abeba is organized to include Basic Emergency
40 obstetric care (BEemoc) facilities and CEemoc facilities. The referral system is developed to work both
41 ways. Referral between facilities is facilitated by the liason office or Maternal Health Task Force. An
42 ambulance system is organized to transport mothers which should be accompanied by midwives. The
43 midwife provides care during transportation and hand-over the mother to the receiving hospital care
44 provider with a referral paper. In the city, all maternity services including labour/delivery and the
45 ambulance services are provided free of charge in all government health facilities.
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49 **Eligibility criteria**

50 All pregnant mothers who were referred for labor and delivery services to the study hospitals and who
51 gave consent were included in the study. The mothers were identified from emergency or labor
52 wards daily and interviewed before they were discharged from the hospitals. Residents and interns at
53 ob-gyn department helped collecting the data using a pre-tested structured and structured
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questionnaire. The completed questionnaires were reviewed by principal investigator. Incomplete questionnaires were returned to the person who completed the questionnaire by asking the mother for the second time.

The referral papers reviewed and date, time and diagnosis of referral were recorded for each mother. The triage paper and patient chart are also reviewed including mode of transportation, date and time of arrival, sources of referrals, obstetrics performances, the time taken to admit/get the service after arrival, diagnosis at receiving hospital, gestational age, place and mode of delivery, newborn outcomes and severe maternal complications types and managements. Mothers interviewed on demographic and economic characteristics, time interval to seek medical advice and reason of delay to seek the care (if there was).

The three delays time frame were operationally defined through a consultative process involving obstetrician & gynecologists who had working experience of 7-20 years in the selected hospitals. Accordingly, first delay, time elapsed time between the recognition of a maternal complication and the decision to transport the patient to a health facility, was considered if the decision was not made within 60 minutes. The second delay was if the mother did not reach to referral hospitals within 60 minutes of referral. The third delay was if the mother didn't receive care or intervention within 30 minutes. Severe Maternal outcomes were any maternal complication including laboratory evidences of organ damage and maternal death during the process of delivery or before discharge from the hospital. Potentially life threatening maternal conditions (PLTMC) was considered when the mother had at least one of the following; hemorrhagic complications, hypertensive disorders and complications, end organ injury, blood product transfusion, ICU admission, uterine rupture, hysterectomy/laparotomy.

Study size: Single proportion formula used. By assuming 50% of the referred mothers have delay, degree of precision of 5% (d) and confidence interval of 95% (Z=1.96) the sample size was 403.

Analyses

Data were entered in epi-info version 7.2.2.6 and transported to SPSS Version-21 statistics software for cleaning and analysis. Descriptive statistical were used to present mothers by their socio-demographic characteristics, referral diagnosis, diagnosis at receiving hospitals, obstetrics characteristics, mode of delivery, newborn outcomes, the three delays, and severe maternal outcomes. Severe maternal outcomes were analyzed for the three delays. The relationship between the three delays and SMO were examined using the multivariate logistic regression. The goodness of the model was tested by Hosmer-Lemeshow test for goodness-of-fit. Selected variables were included in the model to account for maternal characteristics differences other than delays in seeking and receiving care.

Ethics approval

Ethical clearance was obtained from both Addis Continental Institute of Public Health (ACIPH) and Addis Abeba Health Bureau (AAHB). Support letters were written to both study hospitals from the local health authorities to gain access. Informed consent was obtained from each mother who participated in the study after ensuring their privacy and confidentiality of information.

Results

A total of 403 pregnant mothers referred for labor/delivery services to the study hospitals were included. The majorities were married (380, 94.3%), and have completed at least secondary school (54.3%). The median age was 26 years (range 18-43 years) and the median gravidity was 3 (range 1-7). Majority mothers were primigravida (56.1%) and most pregnant mothers (58.8%) were at term pregnancy (37 weeks-41w6d)(Table1).

Table 1. Socio-demographic and obstetrics characteristics of respondents, Addis Abeba, Ethiopia, 2019 (n=403)

Characteristics n=403	Number (%)
Study Hospital	
Gandhi Memorial Hospital (GMH)	173 (42.9)
Zewditu Memorial Hospital (ZMH)	230 (57.1)
Age (years) median: 26 years (range 18-43)	
< 20	32 (7.9)
20-25	158 (39.2)
26-30	151 (37.5)
31-35	46 (11.4)
≥36	16 (4.0)
Marital status	
Married	380 (94.3)
Others(unmarried, divorced)	23 (5.7)
Educational level	
No formal education	49 (12.2)
Primary school	135 (33.5)
Secondary school	117 (29.0)
Preparatory	35 (8.7)
Vocational and above	67 (16.6)

Gravidity n=403	
1	226 (56.1)
2-4	165 (40.9)
≥5	12 (3.0)
Parity n=146	
1	90 (61.6)
≥2	56 (38.4)
Abortion n=60	
1	48 (80)
≥ 2	12 (20)
Gestational age	
28-33w6d	9(2.2)
34-36w6d	22 (5.5)
37-41w6d	237 (58.8)
≥ 42	42 (10.4)
Unknown	93 (23.1)

The majority of the pregnant mothers were referred from health centers (387, 96%) and transported by the ambulance provided by the health facility. The three most common referral diagnosis were term premature rupture of membrane (PROM) (25.8%), latent first stage of labour abnormality (16.6%), and post term pregnancy (15.4%)(Table 2).

The most common diagnosis at the receiving hospital following reassessment of the mother were latent first stage of labor (126, 31.3%), term premature rupture of membrane (123, 30.5%), and active first stage of labor (18.9%) (Table 2).

Table 2. Source of referral, transportation, referral and receiving hospital diagnosis, mode & place of delivery, among referred pregnant mothers for delivery, Addis Abeba, Ethiopia, 2019.

Characteristics	Number (%)
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Source of referral N=403	
Health Center	387 (96.0)
Others	16 (4.0)
Transportation	
Ambulance	290 (72)
Others(Taxi, personal car)	113 (28)
Receiving hospital contacted before the women referred	
Yes	157 (39.0)
No	246 (61.0)
Referral diagnosis ** N=403	
Antepartum hemorrhage (APH)	11 (2.8)
Pregnancy induced hypertension (PIH)	51 (12.7)
Previous c-section scar	19 (4.7)
Latent phase labor abnormality	67 (16.6)
Active phase labor abnormality	52 (12.9)
Second stage labor abnormality	20 (5.0)
Post term pregnancy	62 (15.4)
Malpresentation/malposition	14 (3.5)
Premature rupture of membrane (PROM)	104 (25.8)
Cephalopelvic disproportion (CPD)	6 (1.5)
Non-reassuring fetal heart pattern(NRFHRP)	25 (6.2)
Meconium staining amniotic fluid (MSAF)	25 (6.2)
Others	19 (4.7)
Diagnosis at receiving hospital ** N=403	

Ante partum hemorrhage (APH)	13 (3.2)
Pregnancy induced hemorrhage (PIH)	54 (13.4)
Previous C-section scar	18 (4.5)
Latent first stage of labor (LFSOL)	126 (31.3)
Active first stage of labor	76 (18.9)
Second stage of labor	29 (7.2)
Post-term	52 (12.9)
Malpresentation/malposition	18 (4.5)
Premature rupture of membrane (PROM)	123 (30.5)
Cephalopelvic disproportion (CPD)	7 (1.7)
Non-reassuring fetal heart pattern (NRFHRP)	13 (3.2)
Meconium staining	21 (5.2)
Others	28 (6.9)

** percentage is > 100 % due to more than one answer is possible

The majority of the mothers delivered through vaginal route (254, 63.3%) and the remaining by C-section (148, 36.7%). The most common indication for C-section were non-reassuring fetal heart rate pattern (27 %), cephalo-pelvic disproportion/malpresentation/malposition (24.3%), and meconium staining in latent first stage of labor (22.3%). The majority of the babies were born alive (96.5%). There were eight (2%) intra-partum fetal losses among total deliveries (table 3).

Table 3. Mode of delivery, place of delivery and perinatal outcome of referred mothers, Addis Abeba, Ethiopia 2019.

Mode of delivery	
Vaginal delivery	229 (56.8)
Assisted breech delivery	4 (1.0)
C-section	148 (36.7)
Instrumental delivery	21(5.2)
Vacuum	16 (4.0)

	Forceps		5 (1.2)
	Laparotomy		1 (0.2)
C-section indication N=148			
	Non-reassuring fetal heart rate (NRFHR)		40 (27.0)
	Meconium in LFSOL		33 (22.3)
	Cephalopelvic disproportion (CPD)		21 (14.2)
	Malpresentation/malposition		15 (10.1)
	Previous C-scar with labor/labor abnormality		10 (6.8)
	Cord prolapse/presentation		7 (4.7)
	Non reassuring biophysical profile (NRBPP)		5 (3.4)
	APH		4 (2.7)
	Others		13(8.8)
Place of delivery N=403			
	Labor ward/Operation room		386 (95.8)
	Emergency OPD		17 (4.2)
Outcome N=403			
	Alive		389 (96.5)
	Newborn referred to NICU	Yes	137 (34)
		No	252 (62.5)
	Stillbirth		14 (3.5)
	Fetal heart beat positive on arrival		8(2.0)
	Fetal heart beat negative on arrival		6(1.5)

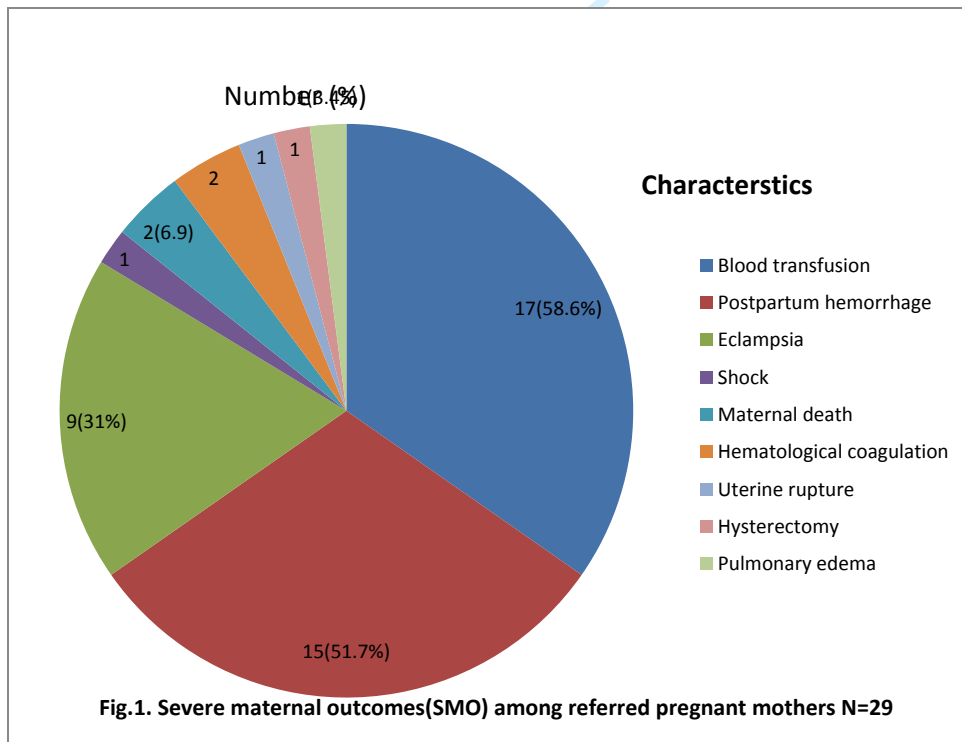
Among 403 referred mothers for childbirth, 71(17.6%) mothers experienced all the three delays. Almost three-fourth referred mothers (74.7%) experienced third delay followed by first delay (52.4%). Majority (366, 90.8%) mothers had at least one of the delays (Table 3).

Table 3. The frequency of the three delays among referred mothers, Addis Abeba, Ethiopia 2019.

Characteristics	Number (%)	
	Yes	No
N=403		
First delay	211 (52.4)	192 (47.6)
Second delay	163 (40.4)	240(59.6)
Third delay	301(74.7)	102(25.3)
At least one delay	366 (90.8)	37 (9.2)
All three delay	71 (17.6)	332 (82.4)

** multiple answer possible

Twenty-nine (7.2%) mothers had severe maternal outcomes. The most common severe maternal outcome was blood transfusion (58.6%) followed by post partum hemorrhage (51.7%) then eclampsia (31%). Nearly three-fourth mothers with SMO (78.5%) had more than one complication (Figure1).



The most common delays in mothers with SMO were third delay (58.6%) followed by first delay (51.7%). All most three-fourth mothers experienced at least one of the delays (79.3%) and one-quarter (24.1%) mothers had all the delays (table 4).

Statistically significant association was observed between SMO and third delay, at least one of the delays. Referred mothers with the third delay had 2.2 times (95% CI of 1.025-4.840) more likely to be a risk for severe maternal outcomes. Mothers who experienced at least one of the delays had 2.9 times (95% CI 1.093-7.620) more likely to be a risk for severe maternal outcomes (table 4).

After adjusted for age, gravidity, parity, educational level and marital status none of the delays were significant. This may be due to small sample of mothers with SMO. Also the three delays were not significant for age, gravidity, parity, educational level, gestational age and marital status.

Table 4. SMO and types of delays Addis Abeba, Ethiopia 2019.

Characteristics	Severe maternal outcomes				
	Types of delay	No	Yes	P-value	COR 95 % CI
		Number (%)	Number (%)		
First delay	No	178 (47.6%)	14 (48.3)		
	Yes	196 (52.4)	15 (51.7)	0.944	1.028(0.483-2.189)
Second delay	No	224 (59.9)	16 (55.2)		
	Yes	150 (40.1)	13 (44.8)	0.618	1.213(0.567-2.596)
Third delay	No	90(24.1)	12 (41.4)		
	Yes	284 (75.9)	15 (58.6)	0.043	2.227(1.025-4.840)
All delays	No	310 (82.9)	22 (75.9)		
	Yes	64 (17.1)	7 (24.1)	0.342	1.541(0.632-3.761)
At least one delay	No	31 (8.3)	6 (20.7)		
	Yes	343 (91.7)	23(79.3)	0.032	2.889(1.093-7.620)

**AOR not significant after adjusted for age, marital status, educational level, gestational age, gravidity, parity.

Eighty (19.9%) of referred mothers had at least one potential life threatening conditions (PLTC). The most common complications was hypertensive disorders 56 (70%) followed by blood transfusion 17 (21.3%) then post partum hemorrhage (table 5).

Table 5. Potentially life threatening conditions among referred mothers Addis Abeba, Ethiopia, 2019

Characteristics* N=80	Number (%)
Hemorrhagic complications	
Ante partum hemorrhage (AP,PP)	13 (16.3)
Post partum hemorrhage (PPH)	15 (18.8)
Ruptured uterus	1 (1.25)
Coagulopathy	2 (2.5)
Hypertensive disorders	
Severe hypertension/Preeclampsia	50 (62.5)
Eclampsia	9 (11.3)
HELLP syndrome	2 (2.5)
Others	
Pulmonary edema	1 (1.25)
Shock	1(1.25)
Thrombocytopenia	2 (2.5)
Management indication of severity	
Transfusion of blood derivatives	17 (21.3)
Major surgical intervention(hysterectomy)	1(1.25)

*Multiple response possible

Discussion

All three types of delay were common in maternity services in the study hospitals; the most severe being the delay within the receiving hospital. The most common referral diagnoses were premature rupture of membranes (PROM), latent phase labor abnormality and post-term pregnancy. The third delay was significantly associated with severe maternal outcomes.

This study is similar to previous study in Addis Abeba showed that PROM was the most common referral diagnosis contributed 19.7 % (16); this is different from other reports in other sub-Saharan countries (17). There were many discrepancies of cases diagnosis between at referring and at receiving hospitals, the most common diagnosis at receiving hospitals are the latent first stage of labor (31.3%) followed by premature rupture of membrane (29%). Some cases were under-/over-diagnosed. Non-reassuring fetal heart rate pattern/fetal distress were twice over diagnosed; on the other hand latent first stage of labor twice less under-diagnosed at referring facilities. These discrepancies might occur due to differences between the qualification of care providers at the health center and referral hospitals. In the health centers midwives are the main caregivers while in the receiving hospitals midwives, medical interns, general practitioners, residents, and obstetrician and gynecologist involved in maternal care. Variation in providers' competences can be contributing factor to the observed gaps (18).

Studies have found that distance to facilities is a clear barrier to women accessing health facilities (19) (20) but in Addis Abeba, proximity to services does not appear to be a problem, as the median distance to a facility that provides surgical services is 5 kilometers, well below the national average of 45 kilometers (21). Two-fifth of mothers had the second delay. When we compare with other studies it may be low however this proportion of the second delay is not expected because referring facilities/catchment health centers are near to the receiving hospitals and expected to refer by ambulance (21).

Our study showed the rate of occurrence of SMO indicators were higher than the findings of an earlier study done in other parts of the country (22) (23) (24) (25) and other countries (26) (27). This high proportion SMO might be due to the fact that our study selected facilities are referral hospitals which are serving complicated cases and cases referred from other health facilities which were beyond their capacity/needed further interventions. This study showed that direct obstetric causes were the most common leading factors of SMO and the most common diagnosis were postpartum hemorrhage (52%) followed by eclampsia (31%) and the most common intervention was blood transfusion (58.6%). Obstetric hemorrhage and hypertensive disorders (eclampsia, hematological coagulation, and pulmonary edema) were found to be the top underlying complications among cases of SMO; similarly, hypertensive disorders and obstetric hemorrhage were the most common underlying causes of PLTC. This is comparable to the findings from studies in other parts of the country (23), (24) (28) and other countries (27, 29-31) including sub-Saharan countries (32).

Emergency obstetric care use by women is influenced by a complex interaction of factors leading to delay in decision-making, accessing services and receipt of proper care once a health facility is reached (33). Receiving appropriate care after reaching at the health facility (delay three) was the most common

(58.6%) followed by delay in seeking care (delay one) (51.7%) then reaching at the appropriate health facility (delay two) (44.8%) were identified among SMO and more than half of (58.6%) SMO cases had encountered at least one of the delays which were similar to study done elsewhere in the country (23) (34) (35) (36); however delay two and one is seen less frequently than the findings from other developing countries (17) (27) (33) (34) (38) (39). This can be justified by overloaded of cases, limited hospitals capacity, a difference in socio-demographic characteristics of the study population and the proximity of health facilities.

In this study, failure to receiving appropriate care after reaching at the health facility (delay three) was found to have the strongest association with SMO: with a two-fold increase in the risk. This supports the WHO hypothesis relating a high case fatality in the hospital as an indicator for the presence of delay in receiving an adequate and proper treatment (40) and it indicates the poor performance of obstetrics services (41). Seeking care from a facility that is incapacitated health facility and system, poor leadership (mismanagements of hospital resources, poor co-ordinations and lack of understanding of obstetrics emergencies) contribute to significant delay after reaching the health facility. These factors were reported as significant contributors to delay in several studies (23)(34) (36). Studies from Tigray, 88% of all maternal deaths were attributed to health system failure (35). In our study, 59 % of SMO cases and both maternal deaths (MD) had health system related factors as a possible reason for delay three.

The limitation of this study include that it was conducted in two referral hospitals which often receive complicated cases and referred mother with complications; and the results might not be representative of other institutions and the community. In addition, cases were missed because they transferred to health centers after two hours of uncomplicated vaginal delivery.

However, we believe that this study gives the extent of delays and SMO & its indicators experienced by women who were referred for an emergency delivery. In fact, if the delay is so severe in these well-established referral centers one may expect it to be worse in some not well staffed and equipped centers. We decided to focus on women with severe maternal outcomes (SMO) rather than less severe forms of obstetric complications because their situations are the closest to maternal deaths.

Conclusion

The burden of severe maternal outcomes (SMO) is high due to preventable and/or treatable direct obstetric. The majority of the mothers in this study had serious delays in both making decision to seek care for birthing and in actually receiving care once at a hospital. We recommend strengthening health referral systems, provision of training to maternal health service providers at the referring facilities, and addressing specific health system bottlenecks during labor and birth in order to ensure no mother will be endanger.

Abbreviations

AFSOL: Active First Stage of Labor

ANC: Antenatal Care

1
2
3 BEmOC: Basic Emergency Obstetrics Care
4
5 CEmOC: Comprehensive Emergency Obstetrics Care
6
7 EOPD: Emergency Out-Patient Department
8
9 GMH: Gandhi Memorial Hospital
10
11 HELLP: Hemolysis, Elevated liver enzyme, Low Platelets
12
13 LFSOL: Latent First Stage of Labor
14
15 LW: Labor Ward
16
17 MD: Maternal Death Ratio
18
19 MNM: Maternal Near-Miss
20
21 MWH: Maternity Waiting Home
22
23 NICU: Neonatal Intensive Care Unit
24
25 PIH: Pregnancy Induced Hypertension
26
27 PLTC: Potential Life Threatening Conditions
28
29 PPH: Post Partum Hemorrhage
30
31 PROM: Premature Rupture of Membrane
32
33 SMO: Severe Maternal Outcomes
34
35 WHO: World Health Organization
36
37 ZMH: Zewditu Memorial Hospital
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Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

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Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

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		Page Number
Title and abstract		
Title	#i Indicate the study's design with a commonly used term in the title or the abstract	
Abstract	#i Provide in the abstract an informative and balanced summary of	

what was done and what was found

Introduction

- Background / rationale [#1](#) Explain the scientific background and rationale for the investigation being reported
- Objectives [#3](#) State specific objectives, including any prespecified hypotheses
- ## Methods
- Study design [#3](#) Present key elements of study design early in the paper
- Setting [#3](#) Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
- Eligibility criteria [#3](#) Give the eligibility criteria, and the sources and methods of selection of participants.
- [#4](#) Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
- Data sources / measurement [#4](#) For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.
- Bias [#4](#) Describe any efforts to address potential sources of bias
- Study size [#4](#) Explain how the study size was arrived at

1	Quantitative	#4	Explain how quantitative variables were handled in the
2			
3	variables		analyses. If applicable, describe which groupings were chosen,
4			
5			and why
6			
7			
8			
9	Statistical	#n/a	Describe all statistical methods, including those used to control
10			
11	methods		for confounding
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14	Statistical	#n/a	Describe any methods used to examine subgroups and
15			
16	methods		interactions
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18			
19	Statistical	#4	Explain how missing data were addressed
20			
21	methods		
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23			
24			
25	Statistical	#4	If applicable, describe analytical methods taking account of
26			
27	methods		sampling strategy
28			
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30	Statistical	#n/a	Describe any sensitivity analyses
31			
32	methods		
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36	Results		
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39	Participants	#n/a	Report numbers of individuals at each stage of study—eg
40			
41			numbers potentially eligible, examined for eligibility, confirmed
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43			eligible, included in the study, completing follow-up, and
44			
45			analysed. Give information separately for for exposed and
46			
47			unexposed groups if applicable.
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51			Note it was cross-sectional study
52			
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54	Participants	#n/a	Give reasons for non-participation at each stage
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57			Note: all participants participated
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1	Participants	#n/a	Consider use of a flow diagram
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4			Note: it was just at one study.
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7	Descriptive data	#5	Give characteristics of study participants (eg demographic,
8			clinical, social) and information on exposures and potential
9			confounders. Give information separately for exposed and
10			unexposed groups if applicable.
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17	Descriptive data	#n/a	Indicate number of participants with missing data for each
18			variable of interest
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20			Note: there was no missed data due to different interests.
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26	Outcome data	#6	Report numbers of outcome events or summary measures.
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28			Give information separately for exposed and unexposed groups
29			if applicable.
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37	Main results	#11	Give unadjusted estimates and, if applicable, confounder-
38			adjusted estimates and their precision (eg, 95% confidence
39			interval). Make clear which confounders were adjusted for and
40			why they were included
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47	Main results	#n/a	Report category boundaries when continuous variables were
48			categorized
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52	Main results	#n/a	If relevant, consider translating estimates of relative risk into
53			absolute risk for a meaningful time period
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57	Other analyses	#10	Report other analyses done—e.g., analyses of subgroups and
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interactions, and sensitivity analyses

Discussion

Key results

[#12](#) Summarise key results with reference to study objectives

Limitations

[#13](#) Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.

Interpretation

[#13](#) Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.

Generalisability

[#13](#) Discuss the generalisability (external validity) of the study results

Other Information

Funding

[#14](#) Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

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Delays in Emergency Obstetrics referrals in Addis Ababa hospitals: a facility-based, cross-sectional study

Endalkachew Mekonnen Assefa¹, Yemane Berhane²

Abstract

Objectives: To assess where the delays occur in the referral chain at most and maternal health outcomes based on the three delay model in Addis Ababa.

Design: This study was a facility-based cross sectional study

Setting: Two public and tertiary hospitals in Addis Ababa

Participants: All pregnant women who were referred for only labor and delivery services after 28 weeks of gestation between December 2018 and February 2019 in Zewditu and Gandhi Memorial hospitals.

Primary and secondary outcome measures: The primary outcome was the type of delays from the three-delay model which met operationally defined time. Maternal health outcomes based on the three-delay model was secondary outcome.

Results: A total of 403 pregnant women referred for delivery to the study hospitals were included in the study. Three-fourth (301, 74.7%) of referred pregnant women had the third delay (delayed receiving appropriate care); (211, 52.4%) had first delay (delay in making decision to seek care). Overall 366(90.8%) pregnant women had experienced at least one of the three delays and 71(17.6%) had all the three delays. Twenty-nine (7.2%) referred women had severe maternal outcomes (SMO). The most leading causes/diagnosis of SMO were blood transfusion 17 (58.6%) followed by post partum hemorrhage 15 (52%) then eclampsia 9 (31%). In addition, women who experienced severe maternal outcomes were 2.9 times more likely to have at least one of the three delays.

Conclusion & recommendation: This study highlights the persistence of delays at all levels and especially delay three and its contribution to the severe maternal outcomes. Strengthening health referral systems and addressing specific health system bottlenecks during labor and birth in order to ensure no mother will be endanger. We also recommend a qualitative method of study (focus group discussion and in-depth interview) and observing the tertiary hospitals set-up and readiness to manage obstetrics emergencies.

Key words: Addis Ababa, Emergency obstetrics referral, severe maternal outcomes, Three-delay model

Article summary

Strengths and limitations

- This study gives the extent of delays and severe maternal outcomes experienced by women who were referred for labor and delivery
- This study focused on women with severe maternal outcomes (SMO) rather than less severe forms of obstetric complications because their situations are the closest to maternal deaths.
- Women after delivery might be missed if they transferred to health centers and to other hospitals after delivery for different reasons.
- The results might not be representative of other institutions and the community because it was conducted in two referral hospitals which often receive and treat complicated cases.

Introduction

The majority of maternal deaths are clustered around labour, delivery and the 24 hours postpartum (1),(2). It is estimated that just five conditions (postpartum hemorrhage; puerperal sepsis; preeclampsia and eclampsia; obstructed or prolonged labour, and complications of unsafe abortion), account for at least 60% of all maternal mortality (3). Life-threatening situations may develop rapidly and without warning, often in previously uncomplicated pregnancies(4).

Globally, it is recognized that significant inroads in maternal mortality cannot be made without dramatically increasing access to emergency obstetrical care (EmOC). The World Health Organization estimates that at least 88–98% of maternal deaths can be averted with timely access to existing, emergency obstetric interventions (5). This produces a triple return on investment, saving women and newborns and preventing stillbirths(6).

A number of factors can influence a woman's ability to access effective interventions to treat complications in the event of an obstetric emergency. Thaddeus and Maine (1994) group these into three broad categories using a classic, pathways-based framework known as the 'three delays model'(7). The 'three delays model' attempts to explain delays in women accessing emergency obstetric care as the result of: 1) decision-making, 2) accessing services and 3) receipt of appropriate care once a health facility is reached.

Referral is often associated with the second delay of the three delays model– associated with reaching the appropriate level of care. But in fact, a referral system can reduce all three delays. If a population knows that a system is reliable and affordable, families may make the decision to seek care more quickly (the first delay(8)).

The major obstacles that affect the referral system reported by both the health workers and women were: 1) financial barriers (for transportation and service payments at health facilities), 2) lack of means of transportation, 3) distance, and 4) lack of awareness of services and the importance of services (9).

Factors associated with health seeking behavior are multidimensional. Socio-cultural and economic problems, lack of awareness, the quality of health services, and infrastructure such as transport services all affect whether and where a woman will seek care, how long it will take to reach care, and whether she receives the appropriate care in a timely fashion(10).

Studies showed referrals in pregnancy and childbirth can be (1) institutional or self-referral, depending on the involvement of first line services; (2) antenatal, delivery or postnatal referral; and (3) elective or emergency referral. Pregnant women may be referred due to demographic risks, obstetric historical risks, prenatal complications and delivery and immediate postnatal complications(11). On the other hand, studies show that high risk prediction may not necessarily mean that the woman will have a complication and many women identified as being at risk go on to have normal deliveries(12).

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3 Defining a framework and process for obstetric referrals may lead to reduction of maternal mortality
4 and morbidity. Referral should be broadly defined to include not only transport, but it should be timely
5 referral to minimize or prevent the delay for transportation (called second delay), and ensure pre-
6 hospital care while transporting a patient to the referral facility(13), (14).

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9 It is widely accepted that substantial reductions in maternal mortality and severe morbidity are
10 impossible to achieve without early decision-making to seek care, an effective referral system for
11 complicated cases and receiving timely and appropriate care (9), (15) .

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14 The objective of this study was to determine the types of delay and maternal health outcomes based on
15 the three delay model among women who referred for labor and delivery. Results from this study may
16 be an input for the hospitals, health bureau, policy-makers and other stakeholders to act on bottle-
17 necks of emergency obstetrics services by identifying the most common types of delay.

18 19 20 **Methods**

21
22 We used the STROBE cross sectional reporting guidelines (16).

23 24 **Study design**

25
26 A facility based cross-sectional study was conducted between December 10/2018-February 28/2019 in
27 two government hospitals Zewditu Memorial Hospital (ZMH) and Gandhi Memorial Hospitals (GMH).

28 29 30 **Study setting**

31
32 This study conducted in tertiary hospitals located in capital city of Ethiopia, Addis Ababa. Both hospitals
33 are under Addis Ababa Health Bureau and affiliated with Addis Ababa University College of Health
34 Sciences. Gandhi Memorial Hospital is a referral maternity hospital and Zewditu Memorial Hospital is
35 also a comprehensive referral hospital. Both hospitals have 40 (forty) health centers under them
36 allocated by Ministry of Health and other health facilities which can refer to them. Both hospitals are
37 giving Comprehensive emergency obstetrics care (CEmOC) and attending more than 17,000 deliveries
38 per a year.

39
40
41 The referral system for obstetric emergency in Addis Ababa is organized to include Basic Emergency
42 obstetric care (BEmOC) facilities and CEmOC facilities. The referral system is developed to work both
43 ways. Referral between facilities is facilitated by the liason office or Maternal Health Task Force. An
44 ambulance system is organized to transport women which should be accompanied by midwives. The
45 midwife provides care during transportation and hand-over the mother to the receiving hospital care
46 provider with a referral paper. In the city, all maternity services including labour/delivery and the
47 ambulance services are provided free of charge in all government health facilities.

48 49 50 51 52 53 54 55 56 **Eligibility criteria**

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3 All pregnant women who were referred for only labor and delivery services after 28 weeks of gestation
4 or baby outcome ≥ 1 kg and delivered in the selected hospitals, and also who gave consent were
5 included.
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7 **Data Collection Tools**

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9 After they gave birth, women were identified and interviewed from emergency OPD, labor ward and in-
10 patient wards every day before they discharged from the hospital by data collectors using pretested and
11 structured questionnaires.
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14 **Data collection Procedures**

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16 The referral papers reviewed and date, time and diagnosis of referral were recorded for each mother.
17 The triage paper and patient chart are also reviewed including mode of transportation, date and time of
18 arrival, sources of referrals, obstetrics performances, the time taken to admit/get the service after
19 arrival, diagnosis at receiving hospital, gestational age, place and mode of delivery, newborn outcomes
20 and severe maternal complications types and managements. Women interviewed on socio-demographic
21 characteristics, time interval to seek medical advice and reason of delay to seek the care (if there was).
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25 The completed questionnaires were reviewed by principal investigator and supervisors. Incomplete
26 questionnaires were filled if the women were not discharged; otherwise incomplete questionnaires
27 were discarded.
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30 **Main outcomes and measures of the study**

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32 The three delays time frame were operationally defined through a consultative process involving six
33 obstetrician & gynecologists (three from each hospitals) who had working experience of 7-20 years in
34 the selected hospitals. Accordingly, first delay defined time elapsed between the recognition of
35 complication/s, and the decision to transport and reach to a health facility, was considered if it took
36 more than 60 minutes. The second delay was defined if the mother did not reach to referral hospitals
37 within 60 minutes of referral. The third delay was if the mother didn't receive care or admitted within 30
38 minutes. Severe maternal outcomes were any maternal complications including blood transfusion (any
39 type & units), Post-partum hemorrhage, shock, eclampsia, uterine rupture, pulmonary edema,
40 laparotomy, laboratory evidences of organ damage and maternal death during the process of delivery
41 and/or before discharge from the hospital. Potentially life threatening maternal conditions (PLTMC) was
42 considered when the mother had at least one of the following; hemorrhagic complications, hypertensive
43 disorders and complications, end organ injury, blood product transfusion, ICU admission, uterine
44 rupture, hysterectomy/laparotomy.
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49 **Sample size:** Single proportion formula used by assuming 50% of the referred women have delay ,
50 degree of precision of 5% (d) , confidence interval of 95% (Z=1.96), assuming 5% non-response rate and
51 the final sample size was 403 .
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Statistical analysis

Data were entered in epi-info version 7.2.2.6 and transported to SPSS Version-21 statistics software for cleaning and analysis. Descriptive statistical were used to present women by their socio-demographic characteristics, referral diagnosis, diagnosis at receiving hospitals, obstetrics characteristics, mode of delivery, newborn outcomes, the three delays, and severe maternal outcomes. Severe maternal outcomes were analyzed for the three delays. The relationship between the three delays and SMO were examined using the multivariate logistic regression. The goodness of the model was tested by Hosmer-Lemeshow test for goodness-of-fit. Selected variables were included in the model to account for maternal characteristics differences other than delays in seeking and receiving care.

Ethical issues

Ethical clearance was obtained from both Addis Continental Institute of Public Health (ACIPH) and Addis Ababa Health Bureau (AAHB) Institution Review Board (IRB). Support letters were written to both study hospitals from AAHB-IRB to gain access.

Patient and public involvement:

Women asked for some questions after obtained informed consent on voluntary basis. All the responses given by the participants and the results obtained kept anonymous and confidential. There was no public involvement in the design, conduct and interpretation of the study. Patients were not asked to advise on interpretation or writing up of results. We did not include patient involvement in the design of this study. We have presented a summary of the findings at medical and public health schools and among health providers in Addis Ababa and plan to continue presenting the results at professional society's conferences. Results were shared with administrative of both selected hospitals and Addis Ababa health Bureau to facilitate improved obstetrics services. There are no plans to disseminate the results of this research to study participants.

Results

Table 1 shows the descriptive information for socio-demographic and obstetrics characteristics of referred pregnant women. The mean age of 403 pregnant women referred for labor/delivery services was 26.47 ± 4.5 years and ranged from 18 to 43. The majorities were married (380,94.3%), and have completed at least secondary school (54.3%). Majority women were primigravida (56.1%), the mean gravidity was 1.77 ± 1.1 and ranged between 1 to 7. Most pregnant women (58.8%) were at term pregnancy (37 weeks- 41w6d) (Table1).

Table 1. Socio-demographic and obstetrics characteristics of respondents, Addis Ababa, Ethiopia, 2019 (n=403)

Characteristics	n=403	Number (%)
Study Hospital		

Gandhi Memorial Hospital (GMH)	173 (42.9)
Zewditu Memorial Hospital (ZMH)	230 (57.1)
Age (years) median: 26 years (range 18-43)	
< 20	32 (7.9)
20-25	158 (39.2)
26-30	151 (37.5)
31-35	46 (11.4)
≥36	16 (4.0)
Marital status	
Married	380 (94.3)
Others(unmarried, divorced)	23 (5.7)
Educational level	
No formal education	49 (12.2)
Primary school	135 (33.5)
Secondary school	117 (29.0)
Preparatory	35 (8.7)
Vocational and above	67 (16.6)
Gravidity n=403	
1	226 (56.1)
2-4	165 (40.9)
≥5	12 (3.0)
Parity n=146	
1	90 (61.6)
≥2	56 (38.4)
Abortion n=60	

1	1	48 (80)
2	≥ 2	12 (20)
3	Gestational age	
4	28-33w6d	9(2.2)
5	34-36w6d	22 (5.5)
6	37-41w6d	237 (58.8)
7	≥ 42	42 (10.4)
8	Unknown	93 (23.1)

The majority of the pregnant women were referred from health centers (387, 96%) and transported by the ambulance (72%) (table 2).

The majority of the women delivered through vaginal route (254, 63.3%) followed by Cesarean-section (148, 36.7%). The most common indication for C-section were non-reassuring fetal heart rate pattern (27 %) followed by cephalo-pelvic disproportion/malpresentation/malposition (24.3%) then meconium staining in latent first stage of labor (22.3%).The majority of the babies were born alive (389, 96.5%). There were eight (2%) intra-partum fetal losses (Table 2).

Table 2. Source of referral, transportation, mode & place of delivery and perinatal outcome, among referred pregnant women for delivery, Addis Ababa, Ethiopia, 2019.

Characteristics	Number (%)
Source of referral N=403	
Health Center	387 (96.0)
Others	16 (4.0)
Transportation	
Ambulance	290 (72)
Others(Taxi, personal car)	113 (28)
Receiving hospital contacted before the women referred	
Yes	157 (39.0)

No	246 (61.0)
Mode of delivery	
Vaginal delivery	229 (56.8)
Assisted breech delivery	4 (1.0)
C-section	148 (36.7)
Instrumental delivery	21(5.2)
Vacuum	16 (4.0)
Forceps	5 (1.2)
Laparotomy	1 (0.2)
C-section indication N=148	
Non-reassuring fetal heart rate (NRFHR)	40 (27.0)
Meconium in LFSOL	33 (22.3)
Cephalopelvic disproportion (CPD)	21 (14.2)
Malpresentation/malposition	15 (10.1)
Previous C-scar with labor/labor abnormality	10 (6.8)
Cord prolapse/presentation	7 (4.7)
Non reassuring biophysical profile (NRBPP)	5 (3.4)
APH	4 (2.7)
Others	13(8.8)
Place of delivery N=403	
Labor ward/Operation room	386 (95.8)
Emergency OPD	17 (4.2)
Outcome N=403	
Alive	389 (96.5)
Newborn referred to NICU	Yes 137 (34)

	No	252 (62.5)
Stillbirth		14 (3.5)
Fetal heart beat positive on arrival		8(2.0)
Fetal heart beat negative on arrival		6(1.5)

Among 403 referred women for childbirth, 71(17.6%) women experienced all the three delays. Almost three-fourth referred women (74.7%) experienced third delay followed by first delay (52.4%). Majority (366, 90.8%) women had at least one of the delays (Table 3).

Table 3. The frequency of the three delays among referred women, Addis Ababa, Ethiopia 2019.

Characteristics	Number (%)	
	Yes	No
N=403		
First delay	211 (52.4)	192 (47.6)
Second delay	163 (40.4)	240(59.6)
Third delay	301(74.7)	102(25.3)
At least one delay	366 (90.8)	37 (9.2)
All three delay	71 (17.6)	332 (82.4)

** multiple answer possible

Twenty-nine (7.2%) women had severe maternal outcomes. The most common severe maternal outcome was blood transfusion (58.6%) followed by post partum hemorrhage (51.7%) then eclampsia (31%). Nearly three-fourth women with SMO (78.5%) had more than one complication (Figure1).

The most common delays in women with SMO were third delay (58.6%) followed by first delay (51.7%). All most three-fourth women experienced at least one of the delays (79.3%) and one-quarter (24.1%) women had all the delays (table 4).

Statistically significant association was observed between SMO and third delay, at least one of the delays. Referred women with the third delay had 2.2 times (95% CI of 1.025-4.840) more likely to be a risk for severe maternal outcomes. Women who experienced at least one of the delays had 2.9 times (95% CI 1.093-7.620) more likely to be a risk for severe maternal outcomes (table 4).

After adjusted for age, gravidity, parity, educational level and marital status none of the delays were significant. This may be due to small sample of women with SMO. Also the three delays were not significant for age, gravidity, parity, educational level, gestational age and marital status.

Table 4. SMO and types of delays Addis Ababa, Ethiopia 2019.

Characteristics	Severe maternal outcomes		P-value	COR 95 % CI
	No	Yes		
Types of delay	Number (%)	Number (%)		
First delay	No	178 (47.6%)	14 (48.3)	
	Yes	196 (52.4)	15 (51.7)	0.944 1.028(0.483-2.189)
Second delay	No	224 (59.9)	16 (55.2)	
	Yes	150 (40.1)	13 (44.8)	0.618 1.213(0.567-2.596)
Third delay	No	90(24.1)	12 (41.4)	
	Yes	284 (75.9)	15 (58.6)	0.043 2.227(1.025-4.840)
All delays	No	310 (82.9)	22 (75.9)	
	Yes	64 (17.1)	7 (24.1)	0.342 1.541(0.632-3.761)
At least one delay	No	31 (8.3)	6 (20.7)	
	Yes	343 (91.7)	23(79.3)	0.032 2.889(1.093-7.620)

**AOR not significant after adjusted for age, marital status, educational level, gestational age, gravidity, parity.

Eighty (19.9%) of referred women had at least one potential life threatening conditions (PLTC). The most common complications was hypertensive disorders 56 (70%) followed by blood transfusion 17 (21.3%) then post partum hemorrhage (table 5).

Table 5. Potentially life threatening conditions among referred women Addis Ababa, Ethiopia, 2019

Characteristics* N=80	Number (%)
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Hemorrhagic complications	
Ante partum hemorrhage (AP,PP)	13 (16.3)
Post partum hemorrhage (PPH)	15 (18.8)
Ruptured uterus	1 (1.25)
Coagulopathy	2 (2.5)
Hypertensive disorders	
Severe hypertension/Preeclampsia	50 (62.5)
Eclampsia	9 (11.3)
HELLP syndrome	2 (2.5)
Others	
Pulmonary edema	1 (1.25)
Shock	1(1.25)
Thrombocytopenia	2 (2.5)
Management indication of severity	
Transfusion of blood derivatives	17 (21.3)
Major surgical intervention(hysterectomy)	1(1.25)

*Multiple response possible

Discussion

All three types of delay were common in maternity services in the study hospitals; the most severe being the delay within the receiving hospital. The third delay was significantly associated with severe maternal outcomes.

Studies have found that distance to facilities is a clear barrier to women accessing health facilities (17) (18) but in Addis Ababa, proximity to services does not appear to be a problem, as the median distance to a facility that provides surgical services is 5 kilometers, well below the national average of 45 kilometers (19). Two-fifth of women had the second delay. When we compare with other studies it may be low however this proportion of the second delay is not expected because referring

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3 facilities/catchment health centers are near to the receiving hospitals and expected to refer by
4 ambulance (20).
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7 This study showed the rate of occurrence of SMO indicators were higher than the findings of an earlier
8 study done in other parts of the country (20) (21) (22) (23) and other countries (24-26). This high
9 proportion SMO might be due to the fact that our study selected facilities are referral hospitals which
10 are serving complicated cases and cases referred from other health facilities which were beyond their
11 capacity/needed further interventions. This study showed that direct obstetric causes were the most
12 common leading factors of SMO and the most common diagnosis were postpartum hemorrhage (52%)
13 followed by eclampsia (31%) and the most common intervention was blood transfusion (58.6%).
14 Obstetric hemorrhage and hypertensive disorders (eclampsia, hematological coagulation, and
15 pulmonary edema) were found to be the top underlying complications among cases of SMO; similarly,
16 hypertensive disorders and obstetric hemorrhage were the most common underlying causes of PLTC.
17 This is comparable to the findings from studies in other parts of the country (21), (22) (23) and other
18 countries (25-29) including sub-Saharan countries (30) (31).
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24 Emergency obstetric care use by pregnant women is influenced by a complex interaction of factors
25 leading to delay in decision-making, accessing services and receipt of proper care once a health facility is
26 reached(30) (31). Receiving appropriate care after reaching at the health facility (delay three) was the
27 most common (58.6%) followed by delay in seeking care (delay one) (51.7%) then reaching at the
28 appropriate health facility (delay two) (44.8%) were identified among SMO and more than half of
29 (58.6%) SMO cases had encountered at least one of the delays which were similar to study done
30 elsewhere in the country (21) (32) (33); however delay two and one is seen less frequently than the
31 findings from other countries (25) (30) (31) (34-37). This can be justified by overloaded of cases, limited
32 hospitals capacity, a difference in socio-demographic characteristics of the study population and the
33 proximity of health facilities.
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37 In this study, failure to receiving appropriate care after reaching at the health facility (delay three) was
38 found to have the strongest association with SMO: with a two-fold increase in the risk. This supports the
39 WHO hypothesis relating a high case fatality in the hospital as an indicator for the presence of delay in
40 receiving an adequate and proper treatment (38) and it indicates the poor performance of obstetrics
41 services (39) (40). Seeking care from a facility that is incapacitated health facility and system, poor
42 leadership (mismanagements of hospital resources, poor co-ordinations and lack of understanding of
43 obstetrics emergencies) contribute to significant delay after reaching the health facility. These factors
44 were reported as significant contributors to delay in several studies (21) (32) (34) (35). Studies from
45 Tigray, 88% of all maternal deaths were attributed to health system failure (33). In our study, 59 % of
46 SMO cases and both maternal deaths (MD) had health system related factors as a possible reason for
47 delay three.
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52 The limitation of this study include that it was conducted in two referral hospitals which often receive
53 complicated cases and referred mother with complications; and the results might not be representative
54 of other institutions and the community. In addition, cases might be missed because if they transferred
55 to health centers and other hospitals after delivery for different reasons.
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3 However, we believe that this study gives the extent of delays and SMO & its indicators experienced by
4 women who were referred for an emergency delivery. In fact, if the delay is so severe in these well-
5 established referral centers one may expect it to be worse in some not well staffed and equipped
6 centers. We decided to focus on women with severe maternal outcomes (SMO) rather than less severe
7 forms of obstetric complications because their situations are the closest to maternal deaths.
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10 **Conclusion**

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12 The burden of severe maternal outcomes (SMO) is high due to preventable and/or treatable direct
13 obstetric. The majority of the women in this study had serious delays in both making decision to seek
14 care for birthing and in actually receiving care once at a hospital. We recommend strengthening health
15 referral systems and addressing specific health systems bottlenecks during labor and birth in order to
16 ensure no mother will be endanger. We also recommend a qualitative method of study (including
17 focus group discussion, in-depth interview) and observing the tertiary hospitals set-up and
18 readiness to manage high-risk pregnancies.
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23 **Abbreviations**

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25 AAHB-IRB: Addis Ababa Health Bureau-Institutional Review Board

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27 BEmOC: Basic Emergency Obstetrics Care

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29 CEmOC: Comprehensive Emergency Obstetrics Care

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31 GMH: Gandhi Memorial Hospital

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33 HELLP: Hemolysis, Elevated liver enzyme, Low Platelets

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35 ICU: Intensive Care Unit

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37 LW: Labor Ward

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39 MD: Maternal Death Ratio

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41 MNM: Maternal Near-Miss

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43 MWH: Maternity Waiting Home

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45 OPD: Out-Patient Department

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47 PIH: Pregnancy Induced Hypertension

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49 PLTC: Potential Life Threatening Conditions

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51 PPH: Post Partum Hemorrhage

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53 SMO: Severe Maternal Outcomes
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3 WHO: World Health Organization
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5 ZMH: Zewditu Memorial Hospital
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26
27

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29

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32

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35
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37 **Data availability statement:** data are available from the corresponding author upon reasonable
38 request.
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3 **Figure 1. Types of severe maternal outcomes among referred pregnant women, Addis Ababa,**
4 **Ethiopia, 2019**
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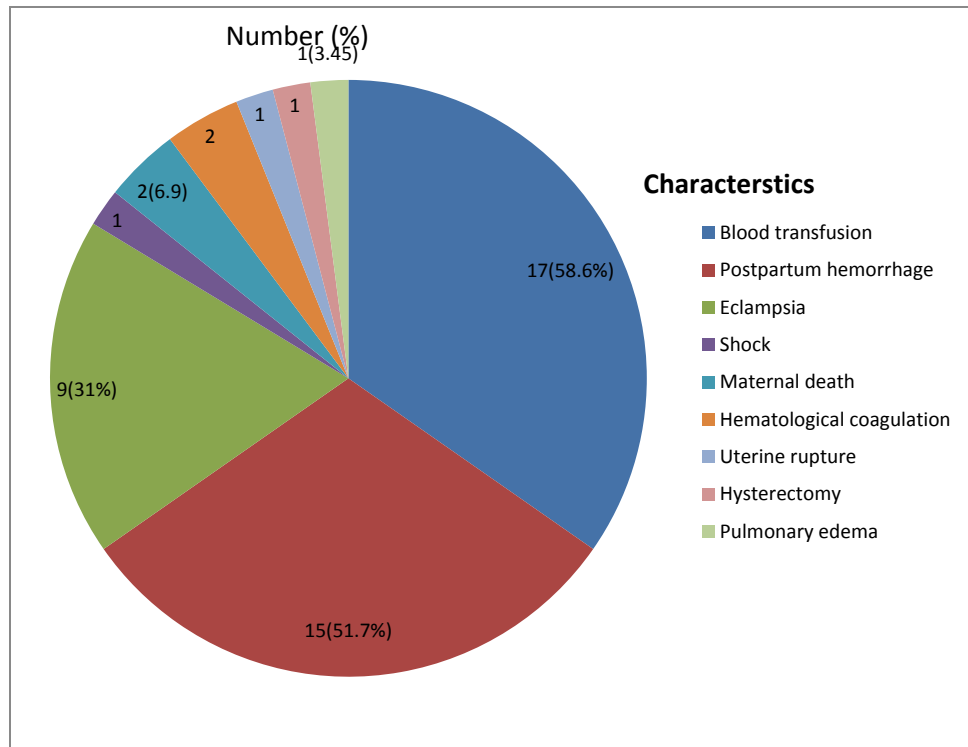


Figure 1. Types of severe maternal outcomes among referred pregnant women, Addis Ababa, Ethiopia, 2019.

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

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Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

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		Page Number
Title and abstract		
Title	#i	Indicate the study's design with a commonly used term in the title or the abstract
Abstract	#i	Provide in the abstract an informative and balanced summary of

what was done and what was found

Introduction

Background /
rationale

[#1](#)

Explain the scientific background and rationale for the investigation being reported

Objectives

[#2](#)

State specific objectives, including any prespecified hypotheses

Methods

Study design

[#2](#)

Present key elements of study design early in the paper

Setting

[#2](#)

Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection

Eligibility criteria

[#3](#)

Give the eligibility criteria, and the sources and methods of selection of participants.

[#3](#)

Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable

Data sources /
measurement

[#3](#)

For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.

Bias

[#n/a](#)

Describe any efforts to address potential sources of bias

Study size

[#3](#)

Explain how the study size was arrived at

1	Quantitative	#4	Explain how quantitative variables were handled in the
2			
3	variables		analyses. If applicable, describe which groupings were chosen,
4			
5			and why
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9	Statistical	#4	Describe all statistical methods, including those used to control
10			
11	methods		for confounding
12			
13			
14	Statistical	#n/a	Describe any methods used to examine subgroups and
15			
16	methods		interactions
17			
18			
19	Statistical	#3	Explain how missing data were addressed
20			
21	methods		
22			
23			
24			
25	Statistical	#4	If applicable, describe analytical methods taking account of
26			
27	methods		sampling strategy
28			
29			
30	Statistical	#n/a	Describe any sensitivity analyses
31			
32	methods		
33			
34			
35			
36	Results		
37			
38			
39	Participants	#4	Report numbers of individuals at each stage of study—eg
40			
41			numbers potentially eligible, examined for eligibility, confirmed
42			
43			eligible, included in the study, completing follow-up, and
44			
45			analysed. Give information separately for for exposed and
46			
47			unexposed groups if applicable.
48			
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51			Note it was cross-sectional study
52			
53			
54	Participants	#n/a	Give reasons for non-participation at each stage
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56			
57			Note: all participants participated
58			
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1	Participants	#n/a	Consider use of a flow diagram
2			
3			
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7	Descriptive data	#4	Give characteristics of study participants (eg demographic,
8			clinical, social) and information on exposures and potential
9			confounders. Give information separately for exposed and
10			unexposed groups if applicable.
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17	Descriptive data	#n/a	Indicate number of participants with missing data for each
18			variable of interest
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26	Outcome data	#6	Report numbers of outcome events or summary measures.
27			
28			Give information separately for exposed and unexposed groups
29			if applicable.
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37	Main results	#n/a	Give unadjusted estimates and, if applicable, confounder-
38			adjusted estimates and their precision (eg, 95% confidence
39			interval). Make clear which confounders were adjusted for and
40			why they were included
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47	Main results	#n/a	Report category boundaries when continuous variables were
48			categorized
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52	Main results	#n/a	If relevant, consider translating estimates of relative risk into
53			absolute risk for a meaningful time period
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57	Other analyses	#9	Report other analyses done—e.g., analyses of subgroups and
58			
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interactions, and sensitivity analyses

Discussion

- Key results [#10](#) Summarise key results with reference to study objectives
- Limitations [#11](#) Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.
- Interpretation [#12](#) Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.
- Generalisability [#12](#) Discuss the generalisability (external validity) of the study results
- Other Information
- Funding [#13](#) Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

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Delays in Emergency Obstetrics referrals in Addis Ababa hospitals: a facility-based, cross-sectional study

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Delays in Emergency Obstetrics referrals in Addis Ababa hospitals: a facility-based, cross-sectional study

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Abstract

Objectives: To assess where the delays occur in the referral chain at most and maternal health outcomes based on the three delay model in Addis Ababa.

Design: The study was a facility-based cross-sectional study

Setting: Two public and tertiary hospitals in Addis Ababa

Participants: All pregnant women who were referred for only labor and delivery services after 28 weeks of gestation between December 2018 and February 2019 in Zewditu and Gandhi Memorial hospitals.

Primary and secondary outcome measures: The primary outcome was the type of delays from the three-delay model which met operationally defined time. Maternal health outcomes based on the three-delay model as a secondary outcome.

Results: A total of 403 pregnant women referred for delivery to the study hospitals were included in the study. Three-fourth (301, 74.7%) of referred pregnant women had the third delay (delayed receiving appropriate care); (211, 52.4%) had a first delay (delay in making a decision to seek care). Overall 366(90.8%) pregnant women had experienced at least one of the three delays and 71(17.6%) had all the three delays. Twenty-nine (7.2%) referred women had severe maternal outcomes (SMO). The most leading causes/diagnosis of SMO were blood transfusion 17 (58.6%) followed by postpartum hemorrhage 15 (52%) then eclampsia 9 (31%). In addition, women who experienced severe maternal outcomes were 2.9 times more likely to have at least one of the three delays.

Conclusion & recommendation: This study highlights the persistence of delays at all levels and especially delay three and its contribution to severe maternal outcomes. Strengthening health referral systems and addressing specific health system bottlenecks during labor and birth in order to ensure no mother will be endangered. We also recommend a qualitative method of study (focus group discussion and in-depth interview) and observing the tertiary hospitals set-up and readiness to manage obstetrics emergencies.

Key words: Addis Ababa, Emergency obstetrics referral, severe maternal outcomes, Three-delay model

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5 Article summary
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7 Strengths and limitations
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9 This study gives the extent of delays and severe maternal outcomes experienced by women who
10 were referred for labor and delivery.

11 This study focused on women with severe maternal outcomes (SMO) rather than less severe
12 forms of obstetric complications because their situations are the closest to maternal deaths.

13 Women after delivery might be missed if they transferred to health centers and to other
14 hospitals after delivery for different reasons.

15 The results might not be representative of other institutions and the communities because it
16 was conducted in two referral hospitals that often receive and treat complicated cases.
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Introduction

The majority of maternal deaths are clustered around labour, delivery and the first 24 hours postpartum period (1),(2). It is estimated that just five conditions (postpartum hemorrhage; puerperal sepsis; preeclampsia and eclampsia; obstructed or prolonged labour, and complications of unsafe abortion), account for at least 60% of all maternal mortality (3). Life-threatening situations may develop rapidly and without warning, often in previously uncomplicated pregnancies(4).

Globally, it is recognized that significant inroads in maternal mortality cannot be made without dramatically increasing access to emergency obstetrical care (EmOC). The World Health Organization estimates that at least 88–98% of maternal deaths can be averted with timely access to existing, emergency obstetric interventions (5). This produces a triple return on investment, saving women and newborns and preventing stillbirths(6).

A number of factors can influence a woman's ability to access effective interventions to treat complications in the event of an obstetric emergency. Thaddeus and Maine (1994) group these into three broad categories using a classic, pathways-based framework known as the 'three delays model'(7). The 'three delays model' attempts to explain delays in women accessing emergency obstetric care as the result of 1) decision-making, 2) accessing services and 3) receipt of appropriate care once a health facility is reached.

Referral is often associated with the second delay of the three delays model– associated with reaching the appropriate level of care. But in fact, a referral system can reduce all three delays. If a population knows that a system is reliable and affordable, families may make the decision to seek care more quickly (the first delay(8)).

The major obstacles that affect the referral system reported by both the health workers and women were: 1) financial barriers (for transportation and service payments at health facilities), 2) lack of means of transportation, 3) distance and 4) lack of awareness of services and the importance of services (9).

Factors associated with health-seeking behavior are multidimensional. Socio-cultural and economic problems, lack of awareness, the quality of health services, and infrastructure such as transport services all affect whether and where a woman will seek care, how long it will take to reach care, and whether she receives the appropriate care in a timely fashion(10).

Studies showed referrals in pregnancy and childbirth can be (1) institutional or self-referral, depending on the involvement of first line services; (2) antenatal, delivery or postnatal referral; and (3) elective or emergency referral. Pregnant women may be referred due to demographic risks, obstetric historical risks, prenatal complications, and delivery and immediate postnatal complications(11). On the other hand, Studies show that high-risk prediction may not necessarily mean that the woman will have a complication and many women identified as being at risk go on to have normal deliveries(12).

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2
3 Defining a framework and process for obstetric referrals may lead to reduction of maternal mortality
4 and morbidity. Referral should be broadly defined to include not only transport, but it should be timely
5 referral to minimize or prevent the delay for transportation (called second delay), and ensure pre-
6 hospital care while transporting a patient to the referral facility(13), (14).
7
8

9 It is widely accepted that substantial reductions in maternal mortality and maternal near- miss are
10 impossible to achieve without early decision-making to seek care, an effective referral system for
11 complicated cases and receiving timely and appropriate care (9), (15) . Near miss cases represent most
12 of the characteristics of maternal deaths, but occur more often (16). The near-miss approach assesses
13 the gap between the actual use and optimal use of high-priority effective interventions in the
14 prevention and management of severe maternal complications related to pregnancy and childbirth (17).
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16

17 The objective of this study was to determine the types of delay and maternal health outcomes based on
18 the three delay model among women who referred for labor and delivery. Results from this study may
19 be an input for the hospitals, health bureau, policy-makers, and other stakeholders to act on bottle-
20 necks of emergency obstetrics services by identifying the most common types of delay.
21
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23 Methods

24 We used the STROBE cross-sectional reporting guidelines (18).
25
26

27 Study design

28 A facility-based cross-sectional study was conducted between December 10/2018-February 28/2019 in
29 two government hospitals Zewditu Memorial Hospital (ZMH) and Gandhi Memorial Hospitals (GMH).
30
31

32 Study setting

33 This study conducted in tertiary hospitals located in the capital city of Ethiopia, Addis Ababa. Both
34 hospitals are under Addis Ababa Health Bureau and affiliated with Addis Ababa University-College of
35 Health Sciences. Gandhi Memorial Hospital is a referral maternity hospital and Zewditu Memorial
36 Hospital is also a comprehensive referral hospital. Both hospitals are catchment hospitals for 40 (forty)
37 health centers and other health facilities. Both hospitals are giving Comprehensive emergency obstetric
38 care (CEmOC) and attending more than 17,000 deliveries per year.
39
40

41 The referral system for an obstetric emergency in Addis Ababa is organized to include Basic Emergency
42 obstetric care (BEmOC) and CEmOC facilities. The referral system is developed to work both ways.
43 Referral between health facilities is facilitated by the liaison office or Maternal Health Task Force. An
44 ambulance system is organized to transport women accompanied by midwives. The midwife provides
45 care during transportation and hand-over the mother to the receiving hospital care provider with a
46 referral paper. In Addis Ababa, all maternity services including labour/delivery and the ambulance
47 services are provided free of charge in all government health facilities. All components of BEmOC are
48 expected to be given in the health centres.
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Eligibility criteria

All pregnant women who were referred for only labor and delivery services after 28 weeks of gestation or baby outcome ≥ 1 kg and delivered in the selected hospitals, and also who gave consent were included.

Data Collection Tools

After they gave birth, women were identified and interviewed from emergency OPD, labor ward, and in-patient wards every day before they discharged from the hospital by data collectors using pretested and structured questionnaires.

Data Collection Procedures

The referral papers reviewed and date, time and diagnosis of referral was recorded for each mother. The triage paper and patient chart are also reviewed including mode of transportation, date and time of arrival, sources of referrals, obstetrics performances, the time taken to admit/get the service after arrival, diagnosis at receiving hospital, gestational age, place and mode of delivery, newborn outcomes, and severe maternal complications types and managements. Women interviewed on socio-demographic characteristics, time interval to seek medical advice and reason for the delay to seek the care (if there was).

The completed questionnaires were reviewed by the principal investigator and supervisors. Incomplete questionnaires were filled if the women were not discharged; otherwise incomplete questionnaires were discarded.

Main outcomes and measures of the study

The three delays time frame was operationally defined through a consultative process involving six obstetrician & gynecologists (three from each hospital) who had working experience of 7-20 years in the selected hospitals. Accordingly, the first delay defined time elapsed between the recognition of complication/s, and the decision to transport and reach to a health facility, was considered if it took more than 60 minutes. The second delay was defined if the mother did not reach to referral hospitals within 60 minutes of referral. The third delay was if the mother didn't receive care or admitted within 30 minutes. Severe maternal outcomes (SMO) were any maternal complications including blood transfusion (any type & ≥ 2 units), Post-partum hemorrhage, shock, eclampsia, uterine rupture, pulmonary edema, laparotomy, laboratory evidence of organ damage and/or maternal death during the process of delivery and/or before discharge from the hospital. Potentially life-threatening maternal conditions (PLTMC) was considered when the mother had at least one of the following; hemorrhagic complications, hypertensive disorders, and complications, end-organ injury, blood product transfusion, ICU admission, uterine rupture, hysterectomy/laparotomy.

Sample size: Single proportion formula used by assuming 50% of the referred women have a delay, degree of precision of a 5% (d), confidence interval of 95% ($Z=1.96$), assuming 5% non-response rate and the final the sample size was 403.

Statistical analysis

Data were entered in epi-info version 7.2.2.6 and transported to SPSS Version-21 statistics software for cleaning and analysis. Descriptive statistics were used to present women by their socio-demographic characteristics, referral diagnosis, diagnosis at receiving hospitals, obstetrics characteristics, mode of delivery, newborn outcomes, the three delays, and severe maternal outcomes. Severe maternal outcomes were analyzed for the three delays. The relationship between the three delays and SMO were examined using the multivariate logistic regression. The goodness of the model was tested by Hosmer-Lemeshow test for goodness-of-fit. Selected variables were included in the model to account for maternal characteristics differences other than delays in seeking and receiving care.

Ethical issues

Ethical clearance was obtained from both Addis Continental Institute of Public Health (ACIPH) and Addis Ababa Health Bureau (AAHB) Institution Review Board (IRB). Support letters were written to both study hospitals from AAHB-IRB to gain access.

Patient and public involvement:

Women asked for some questions after obtained informed consent on a voluntary basis. All the responses were given by the participants and the results obtained kept anonymous and confidential. There was no public involvement in the design, conduct, and interpretation of the study. Patients were not asked to advise on interpretation or writing up of results. We did not include patient involvement in the design of this study. We have presented a summary of the findings at medical and public health schools and among health providers in Addis Ababa and plan to continue presenting the results at professional society's conferences. Results were shared with the administration of both selected hospitals and Addis Ababa health Bureau to facilitate improved obstetrics services. There are no plans to disseminate the results of this research to study participants.

Results

Table 1 shows the descriptive information for socio-demographic and obstetric characteristics of referred pregnant women. The mean age of 403 pregnant women referred for labor delivery services was 26.47 ± 4.5 years and ranged from 18 to 43. The majorities were married (380,94.3%), and have completed at least secondary school (54.3%). Majority women were primigravida (56.1%), the mean gravidity was 1.77 ± 1.1 and ranged between 1 to 7. Most pregnant women (58.8%) were at term pregnancy (37 weeks- 41w6d) (Table1).

Table 1. Socio-demographic and obstetrics characteristics of respondents, Addis Ababa, Ethiopia, 2019 (n=403)

Characteristics n=403	Number (%)
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Study Hospital	
Gandhi Memorial Hospital (GMH)	173 (42.9)
Zewditu Memorial Hospital (ZMH)	230 (57.1)
Age (years) median: 26 years (range 18-43)	
< 20	32 (7.9)
20-25	158 (39.2)
26-30	151 (37.5)
31-35	46 (11.4)
≥36	16 (4.0)
Marital status	
Married	380 (94.3)
Others(unmarried, divorced)	23 (5.7)
Educational level	
No formal education	49 (12.2)
Primary school	135 (33.5)
Secondary school	117 (29.0)
Preparatory	35 (8.7)
Vocational and above	67 (16.6)
Gravidity n=403	
1	226 (56.1)
2-4	165 (40.9)
≥5	12 (3.0)
Parity n=146	
1	90 (61.6)
≥2	56 (38.4)

Abortion n=60	
1	48 (80)
≥ 2	12 (20)
Gestational age	
28-33w6d	9(2.2)
34-36w6d	22 (5.5)
37-41w6d	237 (58.8)
≥ 42	42 (10.4)
Unknown	93 (23.1)

The majority of the pregnant women were referred from health centers (387, 96%) and transported by the ambulance (72%) (Table 2).

The majority of the women delivered through vaginal route (254, 63.3%) followed by Cesarean-section (148, 36.7%). The most common indication for C-section was non-reassuring fetal heart rate pattern (27 %) followed by cephalo-pelvic disproportion/malpresentation/malposition (24.3%) then meconium staining in the latent first stage of labor (22.3%). The majority of the babies were born alive (389, 96.5%). There were eight (2%) intrapartum fetal losses (Table 2).

Table 2. Source of referral, transportation, mode & place of delivery and perinatal outcome, among referred pregnant women for delivery, Addis Ababa, Ethiopia, 2019.

Characteristics	Number (%)
Source of referral N=403	
Health Center	387 (96.0)
Others	16 (4.0)
Transportation	
Ambulance	290 (72)
Others(Taxi, personal car)	113 (28)

Receiving hospital contacted before the women referred	
Yes	157 (39.0)
No	246 (61.0)
Mode of delivery	
Vaginal delivery	229 (56.8)
Assisted breech delivery	4 (1.0)
C-section	148 (36.7)
Instrumental delivery	21(5.2)
Vacuum	16 (4.0)
Forceps	5 (1.2)
Laparotomy	1 (0.2)
C-section indication N=148	
Non-reassuring fetal heart rate (NRFHR)	40 (27.0)
Meconium in LFSOL	33 (22.3)
Cephalopelvic disproportion (CPD)	21 (14.2)
Malpresentation/malposition	15 (10.1)
Previous C-scar with labor/labor abnormality	10 (6.8)
Cord prolapse/presentation	7 (4.7)
Non reassuring biophysical profile (NRBPP)	5 (3.4)
APH	4 (2.7)
Others	13(8.8)
Place of delivery	N=403
Labor ward/Operation room	386 (95.8)
Emergency OPD	17 (4.2)

Outcome	N=403	
Alive		389 (96.5)
Newborn referred to NICU	Yes	137 (34)
	No	252 (62.5)
Stillbirth		14 (3.5)
Fetal heart beat positive on arrival		8(2.0)
Fetal heart beat negative on arrival		6(1.5)

Among 403 referred women for childbirth, 71(17.6%) women experienced all the three delays. Almost three-fourth referred women (74.7%) were experienced the third delay followed by first delay (52.4%). The majority (366, 90.8%) women had at least one of the delays (Table 3).

Table 3. The frequency of the three delays among referred women, Addis Ababa, Ethiopia 2019.

Characteristics	Number (%)	
	Yes	No
N=403		
First delay	211 (52.4)	192 (47.6)
Second delay	163 (40.4)	240(59.6)
Third delay	301(74.7)	102(25.3)
At least one delay	366 (90.8)	37 (9.2)
All three delay	71 (17.6)	332 (82.4)

** multiple answer possible

Twenty-nine (7.2%) women had severe maternal outcomes. The most common severe maternal outcomes were blood transfusion (58.6%) followed by postpartum hemorrhage (51.7%) then eclampsia (31%). Nearly three-fourth women with SMO (78.5%) had more than one complication (Figure1).

The most common delays in women with SMO were the third delay (58.6%) followed by first delay (51.7%). All most three-fourth women experienced at least one of the delays (79.3%) and one-quarter (24.1%) women had all the delays (Table 4).

Statistically, a significant association was observed between SMO and third delay, at least one of the delays. Referred women with the third delay had 2.2 times (95% CI of 1.025-4.840) more likely to be a

risk for severe maternal outcomes. Women who experienced at least one of the delays had 2.9 times (95% CI 1.093-7.620) more likely to be a risk for severe maternal outcomes (Table 4).

After adjusted for age, gravidity, parity, educational level, and marital status none of the delays were significant. This may be due to a small sample of women with SMO. Also, the three delays were not significant for age, gravidity, parity, educational level, gestational age, and marital status.

Table 4. SMO and types of delays Addis Ababa, Ethiopia 2019.

Types of delay	Severe maternal outcomes				
	No	Yes	P-value	COR 95 % CI	
	Number (%)	Number (%)			
First delay	No	178 (47.6%)	14 (48.3)	0.944	1.028(0.483-2.189)
	Yes	196 (52.4)	15 (51.7)		
Second delay	No	224 (59.9)	16 (55.2)	0.618	1.213(0.567-2.596)
	Yes	150 (40.1)	13 (44.8)		
Third delay	No	90(24.1)	12 (41.4)	0.043	2.227(1.025-4.840)
	Yes	284 (75.9)	15 (58.6)		
All delays	No	310 (82.9)	22 (75.9)	0.342	1.541(0.632-3.761)
	Yes	64 (17.1)	7 (24.1)		
At least one delay	No	31 (8.3)	6 (20.7)	0.032	2.889(1.093-7.620)
	Yes	343 (91.7)	23(79.3)		

**AOR not significant after adjusted for age, marital status, educational level, gestational age, gravidity, parity.

Eighty (19.9%) of referred women had at least one potential life- threatening conditions (PLTC). The most common complications were hypertensive disorders 56 (70%) followed by blood transfusion 17 (21.3%) then postpartum hemorrhage (Table 5).

Table 5. Potentially life threatening conditions among referred women Addis Ababa, Ethiopia, 2019

Characteristics* N=80	Number (%)
-----------------------	------------

Hemorrhagic complications	
Ante partum hemorrhage (AP,PP)	13 (16.3)
Post partum hemorrhage (PPH)	15 (18.8)
Ruptured uterus	1 (1.25)
Coagulopathy	2 (2.5)
Hypertensive disorders	
Severe hypertension/Preeclampsia	50 (62.5)
Eclampsia	9 (11.3)
HELLP syndrome	2 (2.5)
Others	
Pulmonary edema	1 (1.25)
Shock	1(1.25)
Thrombocytopenia	2 (2.5)
Management indication of severity	
Transfusion of blood derivatives	17 (21.3)
Major surgical intervention(hysterectomy)	1(1.25)
*Multiple response possible	

Discussion

All three types of delay were common in the study hospitals; the most severe being the delay within the receiving hospital. The third delay was significantly associated with severe maternal outcomes.

Studies have found that distance to facilities is a clear barrier to women accessing health facilities (19) (20) but in Addis Ababa, proximity to services does not appear to be a problem, as the median distance to a facility that provides surgical services is 5 kilometers, well below the national average of 45 kilometers (21). Two-fifth of women had the second delay. When we compare with other studies it may be low however this proportion of the second delay is not expected because referring facilities/catchment health centers are near to the receiving hospitals and expected to refer by ambulance (22).

This study showed the rate of occurrence of SMO indicators were higher than the findings of an earlier study done in other parts of the country (22) (23) (24) (25) and other countries (26-28). This high proportion SMO might be due to the fact that our study selected facilities are referral hospitals which are serving complicated cases and cases referred from other health facilities which were beyond their capacity/needed further interventions. This study showed that direct obstetric causes were the most common leading factors of SMO and the most common diagnosis were postpartum hemorrhage (52%) followed by eclampsia (31%) and the most common intervention was blood transfusion (58.6%). Obstetric hemorrhage and hypertensive disorders (eclampsia, hematological coagulation, and pulmonary edema) were found to be the top underlying complications among cases of SMO; similarly, hypertensive disorders and obstetric hemorrhage were the most common underlying causes of PLTC. This is comparable to the findings from studies in other parts of the country (23), (24) (25) and other countries (27-31) including sub-Saharan countries (32) (33).

Emergency obstetric care use by pregnant women is influenced by a complex interaction of factors leading to delay in decision-making, accessing services and receipt of proper care once a health facility is reached(32) (33). Receiving appropriate care after reaching the health facility (delay three) was the most common (58.6%) followed by a delay in seeking care (delay one) (51.7%) then reaching at the appropriate health facility (delay two) (44.8%) were identified among SMO and more than half of (58.6%) SMO cases had encountered at least one of the delays which were similar to study done elsewhere in the country (23) (34) (35); however, delay two and one is seen less frequently than the findings from other countries (27) (32) (33) (36-39). This can be justified by overloaded of cases, limited hospitals capacity, the difference in socio-demographic characteristics of the study population and the proximity of health facilities.

In this study, failure to receiving appropriate care after reaching the health facility (delay three) was found to have the strongest association with SMO: with a two-fold increase in the risk. This supports the WHO hypothesis relating a high case fatality in the hospital as an indicator for the presence of delay in receiving adequate and proper treatment (19) and it indicates the poor performance of obstetrics services (40) (41). Seeking care from a facility that is incapacitated health facility and system, poor leadership (mismanagements of hospital resources, poor co-ordinations and lack of understanding of obstetrics emergencies) contribute to significant delay after reaching the health facility. These factors were reported as significant contributors to delay in several studies (23) (34) (36) (37). Studies from Tigray, 88% of all maternal deaths were attributed to health system failure (35). In our study, 59 % of SMO cases and both maternal deaths (MD) had a health system related factors as a possible reason for delay three.

The limitation of this study include that it was conducted in two referral hospitals which often receive complicated cases and referred women with complications; and the results might not be representative of other institutions and the community. In addition, cases might be missed because if they transferred to health centers and other hospitals after delivery for different reasons.

However, we believe that this study gives the extent of delays and SMO & its indicators experienced by women who were referred for an emergency delivery. In fact, if the delay is so severe in these well-

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3 established referral centers one may expect it to be worse in some not well-staffed and equipped
4 centers. We decided to focus on women with severe maternal outcomes (SMO) rather than less severe
5 forms of obstetric complications because their situations are the closest to maternal deaths.
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7

8 Conclusion

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10 The burden of severe maternal outcomes (SMO) is high due to preventable and/or treatable direct
11 obstetric. The majority of the women in this study had serious delays in both making decisions to seek
12 care for birthing and in actually receiving care once at a hospital. We recommend strengthening health
13 referral systems and addressing specific health systems bottlenecks during labor and delivery in order to
14 ensure no woman will be endangered. We also recommend a qualitative method of study
15 (including focus group discussion, in-depth interview) and observing the tertiary hospitals set-
16 up and readiness to manage high-risk pregnancies.
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20 Abbreviations

21
22 AAHB-IRB: Addis Ababa Health Bureau-Institutional Review Board

23
24 BEmOC: Basic Emergency Obstetrics Care

25
26 CEmOC: Comprehensive Emergency Obstetrics Care

27
28 GMH: Gandhi Memorial Hospital

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30 HELLP: Hemolysis, Elevated liver enzyme, Low Platelets

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32 ICU: Intensive Care Unit

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34 LW: Labor Ward

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36 MD: Maternal Death Ratio

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38 MNM: Maternal Near-Miss

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40 MWH: Maternity Waiting Home

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42 OPD: Out-Patient Department

43
44 PIH: Pregnancy Induced Hypertension

45
46 PLTC: Potential Life Threatening Conditions

47
48 PPH: Post Partum Hemorrhage

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50 SMO: Severe Maternal Outcomes

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52 WHO: World Health Organization

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3 ZMH: Zewditu Memorial Hospital
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6

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8 without their support on data collection this research may not be reached to this stage.
9

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20 Contributors: EMA did design of the work, drafting the work, analysis, interpretation of data for the
21 work and write-up the manuscript. YB advised the paper's scope, the draft of the manuscript and did
22 revise it critically for important intellectual content. Both authors approved the final version.
23

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25

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28

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31 and Addis Ababa Health Bureau ethical review board.
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33 Data availability statement: data are available from the corresponding author upon reasonable request.
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48 Figure 1. Types of severe maternal outcomes among referred pregnant women, Addis Ababa, Ethiopia,
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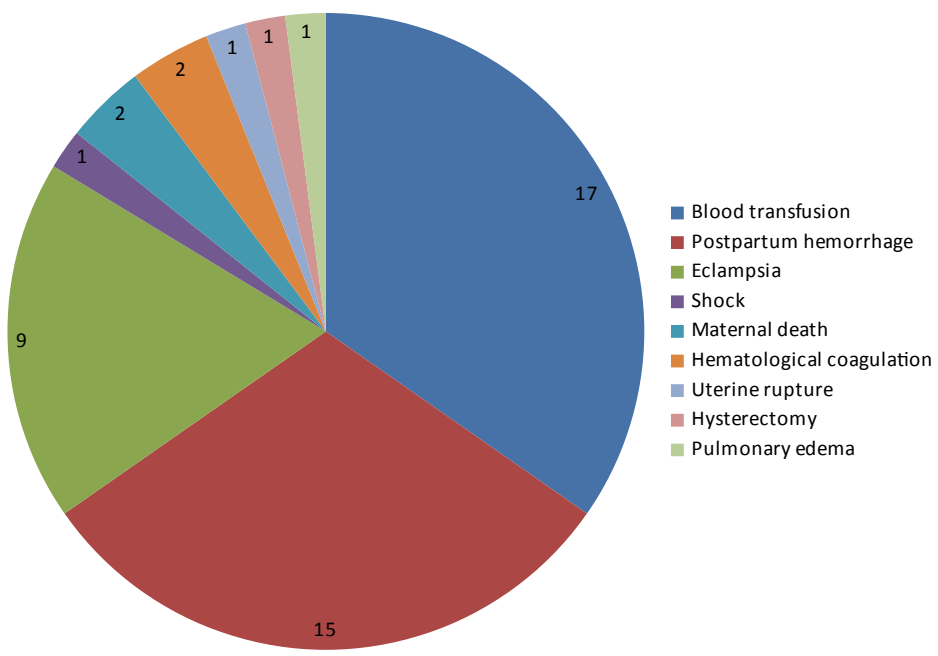


Figure 1. Types of severe maternal outcomes among referred pregnant women, Addis Ababa, Ethiopia, 2019.

Review only

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

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			Page Number
Title and abstract			
Title	#1	Indicate the study's design with a commonly used term in the title or the abstract	
Abstract	#1	Provide in the abstract an informative and balanced summary of what was done and what was found	
Introduction			
Background / rationale	#1	Explain the scientific background and rationale for the investigation being reported	
Objectives	#2	State specific objectives, including any prespecified hypotheses	
Methods			
Study design	#2	Present key elements of study design early in the paper	
Setting	#2	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	
Eligibility criteria	#3	Give the eligibility criteria, and the sources and methods of selection of participants.	
	#3	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers.	

Give diagnostic criteria, if applicable

1
2 Data sources / [#3](#) For each variable of interest give sources of data and details of methods of assessment
3 measurement (measurement). Describe comparability of assessment methods if there is more than one group.
4 Give information separately for for exposed and unexposed groups if applicable.
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8 Bias [#3](#) Describe any efforts to address potential sources of bias
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12 Study size [#4](#) Explain how the study size was arrived at
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15 Quantitative [#4](#) Explain how quantitative variables were handled in the analyses. If applicable, describe which
16 variables groupings were chosen, and why
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19 Statistical methods [#4](#) Describe all statistical methods, including those used to control for confounding
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21 Statistical methods [#4](#) Describe any methods used to examine subgroups and interactions
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23 Statistical methods [#3](#) Explain how missing data were addressed
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26 Statistical methods [#3](#) If applicable, describe analytical methods taking account of sampling strategy
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28 Statistical methods [#3](#) Describe any sensitivity analyses
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30 **Results**

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33 Participants [#3](#) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined
34 for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed.
35 Give information separately for for exposed and unexposed groups if applicable.
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38 Note it was cross-sectional study
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41 Participants [#3](#) Give reasons for non-participation at each stage
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43 Note: all participants participated
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46 Participants [#n/a](#) Consider use of a flow diagram
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50 Descriptive data [#4](#) Give characteristics of study participants (eg demographic, clinical, social) and information on
51 exposures and potential confounders. Give information separately for exposed and unexposed
52 groups if applicable.
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56 Descriptive data [#4](#) Indicate number of participants with missing data for each variable of interest
57

1	Outcome data	#6	Report numbers of outcome events or summary measures. Give information separately for
2			exposed and unexposed groups if applicable.
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7	Main results	#9	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision
8			(eg, 95% confidence interval). Make clear which confounders were adjusted for and why they
9			were included
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12	Main results	#10	Report category boundaries when continuous variables were categorized
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15	Main results	#n/a	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time
16			period
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19	Other analyses	#10	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity
20			analyses
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23	Discussion		
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25	Key results	#11	Summarise key results with reference to study objectives
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28	Limitations	#12	Discuss limitations of the study, taking into account sources of potential bias or imprecision.
29			Discuss both direction and magnitude of any potential bias.
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31	Interpretation	#12	Give a cautious overall interpretation considering objectives, limitations, multiplicity of
32			analyses, results from similar studies, and other relevant evidence.
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35	Generalisability	#12	Discuss the generalisability (external validity) of the study results
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38	Other		
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42	Funding	#13	Give the source of funding and the role of the funders for the present study and, if applicable, for
43			the original study on which the present article is based
44			

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BMJ Open

Delays in Emergency Obstetrics referrals in Addis Ababa hospitals, Ethiopia: a facility-based, cross-sectional study

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Primary Subject Heading:	Obstetrics and gynaecology
Secondary Subject Heading:	Obstetrics and gynaecology, Evidence based practice, Health services research
Keywords:	Human resource management < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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3 Delays in Emergency Obstetrics referrals in Addis Ababa hospitals, Ethiopia: a facility-based, cross-
4 sectional study
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6 Endalkachew Mekonnen Assefa¹, Yemane Berhane²

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11

12 Abstract
13

14 **Objectives:** To assess where the delays occur in the referral chain at most and maternal health
15 outcomes based on the three delay model in Addis Ababa, Ethiopia.
16

17 **Design:** The study was a facility-based cross-sectional study
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19 **Setting:** Two public and tertiary hospitals in Addis Ababa
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21 **Participants:** All pregnant women who were referred for only labor and delivery services after 28 weeks
22 of gestation between December 2018 and February 2019 in Zewditu and Gandhi Memorial hospitals.
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24 **Primary and secondary outcome measures:** The primary outcome was the type of delays from the
25 three-delay model which met operationally defined time. Maternal health outcomes based on the
26 three-delay model as a secondary outcome.
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28 **Results:** A total of 403 pregnant women referred for delivery to the study hospitals were included in
29 the study. Three-fourth (301, 74.7%) of referred pregnant women had the third delay (delayed receiving
30 appropriate care); (211, 52.4%) had a first delay (delay in making a decision to seek care). Overall
31 366(90.8%) pregnant women had experienced at least one of the three delays and 71(17.6%) had all the
32 three delays. Twenty-nine (7.2%) referred women had severe maternal outcomes (SMO). The most
33 leading causes/diagnosis of SMO were blood transfusion 17 (58.6%) followed by postpartum
34 hemorrhage 15 (52%) then eclampsia 9 (31%). In addition, women who experienced severe maternal
35 outcomes were 2.9 times more likely to have at least one of the three delays.
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38 **Conclusion & recommendation:** This study highlights the persistence of delays at all levels and
39 especially delay three and its contribution to severe maternal outcomes. Strengthening health referral
40 systems and addressing specific health system bottlenecks during labor and birth in order to ensure no
41 mother will be endangered. We also recommend a qualitative method of study (focus group discussion
42 and in-depth interview) and observing the tertiary hospitals set-up and readiness to manage obstetrics
43 emergencies.
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49 **Key words:** Addis Ababa, Emergency obstetrics referral, Severe maternal outcomes, Three-delay model
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7 Article summary
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9 Strengths and limitations
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- 11 ➤ This study gives the extent of delays and severe maternal outcomes experienced by
12 women who were referred for labor and delivery.
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15 ➤ This study focused on women with severe maternal outcomes (SMO) rather than less
16 severe forms of obstetric complications because their situations are the closest to
17 maternal deaths.
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20 ➤ Women after delivery might be missed if they transferred to health centers and to
21 other hospitals after delivery for different reasons.
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26 ➤ The results might not be representative of other institutions and the communities
27 because it was conducted in two referral hospitals that often receive and treat
28 complicated cases.
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Introduction

According to the World Health Organization's (WHO) report on maternal mortality trends, about 295, 000 women died during and following pregnancy and childbirth in 2017 (1). Similarly, the 2019 WHO maternal mortality fact sheet reported that approximately 810 women die every day from pregnancy related complications. The vast majority of these deaths (94%) occurred in low-resource settings, and most could have been prevented (2). Sub-Saharan Africa alone accounted for roughly two-thirds (196, 000) of maternal deaths and Ethiopia is among thus countries (1, 2).

Globally, it is recognized that significant inroads maternal mortality cannot be made without dramatically increasing access to emergency obstetrical care (EmOC). The World Health Organization estimates that at least 88–98% of maternal deaths can be averted with timely access to existing, emergency obstetric interventions (3). This produces a triple return on investment, saving women and newborns and preventing stillbirths(4).

A number of factors can influence a woman's ability to access effective interventions to treat complications in the event of an obstetric emergency. Thaddeus and Maine (1994) group these into three broad categories using a classic, pathways-based framework known as the 'three delays model'(5).The 'three delays model' attempts to explain delays in women accessing emergency obstetric care as the result of 1) decision-making, 2) accessing services and 3) receipt of appropriate care once a health facility is reached.

Referral is often associated with the second delay of the three delays model– associated with reaching the appropriate level of care. But in fact, a referral system can reduce all three delays. If a population knows that a system is reliable and affordable, families may make the decision to seek care more quickly (the first delay(6).

The major obstacles that affect the referral system reported by both the health workers and women were: 1) financial barriers (for transportation and service payments at health facilities), 2) lack of means of transportation, 3) distance and 4) lack of awareness of services and the importance of services (7).

Factors associated with health-seeking behavior are multidimensional. Socio-cultural and economic problems, lack of awareness, the quality of health services, and infrastructure such as transport services all affect whether and where a woman will seek care, how long it will take to reach care, and whether she receives the appropriate care in a timely fashion(8).

Studies showed referrals in pregnancy and childbirth can be: (1) institutional or self-referral, depending on the involvement of first-line services; (2) antenatal, delivery or postnatal referral; and (3) elective or emergency referral. Pregnant women may be referred due to demographic risks, obstetric historical risks, prenatal complications, and delivery and immediate postnatal complications(9). On the other hand, Studies show that high-risk prediction may not necessarily mean that the woman will have a complication and many women identified as being at risk go on to have normal deliveries(10).

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3 Defining a framework and process for obstetric referrals may lead to a reduction of maternal mortality
4 and morbidity. Referral should be broadly defined to include not only transport, but it should be a timely
5 referral to minimize or prevent the delay for transportation (called the second delay) and ensure pre-
6 hospital care while transporting a patient to the referral facility(11), (12).
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9 It is widely accepted that substantial reductions in maternal mortality and maternal near- miss are
10 impossible to achieve without early decision-making to seek care, an effective referral system for
11 complicated cases and receiving timely and appropriate care (7), (13). Near- miss cases represent most
12 of the characteristics of maternal deaths but occur more often (14). The near-miss approach assesses
13 the gap between the actual use and optimal use of high-priority effective interventions in the
14 prevention and management of severe maternal complications related to pregnancy and childbirth (15).
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17 The objective of this study was to determine the types of delay and maternal health outcomes based on
18 the three delay model among women who referred for labor and delivery. Results from this study may
19 be an input for the hospitals, health bureau, policy-makers, and other stakeholders to act on bottle-
20 necks of emergency obstetrics services by identifying the most common types of delay.
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23 Methods

24 We used the STROBE cross-sectional reporting guidelines (16).
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27 Study design

28 A facility-based cross-sectional study was conducted between December 10/2018-February 28/2019 in
29 two government hospitals Zewditu Memorial Hospital (ZMH) and Gandhi Memorial Hospitals (GMH).
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32 Study setting

33 This study conducted in tertiary hospitals located in the capital city of Ethiopia, Addis Ababa. Both
34 hospitals are under Addis Ababa Health Bureau and affiliated with Addis Ababa University-College of
35 Health Sciences. Gandhi Memorial Hospital is a referral maternity hospital and Zewditu Memorial
36 Hospital is also a comprehensive referral hospital. Both hospitals are catchment hospitals for 40 (forty)
37 health centers and other health facilities. Both hospitals are giving Comprehensive emergency obstetric
38 care (CEmOC) and attending more than 17,000 deliveries per year.
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41 The referral system for an obstetric emergency in Addis Ababa is organized to include Basic Emergency
42 obstetric care (BEmOC) and CEmOC facilities. The referral system is developed to work both ways.
43 Referral between health facilities is facilitated by the liaison office or Maternal Health Task Force. An
44 ambulance system is organized to transport women accompanied by midwives. The midwife provides
45 care during transportation and hand-over the mother to the receiving hospital care provider with a
46 referral paper. In Addis Ababa, all maternity services including labour/delivery and the ambulance
47 services are provided free of charge in all government health facilities. All hospitals (including primary,
48 secondary and tertiary), Maternity and Child hospitals are expected to give CEmOC: On the other hand,
49 all components of BEmOC are expected to be given in the health centres, medium clinics, and specialty
50 clinics.
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Eligibility criteria

All pregnant women who were referred for only labor and delivery services after 28 weeks of gestation or baby outcome ≥ 1 kg and delivered in the selected hospitals, and also who gave consent were included.

Data Collection Tools

After they gave birth, women were identified and interviewed from emergency OPD, labor ward, and in-patient wards every day before they discharged from the hospital by data collectors using pretested and structured questionnaires.

Data Collection Procedures

The referral papers reviewed and date, time and diagnosis of referral was recorded for each mother. The triage paper and patient chart are also reviewed including mode of transportation, date and time of arrival, sources of referrals, obstetrics performances, the time taken to admit/get the service after arrival, diagnosis at receiving hospital, gestational age, place and mode of delivery, newborn outcomes, and severe maternal complications types and managements. Women interviewed on socio-demographic characteristics, time interval to seek medical advice and reason for the delay to seek the care (if there was).

The completed questionnaires were reviewed by the principal investigator and supervisors. Incomplete questionnaires were filled if the women were not discharged; otherwise incomplete questionnaires were discarded.

Main outcomes and measures of the study

The three delays time frame was operationally defined through a consultative process involving six obstetricians & gynecologists (three from each hospital) who had working experience of 7-20 years in the selected hospitals. Accordingly, the first delay defined time elapsed between the recognition of complication/s, and the decision to transport and reach a health facility, was considered if it took more than 60 minutes. The second delay was defined if the mother did not reach to referral hospitals within 60 minutes of referral. The third delay was if the mother didn't receive care or admitted within 30 minutes. Severe maternal outcomes (SMO) were any maternal complications including blood transfusion (any type & ≥ 2 units), Post-partum hemorrhage, shock, eclampsia, uterine rupture, pulmonary edema, laparotomy, laboratory evidence of organ damage and/or maternal death during the process of delivery and/or before discharge from the hospital. Potentially life-threatening maternal conditions (PLTMC) was considered when the mother had at least one of the following; hemorrhagic complications, hypertensive disorders, and complications, end-organ injury, blood product transfusion, ICU admission, uterine rupture, hysterectomy/laparotomy.

Sample size: Single proportion formula used by assuming 50% of the referred women have a delay, degree of precision of a 5% (d), confidence interval of 95% ($Z=1.96$), assuming 5% non-response rate and the final the sample size was 403.

Statistical analysis

Data were entered in epi-info version 7.2.2.6 and transported to SPSS Version-21 statistics software for cleaning and analysis. Descriptive statistics were used to present women by their socio-demographic characteristics, referral diagnosis, diagnosis at receiving hospitals, obstetrics characteristics, mode of delivery, newborn outcomes, the three delays, and severe maternal outcomes. Severe maternal outcomes were analyzed for the three delays. The relationship between the three delays and SMO were examined using the multivariate logistic regression. The goodness of the model was tested by the Hosmer-Lemeshow test for goodness-of-fit. Selected variables were included in the model to account for maternal characteristics differences other than delays in seeking and receiving care.

Ethical issues

Ethical clearance was obtained from both Addis Continental Institute of Public Health (ACIPH) and Addis Ababa Health Bureau (AAHB) Institution Review Board (IRB). Support letters were written to both study hospitals from AAHB-IRB to gain access. Women asked for some questions after obtained informed consent on a voluntary basis. All the responses were given by the participants and the results obtained kept anonymous and confidential.

Patient and public involvement:

There was no public involvement in the design, conduct, and interpretation of the study. Patients were not asked to advise on interpretation or writing up of results. We did not include patient involvement in the design of this study. We have presented a summary of the findings at medical and public health schools and among health providers in Addis Ababa and plan to continue presenting the results at professional society's conferences. Results were shared with the administration of both selected hospitals and Addis Ababa health Bureau to facilitate improved obstetrics services. There are no plans to disseminate the results of this research to study participants.

Results

Table 1 shows the descriptive information for socio-demographic and obstetric characteristics of referred pregnant women. The mean age of 403 pregnant women referred for labor-delivery services was 26.47 ± 4.5 years and ranged from 18 to 43. The majority were married (380,94.3%), and have completed at least secondary school (54.3%). The majority of women were primigravida (56.1%), the mean gravidity was 1.77 ± 1.1 and ranged between 1 to 7. Most pregnant women (58.8%) were at term pregnancy (37 weeks- 41w6d) (Table1).

Table 1. Socio-demographic and obstetrics characteristics of respondents, Addis Ababa, Ethiopia, 2019 (n=403)

Characteristics n=403	Number (%)
Study Hospital	
Gandhi Memorial Hospital (GMH)	173 (42.9)
Zewditu Memorial Hospital (ZMH)	230 (57.1)
Age (years) median: 26 years (range 18-43)	
< 20	32 (7.9)
20-25	158 (39.2)
26-30	151 (37.5)
31-35	46 (11.4)
≥36	16 (4.0)
Marital status	
Married	380 (94.3)
Others(unmarried, divorced)	23 (5.7)
Educational level	
No formal education	49 (12.2)
Primary school	135 (33.5)
Secondary school	117 (29.0)
Preparatory	35 (8.7)
Vocational and above	67 (16.6)
Gravidity n=403	
1	226 (56.1)
2-4	165 (40.9)
≥5	12 (3.0)

Parity n=146	
1	90 (61.6)
≥2	56 (38.4)
Abortion n=60	
1	48 (80)
≥ 2	12 (20)
Gestational age	
28-33w6d	9(2.2)
34-36w6d	22 (5.5)
37-41w6d	237 (58.8)
≥ 42	42 (10.4)
Unknown	93 (23.1)

The majority of the pregnant women were referred from health centers (387, 96%) and transported by the ambulance (72%) (Table 2).

The majority of the women delivered through vaginal route (254, 63.3%) followed by Cesarean-section (148, 36.7%). The most common indication for C-section was non-reassuring fetal heart rate pattern (27 %) followed by cephalo-pelvic disproportion/malpresentation/malposition (24.3%) then meconium staining in the latent first stage of labor (22.3%). The majority of the babies were born alive (389, 96.5%). There were eight (2%) intrapartum fetal losses (Table 2).

Table 2. Source of referral, transportation, mode & place of delivery and perinatal outcome, among referred pregnant women for delivery, Addis Ababa, Ethiopia, 2019.

Characteristics	Number (%)
Source of referral N=403	
Health Center	387 (96.0)
Others	16 (4.0)

Transportation	
Ambulance	290 (72)
Others(Taxi, personal car)	113 (28)
Receiving hospital contacted before the women referred	
Yes	157 (39.0)
No	246 (61.0)
Mode of delivery	
Vaginal delivery	229 (56.8)
Assisted breech delivery	4 (1.0)
C-section	148 (36.7)
Instrumental delivery	21(5.2)
Vacuum	16 (4.0)
Forceps	5 (1.2)
Laparotomy	1 (0.2)
C-section indication N=148	
Non-reassuring fetal heart rate (NRFHR)	40 (27.0)
Meconium in LFSOL	33 (22.3)
Cephalopelvic disproportion (CPD)	21 (14.2)
Malpresentation/malposition	15 (10.1)
Previous C-scar with labor/labor abnormality	10 (6.8)
Cord prolapse/presentation	7 (4.7)
Non reassuring biophysical profile (NRBPP)	5 (3.4)
APH	4 (2.7)
Others	13(8.8)

Place of delivery		N=403
Labor ward/Operation room		386 (95.8)
Emergency OPD		17 (4.2)
Outcome		N=403
Alive		389 (96.5)
Newborn referred to NICU		Yes
		137 (34)
		No
		252 (62.5)
Stillbirth		14 (3.5)
Fetal heart beat positive on arrival		8(2.0)
Fetal heart beat negative on arrival		6(1.5)

Among 403 referred women for childbirth, 71(17.6%) women experienced all the three delays. Almost three-fourth referred women (74.7%) were experienced the third delay followed by the first delay (52.4%). The majority (366, 90.8%) women had at least one of the delays (Table 3).

Table 3. The frequency of the three delays among referred women, Addis Ababa, Ethiopia 2019.

Characteristics	Number (%)	
	N=403	No
First delay	211 (52.4)	192 (47.6)
Second delay	163 (40.4)	240(59.6)
Third delay	301(74.7)	102(25.3)
At least one delay	366 (90.8)	37 (9.2)
All three delay	71 (17.6)	332 (82.4)

** multiple answer possible

Twenty-nine (7.2%) women had severe maternal outcomes. The most common severe maternal outcomes were blood transfusion (58.6%) followed by postpartum hemorrhage (51.7%) then eclampsia (31%). Nearly three-fourth women with SMO (78.5%) had more than one complication (Figure1).

The most common delays in women with SMO were the third delay (58.6%) followed by the first delay (51.7%). All most three-fourth women experienced at least one of the delays (79.3%) and one-quarter (24.1%) women had all the delays (Table 4).

Statistically, a significant association was observed between SMO and third delay, at least one of the delays. Referred women with the third delay had 2.2 times (95% CI of 1.025-4.840) more likely to be a risk for severe maternal outcomes. Women who experienced at least one of the delays had 2.9 times (95% CI 1.093-7.620) more likely to be a risk for severe maternal outcomes (Table 4).

After adjusted for age, gravidity, parity, educational level, gestational age, and marital status none of the delays were significant. This may be due to a small sample of women with SMO.

Table 4. SMO and types of delays Addis Ababa, Ethiopia 2019.

Characteristics	Severe maternal outcomes				
	Types of delay	No	Yes	P-value	COR 95 % CI
		Number (%)	Number (%)		
First delay	No	178 (47.6%)	14 (48.3)	0.944	1.028(0.483-2.189)
	Yes	196 (52.4)	15 (51.7)		
Second delay	No	224 (59.9)	16 (55.2)	0.618	1.213(0.567-2.596)
	Yes	150 (40.1)	13 (44.8)		
Third delay	No	90(24.1)	12 (41.4)	0.043	2.227(1.025-4.840)
	Yes	284 (75.9)	15 (58.6)		
All delays	No	310 (82.9)	22 (75.9)	0.342	1.541(0.632-3.761)
	Yes	64 (17.1)	7 (24.1)		
At least one delay	No	31 (8.3)	6 (20.7)	0.032	2.889(1.093-7.620)
	Yes	343 (91.7)	23(79.3)		

**AOR not significant after adjusted for age, marital status, educational level, gestational age, gravidity, parity.

Eighty (19.9%) of referred women had at least one potential life- threatening conditions (PLTC). The most common complications were hypertensive disorders 56 (70%) followed by blood transfusion 17 (21.3%) then postpartum hemorrhage (Table 5).

Table 5. Potentially life threatening conditions among referred women Addis Ababa, Ethiopia, 2019

Characteristics* N=80	Number (%)
Hemorrhagic complications	
Ante partum hemorrhage (AP,PP)	13 (16.3)
Post partum hemorrhage (PPH)	15 (18.8)
Ruptured uterus	1 (1.25)
Coagulopathy	2 (2.5)
Hypertensive disorders	
Severe hypertension/Preeclampsia	50 (62.5)
Eclampsia	9 (11.3)
HELLP syndrome	2 (2.5)
Others	
Pulmonary edema	1 (1.25)
Shock	1(1.25)
Thrombocytopenia	2 (2.5)
Management indication of severity	
Transfusion of blood derivatives	17 (21.3)
Major surgical intervention(hysterectomy)	1(1.25)

*Multiple response possible

Discussion

All three types of delays were common in the study hospitals; the most severe being the delay within the receiving hospital. The third delay was significantly associated with severe maternal outcomes.

Studies have found that distance to facilities is a clear barrier to women accessing health facilities (17) (18) but in Addis Ababa, proximity to services does not appear to be a problem, as the median distance to a facility that provides surgical services is 5 kilometers, well below the national average of 45 kilometers (19). Two-fifth of women had the second delay. When we compare with other studies it may be low however this proportion of the second delay is not expected because referring facilities/catchment health centers are near to the receiving hospitals and expected to refer by ambulance (20).

This study showed the rate of occurrence of SMO indicators were higher than the findings of an earlier study done in other parts of the country (20-23) and other countries (24-26). This high proportion SMO might be due to the fact that our study selected facilities are referral hospitals that are serving complicated cases and cases referred from other health facilities that were beyond their capacity/needed further interventions. This study showed that direct obstetric causes were the most common leading factors of SMO and the most common diagnosis were postpartum hemorrhage (52%) followed by eclampsia (31%) and the most common intervention was blood transfusion (58.6%). Obstetric hemorrhage and hypertensive disorders (eclampsia, hematological coagulation, and pulmonary edema) were found to be the top underlying complications among cases of SMO; similarly, hypertensive disorders and obstetric hemorrhage were the most common underlying causes of PLTC. This is comparable to the findings from studies in other parts of the country (23), (24) (25) and other countries (25-29) including sub-Saharan countries (30) (31).

Emergency obstetric care use by pregnant women is influenced by a complex interaction of factors leading to delay in decision-making, accessing services and receipt of proper care once a health facility is reached(30) (31). Receiving appropriate care after reaching the health facility (delay three) was the most common (58.6%) followed by a delay in seeking care (delay one) (51.7%) then reaching at the appropriate health facility (delay two) (44.8%) were identified among SMO and more than half of (58.6%) SMO cases had encountered at least one of the delays which were similar to study done elsewhere in the country (21) (32) (33); however, delay two and one is seen less frequently than the findings from other countries (25) (30) (31) (34-37). This can be justified by the overloaded cases, limited hospital capacity, the difference in socio-demographic characteristics of the study population and the proximity of health facilities.

In this study, failure to receiving appropriate care after reaching the health facility (delay three) was found to have the strongest association with SMO: with a two-fold increase in the risk. This supports the WHO hypothesis relating a high case fatality in the hospital as an indicator for the presence of delay in receiving adequate and proper treatment (17) and it indicates the poor performance of obstetrics services (38) (39). Seeking care from a facility that is incapacitated health facility and system, poor leadership (mismanagements of hospital resources, poor co-ordinations and lack of understanding of

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3 obstetrics emergencies) contribute to significant delay after reaching the health facility. These factors
4 were reported as significant contributors to delay in several studies (21) (32) (34) (35). Studies from
5 Tigray, 88% of all maternal deaths were attributed to health system failure (33). In our study, 59 % of
6 SMO cases and both maternal deaths (MD) had health system-related factors as a possible reason for
7 delay three.
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10 The limitation of this study include that it was conducted in two referral hospitals which often receive
11 complicated cases and referred women with complications; the results might not be representative of
12 other institutions and the community. In addition, cases might be missed because if they transferred to
13 health centers and other hospitals after delivery for different reasons.
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16 However, we believe that this study gives the extent of delays and SMO & its indicators experienced by
17 women who were referred for an emergency delivery. In fact, if the delay is so severe in these well-
18 established referral centers one may expect it to be worse in some not well-staffed and equipped
19 centers. We decided to focus on women with severe maternal outcomes (SMO) rather than less severe
20 forms of obstetric complications because their situations are the closest to maternal deaths.
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23 Conclusion

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25 The burden of severe maternal outcomes (SMO) is high due to preventable and/or treatable direct
26 obstetric causes. The majority of the women in this study had serious delays in both making decisions to
27 seek care for birthing and in actually receiving care once at a hospital. We recommend strengthening
28 health referral systems and addressing specific health systems bottlenecks during labor and delivery in
29 order to ensure no woman will be endangered. We also recommend a qualitative method of study
30 (including focus group discussion, in-depth interview) and observing the tertiary hospitals set-up and
31 readiness to manage high-risk pregnancies.
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35 Abbreviations

36 AAHB-IRB: Addis Ababa Health Bureau-Institutional Review Board

37 BEmOC: Basic Emergency Obstetrics Care

38 CEmOC: Comprehensive Emergency Obstetrics Care

39 GMH: Gandhi Memorial Hospital

40 HELLP: Hemolysis, Elevated liver enzyme, Low Platelets

41 ICU: Intensive Care Unit

42 LW: Labor Ward

43 MD: Maternal Death Ratio

44 MNM: Maternal Near-Miss

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3 MWH: Maternity Waiting Home

4
5 OPD: Out-Patient Department

6
7 PIH: Pregnancy Induced Hypertension

8
9 PLTC: Potential Life Threatening Conditions

10
11 PPH: Post Partum Hemorrhage

12
13 SMO: Severe Maternal Outcomes

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15 WHO: World Health Organization

16
17 ZMH: Zewditu Memorial Hospital

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21
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33
34 Contributors: EMA did design of the work, drafting the work, analysis, interpretation of data for the
35 work and write-up the manuscript. YB advised the paper's scope, the draft of the manuscript and did
36 revise it critically for important intellectual content. Both authors approved the final version.

37
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39
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42
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44 and Addis Ababa Health Bureau ethical review board.

45
46 Data availability statement: Extra data can be accessed via the Dryad data repository at
47 <http://datadryad.org/> with the doi: 10.5061/dryad.x95x69pfh

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48 Figure 1. Types of severe maternal outcomes among referred pregnant women, Addis Ababa, Ethiopia,
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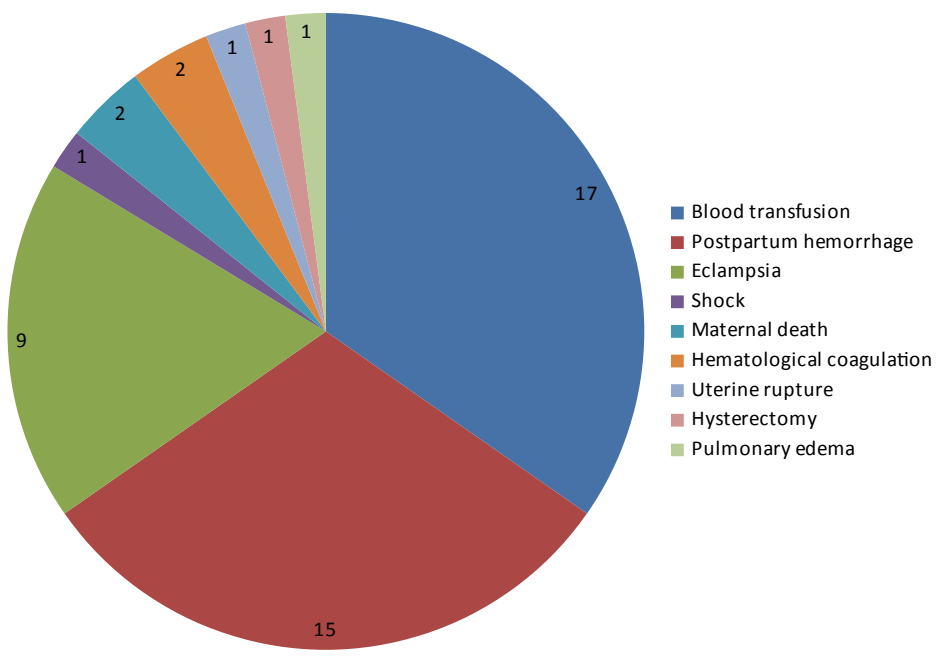


Figure 1. Types of severe maternal outcomes among referred pregnant women, Addis Ababa, Ethiopia, 2019.

Review only

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

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In your methods section, say that you used the STROBE cross sectional reporting guidelines, and cite them as:

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			Page Number
Title and abstract			
Title	#1	Indicate the study's design with a commonly used term in the title or the abstract	
Abstract	#1	Provide in the abstract an informative and balanced summary of what was done and what was found	
Introduction			
Background / rationale	#1	Explain the scientific background and rationale for the investigation being reported	
Objectives	#2	State specific objectives, including any prespecified hypotheses	
Methods			
Study design	#2	Present key elements of study design early in the paper	
Setting	#2	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	
Eligibility criteria	#3	Give the eligibility criteria, and the sources and methods of selection of participants.	
	#3	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers.	

Give diagnostic criteria, if applicable

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2 Data sources / [#3](#) For each variable of interest give sources of data and details of methods of assessment
3 measurement (measurement). Describe comparability of assessment methods if there is more than one group.
4 Give information separately for for exposed and unexposed groups if applicable.
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8 Bias [#n/a](#) Describe any efforts to address potential sources of bias
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12 Study size [#3](#) Explain how the study size was arrived at
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15 Quantitative [#3](#) Explain how quantitative variables were handled in the analyses. If applicable, describe which
16 variables groupings were chosen, and why
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19 Statistical methods [#4](#) Describe all statistical methods, including those used to control for confounding
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21 Statistical methods [#4](#) Describe any methods used to examine subgroups and interactions
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23 Statistical methods [#3](#) Explain how missing data were addressed
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26 Statistical methods [#3](#) If applicable, describe analytical methods taking account of sampling strategy
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28 Statistical methods [#n/a](#) Describe any sensitivity analyses
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30 31 Results

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33 Participants [#4](#) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined
34 for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed.
35 Give information separately for for exposed and unexposed groups if applicable.
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40 Participants [#4](#) Give reasons for non-participation at each stage
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44 Participants [#n/a](#) Consider use of a flow diagram
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50 Descriptive data [#4](#) Give characteristics of study participants (eg demographic, clinical, social) and information on
51 exposures and potential confounders. Give information separately for exposed and unexposed
52 groups if applicable.
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56 Descriptive data [#5](#) Indicate number of participants with missing data for each variable of interest
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1	Outcome data	#5	Report numbers of outcome events or summary measures. Give information separately for
2			exposed and unexposed groups if applicable.
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7	Main results	#9	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision
8			(eg, 95% confidence interval). Make clear which confounders were adjusted for and why they
9			were included
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12	Main results	#10	Report category boundaries when continuous variables were categorized
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15	Main results	#n/a	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time
16			period
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19	Other analyses	#10	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity
20			analyses
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23	Discussion		
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25	Key results	#11	Summarise key results with reference to study objectives
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28	Limitations	#12	Discuss limitations of the study, taking into account sources of potential bias or imprecision.
29			Discuss both direction and magnitude of any potential bias.
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32	Interpretation	#12	Give a cautious overall interpretation considering objectives, limitations, multiplicity of
33			analyses, results from similar studies, and other relevant evidence.
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35	Generalisability	#12	Discuss the generalisability (external validity) of the study results
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38	Other		
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42	Funding	#13	Give the source of funding and the role of the funders for the present study and, if applicable, for
43			the original study on which the present article is based
44			

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