



Abortion-related near-miss morbidity and mortality in 43 health facilities with differences in readiness to provide abortion care in Uganda

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ABSTRACT

Introduction With a view to inform policy for improved postabortion care, we describe abortion-related near-miss and mortality by sociodemographic risk factors and management options by pregnancy trimester in Uganda. **Methods** This secondary data analysis used an adapted WHO near-miss methodology to collect cross-sectional maternal near-miss and abortion complications data at 43 health facilities in Central and Eastern Uganda in 2016–2017. We computed abortion severe morbidity, near-miss and mortality ratios per 100 000 live births, and described the proportion of cases that worsened to an abortion near-miss or death, stratified by geographical region and trimester. We tested for association between independent variables and abortion near-miss, and obtained prevalence ratios for association between second trimester near-miss and independent demographic and management indicators. We assessed health facility readiness for postabortion care provision in Central and Eastern regions. **Results** Of 3315 recorded severe abortion morbidity cases, 1507 were near-misses. Severe abortion morbidity, near-miss and mortality ratios were 2063, 938 and 23 per 100 000 live births, respectively. Abortion-related mortality ratios were 11 and 57 per 100 000 in Central and Eastern regions, respectively. Abortion near-miss cases were significantly associated with referral ($p < 0.001$). Second trimester had greater abortion mortality than first trimester. Eastern region had greater abortion-related morbidity and mortality than Central region with facilities in the former characterised by inferior readiness to provide postabortion care.

Conclusions Uganda has a major abortion near-miss morbidity and mortality; with mortality higher in the second trimester. Life-saving commodities are lacking especially in Eastern region compromising facility readiness for postabortion care provision.

INTRODUCTION

Unsafe abortion is a major reproductive health challenge contributing to 7.9% global and 9.6% regional maternal deaths.^{1,2} Over 75% of all abortions in sub-Saharan Africa, Uganda inclusive, are unsafe due to restrictive

Key questions

What is already known?

- ▶ The WHO near-miss indicator is proposed to assess the quality of maternal services and several studies provide evidence on the usefulness of the concept using the original and adapted WHO near-miss approaches.
- ▶ A systematic review of 70 studies from 28 countries published in 2018 estimates an abortion near-miss rate of 9%, and a mortality rate of 1.5% among abortion-related hospital admissions.

What are the new findings?

- ▶ This is the first study to provide detailed characterisation of abortion near-miss by pregnancy trimester.
- ▶ Using the adapted WHO near-miss criteria, we found a higher abortion-related mortality in the second compared with first trimester. Referred women were more likely to develop abortion near-miss. Women who had a near-miss abortion event in the second trimester had a lesser prevalence of uterine evacuation or manual vacuum aspiration than spontaneous expulsion compared with women in the first trimester (crude prevalence ratio (cPR) 0.69, 95% CI 0.51 to 0.93).
- ▶ The Eastern region of Uganda had less readiness for Post Abortion Care, with higher abortion-related morbidity and mortality. Although both results come from independent cross-sectional data and precluding causal inference, our result points to the importance of providing adequate services for women with abortion complications.

abortion laws.^{3,4} Furthermore, low socio-economic status, low literacy rates and low contraceptive uptake are associated with high unsafe abortion rates and severe abortion morbidity (SAM).^{5–8} Abortion-related deaths are largely preventable if patients receive timely appropriate care such as postabortion care (PAC).^{9,10} PAC is essential life-saving care to address the impact of abortion-related

Key questions

What do the new findings imply?

- ▶ There is a major burden of abortion near-miss and mortality particularly in low-income settings.
- ▶ Women with second trimester abortion complications need urgent attention to avert severe abortion-related complications and deaths.
- ▶ Provision of essential drugs and supplies is crucial to averting abortion-related near-miss and deaths.

complications which are primarily due to ‘unsafe’ abortions.

Assessing the incidence of severe abortion and abortion-related mortality is important to gauge the quality and effectiveness of PAC. To standardise the assessments of morbidity, WHO defined a near-miss as ‘a woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy’.¹¹ Abortion near-miss (ANM), a subset of maternal near-miss, may be the result of delays in accessing safe abortion care as well as delays in getting PAC when complications arise. While spontaneous and safe abortions are less likely to have near-miss complications (and deaths) than unsafe induced abortions, PAC addresses both.¹² Quality PAC is dependent on appropriate equipment, commodities, laboratory tests, guidelines and trained staff; this averts further harm and improves patient survival.

ANM is both a success and a failure with respect to quality of care. A success because the woman has been saved in extremis by hospital teams, especially if she arrived in a very severe condition at the facility. A failure, because she became so severely ill.¹³ Still, ANM occurrence and mortality is a valuable indicator for health systems’ planning, case management strategies and evaluation of healthcare provided. Previous research proposed ANM incidences per 100 000 live births between 200 and 450 and abortion-related mortality ratio (AMR) about 85 per 100 000 live births in Africa.^{14–17}

PAC was introduced in Uganda in the early 1990s as part of basic and comprehensive emergency obstetric care (EmOC) packages.^{18 19} PAC is offered by both midwives and doctors from primary level health facilities and hospitals.²⁰ Paul *et al* published research on barriers that women in Uganda face in accessing PAC services which lead to more severe complications.²¹ Little is known, however, if incidence and mortality differ in relation to PAC services by country region and to which extent complication rates are driven by sociodemographic status, reproductive characteristics or management options by pregnancy trimester.¹⁷ Our study from 43 facilities in two distinct regions of Uganda²² aims to assess abortion-related morbidity and mortality by region, and therewith differences in the availability of PAC services—and by sociodemographic and reproductive characteristics including trimester in Uganda.

METHODS

Study design, setting and participants

We collected cross-sectional data on maternal near-miss as part of a cluster randomised two-arm trial to assess the impact of a 1 day competency-based training ‘Helping Mothers Survive: Bleeding after Birth’ on morbidity and mortality due to postpartum haemorrhage (PPH). The primary trial details are reported elsewhere.²³ The study was conducted in 11, and 7 districts in Central and Eastern regions of Uganda, respectively, at 22 hospitals, and 21 high case load health centres; 9 were private not for profit (PNFP) and 34 public. In each district, taken as a cluster, we included all public hospitals and randomly sampled health centres and PNFP health facilities with more than 400 deliveries per year. Ministry of Health Uganda recommended the selected districts and all health facilities offer at least basic EmOC services. Data collection run from June 2016 to September 2017.

Data collection

We used the WHO near-miss form to collect data of all maternal near-miss events, and deaths which took place in the selected health facilities.²⁴ The data collection form was amended and included severe abortion complications, see online supplemental appendix I, as a screening question to ensure that these events were captured consistently. Details of categories for organ dysfunction, critical interventions, and other data collected are reported elsewhere.²³

At each health facility, two of the midwives, selected as data collectors received a 1-day training on near-miss methodology and the data collection process. We collected data prospectively from several service points at the health facilities including (1) antenatal, labour and postnatal ward, (2) female and surgical ward, (3) laboratory and (4) theatre to ensure that all cases of near-miss and maternal deaths were included. A standard protocol was used to abstract information from the patient’s clinical case notes and registries for admission, birth, theatre, laboratory and discharge. From the paper forms, the data collectors entered data onto a tablet-based application (Lenovo A3500-F) and uploaded onto the cloud server biweekly using Open Data Kit Collect software application. Data on the total number of live births in the facilities were collected through monthly telephone calls and verified during supervision visits. The data collectors were supported through biweekly supervision visits and regular telephone calls to ensure complete and correct abstraction of data.

This paper uses only the data on maternal near-misses admitted as abortion-related complications. An abortion was defined as termination of a pregnancy less than 28 weeks gestation age. We extracted data for women coded as having abortion complications from those with severe maternal morbidity. Women with ectopic pregnancy or gestation age above 27 weeks were excluded, viability in Uganda begins at 28 weeks.¹⁹ Since PPH and abortion are both bleeding complications, we screened the PPH cases

to identify the abortion cases that were miscoded as PPH using a gestation age less than 28 weeks. Cases that were coded as abortion cases but where the gestation age was missing were not excluded from the data set (see online supplemental appendix II).

We assessed for PAC provision health facility readiness at the 43 health facilities from February to April 2016 using an adapted Uganda health facility assessment tool. Components therein are very similar to the WHO service availability and readiness assessment tool,²⁵ however, we did not collect information on whether the abortion was spontaneous or induced, and provision of family planning services as these were not captured in the primary study tool. Key items measured that influence access and availability to PAC services at all the health facilities included: (1) uterotonics like misoprostol and oxytocin; (2) manual vacuum aspiration (MVA) sets; (3) intravenous fluids; (4) parenteral antibiotics; (5) ability to provide PAC services 24 hours a day, 7 days a week (24/7); (6) referral capability (motorised transport for referral, health provider accompanying a referral); (7) communication means; and for health facilities offering comprehensive EmOC; (8) blood transfusion services and (9) surgical/laparotomy capability.

Service readiness components like equipment and commodities were verified by checking their presence on the wards, pharmacy, laboratory and the health facility stores. Health facilities' ability to provide PAC services 24/7 was verified with checking duty schedules, ward and theatre registers for the previous 3 months. We inquired about the presence of motorised transport at the health facility, and whether the most recent referral to a higher facility had been accompanied by a health provider to check the referral capability.

Outcomes and explanatory variables

The main outcome, ANM, was defined using our adapted WHO near-miss criteria as a case of severe abortion complication with either organ dysfunction, severe sepsis, blood transfusion or laparotomy. Given the paucity of blood products in low to middle income countries, the threshold for massive blood transfusion was reduced to two units down from the five units recommended by WHO.^{14 26 27} Other outcomes were:

- ▶ SAM ratio (SAMR) as the number of all cases with severe abortion complications per 100 000 live births.
- ▶ ANMR as the number of abortion-related near-miss cases per 100 000 live births.
- ▶ AMR as the number of maternal deaths due to abortion per 100 000 live births.

Independent variables included background characteristics like gestation age based on weeks of amenorrhoea, patient's age in completed years, number of pregnancies and timing of onset of complications. Reproductive and institutional factors like HIV status, referral status (referred into the facility), type of health facility and ownership. We also collected information on complications including infection, organ dysfunction

and maternal death; as well as management options like types of uterine evacuation, uterotonics administered, and additional interventions, for example, blood transfusion, number of blood transfusion units administered and laparotomy, all abstracted from the patient's clinical case notes.

Statistical analysis

Statistical analysis was performed using Stata V.14. We present the number of women with severe abortion complications, ANM, abortion-related deaths; and SAMR, ANMR and AMR for all women in the study, then segregated by region. We also present the proportions of SAM that had ANM or abortion-related deaths by region and pregnancy trimester. The estimates were not weighted for region. We designated health facility as a primary sampling unit and assigned all health facilities the same weight using STATA command `svyset (pw=wgt), psu(id3) singleunit (centred)`.

Background characteristics and categorical outcomes were presented with descriptive statistics. Continuous variables were summarised using means (SD) or medians (IQR) and categorical variables using proportions (CIs). Pearson's χ^2 was used to test the difference between severe abortion complications cases and those that progressed to be ANM across different sociodemographic, reproductive and institutional characteristics. We computed 95% CIs and statistical significance established at $p < 0.05$. We excluded women with missing data for gestation age and unrecorded HIV status in the statistical test computation for background and reproductive characteristics comparison among near-miss cases to avoid misinterpretation of findings.

We then described the proportion of women with severe abortion complications or ANM that suffered complications such as infection, organ dysfunction, maternal death and the management options received including type of uterine evacuation, uterotonics administered, blood transfusion and when a laparotomy was performed. To examine the association between first and second trimester ANM and background characteristics, reproductive factors, institutional factors, types of complications and management options, we did multiple generalised linear models with binomial family and log link to obtain unadjusted prevalence ratios effect estimates.

Regarding health facility readiness for PAC, we computed the percentage of facilities that fulfilled each readiness indicator, for all health facilities and for central and eastern region. Performed Pearson χ^2 or Fischer's exact tests to compare PAC health facility readiness between the central and eastern region.

Role of the funding source

The funder had no role in study conceptualisation, data collection, analysis and manuscript writing. All authors had full access to the study data and the corresponding author had final responsibility for the decision to submit for publication.

RESULTS

We extracted data of 3315 (25.8%) SAM cases from the total of 12843 severe maternal complications collected over a period of 15 months from 43 health facilities. Forty five percent (n=1507) of the 3315 women with severe abortion-related complications fulfilled the criteria as ANM cases (see online supplemental appendix II). During the same period, there were a total of 160701 live births at the study sites with the Central and Eastern regions having 118674 and 42027 live births, respectively.

The facility SAMR, ANMR and AMR were 2063, 938 and 23 per 100000 live births, respectively (see table 1). The Eastern region had an SAMR of 3641 and ANMR of 1785 per 100000 live births; while the Central region had an SAMR of 1504 and ANMR of 638 per 100000 live births. Thirty-seven women died from abortion complications with an AMR of 11 vs 57 per 100000 live births in Central and Eastern region, respectively. Of the documented 1459 and 1044 first and second trimester severe abortion complications, 589 (40.4%) and 499 (47.8%), respectively, developed into an ANM and 5 (0.3%) and 21 (2.0%), respectively, died.

In the Central region, out of 625 and 543 first and second trimester women with SAM, 284 (45.4%) and 212 (39.0%), respectively, developed into ANM and 1 (0.2%) and 6 (1.1%), respectively, died. While the Eastern region, had 36.6% and 57.3% of the SAM in the first and second trimester respectively develop ANM, and death occurred in 0.5% and 3.0% in the first and second trimester, respectively. The mean age of participants was 26 years (SD 7), and the median number of pregnancies was three (IQR 2–5) (see table 2). Patients referred into the health facilities were more likely to progress to develop an ANM (p<0.001). Regarding complications seen and management options in table 3, only 243 women (16%) with ANM had an infection and 76% presented with organ dysfunction. Surgical uterine evacuation using MVA or curettage (D&C) was performed in 58% of ANM cases, 41% had a spontaneous expulsion while only 1% got medical evacuation. Oxytocin was the commonly administered uterotonic in 58% of the cases, followed by misoprostol in 40%.

Only 42% of all ANM cases received a blood transfusion, and 47% of patients who received blood transfusion had their haemoglobin (Hb) checked at discharge. The median Hb at discharge was 72 g/L (IQR 58–90). Majority (58%) of the near-miss cases only got one unit of blood, 40% got 2–4 units of blood and 2% received five or more units.

Laparotomy was performed in 27 patients; nine and 11 of whom were in the first and second trimester, respectively, with gestation age not specified in seven patients (table 3). The indications for laparotomy included: uterine perforation in 10, 8 had pelvic abscess, 3 got subtotal hysterectomy, 1 patient with missed abortion and disseminated intravascular coagulopathy had a hysterotomy, 2 patients with induced abortion had vesicovaginal fistula and 1 of them in addition had a rectovaginal fistula. Majority

(52%) of these laparotomies were performed between 3 and 12 hours from admission. The prevalence of ANM complications developing after having been admitted at least 12 hours was 37% (cPR 1.37, 95% CI 1.07 to 1.76) higher in women with second trimester ANM compared with women with first trimester ANM (table 4). We also observed an association between second trimester ANM and the methods used for uterine evacuation. Women with second trimester ANM had a 31% (cPR 0.69, 95% CI 0.51 to 0.93) lesser prevalence of uterine evacuation or MVA as opposed to a spontaneous expulsion compared with women with first trimester ANM.

All 43 health facilities could offer PAC services 24/7. Majority of the health facilities had intravenous fluids (93%), parenteral antibiotics (86%) and oxytocin (86%) while misoprostol (42%) was grossly lacking with MVA sets in only 70% of them. Approximately 74% of the health facilities had motorised transport for referral; and only 42% had a health provider accompanying the referral. A comparison of the central and eastern regions for PAC readiness revealed that the central region had significantly more MVA sets (p=0.003), motorised transport for referral (p=0.004) and health provider accompaniment of referrals (p=0.034). Availability of uterotonics, intravenous fluids, parenteral antibiotics, communication means, blood transfusion services and surgical/laparotomy capability did not significantly differ by region (table 5).

DISCUSSION

Main findings

This study reveals the high burden of abortion-related morbidity and mortality in Uganda which agrees with evidence from similar settings with highly restrictive abortion laws.^{2 28} Close to 1.8% of women with SAM died particularly those in the second trimester. The Eastern region of the country had less PAC readiness, only 40% of facilities had MVA kits compared with 86% in the Central region (p=0.003) but also had worse abortion-related near-miss and mortality outcomes.

A WHO multicountry survey of 23 countries cites Uganda second to Afghanistan in reporting abortion-related severe maternal outcomes.² Uganda has one of the highest fertility rates in the sub-Saharan region hence more pregnancy-related complications.²⁹ We report a high ANMR of 938 per 100000 live births, which can be attributed to the fact that we modified the near-miss definition to also include those with at least two instead of at least five blood transfusions.^{14 15} Despite the huge morbidity burden shown in this study, our AMR (23 per 100000 live births) is lower compared with other countries like Zambia (52 per 100000 live births), and Nigeria (85 per 100000 live births).^{10 14 15}

PAC is globally accepted as life-saving care to women with abortion complications.³⁰ In Uganda, PAC is recognised as a core signal function from health centre III level, and trained health providers including midwives

Table 1 Abortion-related severe morbidity, near-miss and mortality indicators by pregnancy trimester and by region in Uganda

Region and trimester distribution	Severe abortion morbidity			Abortion near-miss			Abortion-related deaths			Live births			Severe abortion morbidity ratio			Abortion near-miss ratio			Abortion-related mortality ratio		
	SAM	ANM	n/% of reported SAM, 95% CI	ANM			Abortion-related deaths			births	SAMR	per 100 000 live births	ANMR			AMR					
	N								N												
All women	3315	1507	45.5, 31.1 to 59.8	37	1.1, 0.1 to 2.1	160701	2063	938	23												
Timing of abortion																					
First trimester	1459	589	40.4, 22.5 to 61.2	5	0.3, 0.1 to 1.3																
Second trimester	1044	499	47.8, 36.4 to 59.4	21	2.0, 0.8 to 5.0																
Trimester not indicated	812	419	51.6, 35.6 to 67.3	11	1.4, 0.7 to 2.4																
Central region	1785	757	42.4, 31.3 to 54.3	13	0.7, 0.4 to 1.4	118674	1504	638	11												
First trimester	625	284	45.4, 39.6 to 51.2	1	0.2*																
Second trimester	543	212	39.0, 32.4 to 45.6	6	1.1, 0 to 9.4																
Trimester not indicated	617	261	38.9, 33.0 to 44.8	6	1.0, 0 to 9.0																
Eastern region	1530	750	49.0, 23.2 to 75.3	24	1.6, 0.4 to 5.6	42027	3641	1785	57												
First trimester	834	305	36.6, 31.2 to 42.0	4	0.5, 0 to 7.4																
Second trimester	501	287	57.3, 51.6 to 63.0	15	3.0, 0 to 11.6																
Trimester not indicated	195	158	81.0, 74.9 to 87.1	5	2.7, 0 to 16.9																

Estimates are not weighted for regions.

*Insufficient observations for CI computation.

AMR, abortion-related mortality ratio; ANM, abortion near-miss; ANMR, Abortion near-miss ratio; SAM, severe abortion morbidity; SAMR, severe abortion morbidity ratio.

Table 2 Sociodemographic, reproductive and institutional characteristics of severe abortion morbidity and abortion near-miss in Uganda

Characteristics	Severe abortion complications n* N=3315	Abortion near-miss cases n† N=1507	Abortion near-miss row %‡ (95% CI)	χ	P value§
Age group (years)				8.74	0.22
<18	180	94	52 (37 to 67)		
18–24	1335	572	43 (29 to 58)		
25–29	729	334	46 (33 to 59)		
30–34	542	260	48 (36 to 60)		
35 +	529	247	47(29 to 65)		
Number of pregnancies				9.75	0.22
1	752	313	42(28 to 56)		
2	589	263	45(30 to 60)		
3	482	216	45(32 to 59)		
4	369	167	45(32 to 59)		
5 or more	1123	548	49(33 to 65)		
Gestation age				13.66¶	0.33¶
First trimester	1459	589	40(23 to 61)		
Second trimester	1044	499	48(36 to 59)		
Trimester not indicated	812	419	52(36 to 67)		
HIV status				10.18**	0.12**
Negative	2388	942	39(26 to 55)		
Positive	148	78	53(37 to 68)		
Not recorded	779	487	63(44 to 78)		
Timing of complications				7.75	0.07
At arrival or within 12 hours	3253	1468	45(31 to 60)		
Developed after 12 hours	62	39	63(46 to 77)		
Referral status				198.11	<0.001
Not referred	2880	1173	41(28 to 55)		
Referred††	435	334	77(64 to 86)		
Type of health facility				34.22	0.42
Health Centre	1204	628	52(34 to 70)		
Hospital	2111	879	42(25 to 61)		
Ownership of health facility				18.7	0.40
Public	2675	1265	47(31 to 64)		
Private	640	242	38 (25 to 53)		

*Number of women with severe abortion complications in each row category, the denominator includes abortion near-miss cases as well .
 †Number of abortion near-miss cases in each row category.
 ‡Proportion of women with abortion near-miss out of the total with severe abortion complications in each row category.
 §Using the Pearson χ^2 to test difference in the proportion of all severe abortion complications that are near-miss across different sociodemographic, reproductive and institutional characteristics.
 ¶Excludes patients where the trimester was not indicated.
 **Excludes patients that did not have a recorded HIV status.
 ††Patients referred into the health facility for management of abortion complications.

can manage bleeding complications by performing MVA especially for first trimester abortions. This deliberate effort by the Uganda Ministry of Health to task share in

patient management probably contributes to the reduced mortality from abortion complications.¹⁹ Our study shows that ANM morbidity and mortality is greater in the Eastern region compared with the

Table 3 Postabortion complications and management options for women with severe abortion complications and abortion near-miss

Characteristics	Complication/ management option n*	Proportion (%) of complication among severe abortion complications † (95% CI) N=3315	Proportion (%) of complication among abortion near-miss‡ (95% CI) N=1507
Complications			
Maternal deaths	37	1 (0 to 3)	N/A
Infection	243	7 (4 to 12)	16 (10 to 24)
Organ dysfunction	1138	34 (23 to 48)	76 (65 to 84)
Management options			
Types of uterine evacuation			
Spontaneous expulsion	1086	35 (24 to 47)	41 (27 to 56)
Evacuation/MVA	2038	65 (53 to 75)	58 (43 to 72)
Medical	17	1 (0 to 1)	1 (0 to 3)
Uterotonics administered			
Misoprostol	950	33 (23 to 46)	40 (27 to 54)
Oxytocin	1826	64 (52 to 75)	58 (44 to 71)
Other uterotonics	69	2 (1 to 11)	2 (1 to 7)
Additional interventions			
Blood transfusion			
Yes	636	-§	42 (24 to 62)
Blood units received (n=636)			
1	367¶	-§	58 (45 to 69)**
2	188	-§	30 (23 to 37)**
3–4	64	-§	10 (5 to 18)**
5 or more	10	-§	2 (1 to 3)**
Units unknown	7	-§	1 (0 to 3)**
Laparotomy(n=27)			
Done <3 hours from admission	9	-§	33 (12 to 64)
Done 3–12 hours from admission	14	-§	52 (21 to 81)
Performed after 12 hours of admission	4	-§	15 (5 to 36)

Pearson χ^2 was the statistical test used however we do not present the χ^2 or p value .

*Number of all women with each row characteristic.

†Proportion of severe abortion complications with row characteristic out of the total number of severe abortion complications, severe abortion complications also include the near-miss cases.

‡Proportion of abortion near-miss cases with row characteristic out of the total number of abortion near-miss cases.

§All patients who received additional interventions (blood transfusion and laparotomy) were near-miss cases.

¶Women who received only one unit of blood transfusion but had other near-miss criteria.

**Proportion of women who received each number of blood transfusions out of 636.

MVA, manual vacuum aspiration.

central region of the country. The Eastern region is characterised by a slightly younger age of sexual debut and higher unmet need for family planning which translates to increased unintended pregnancies.^{22 31 32} Previous evidence shows that the Eastern region has a huge burden of unintended pregnancies, 8% of them end in abortions and complications occur in 58% of the women.²² Family planning or postabortion contraception

is a key intervention to reduce unintended pregnancies and repeat unsafe abortions respectively, ultimately decreasing ANM and mortality. In addition, access to safe abortion within the confines of the law mitigates the negative effects of unsafe abortion.

Our health facility assessment in the two regions reveals that the Eastern region has less readiness to manage abortion complications such as fewer MVA kits—yet these are

Table 4 Background indicators, complications and management options of abortion near-miss cases by pregnancy trimester

Characteristic	Abortion near-miss Column % (95% CI)		Prevalence ratio* (95% CI)	P value†
	First trimester‡ N=589	Second trimester§ N=499		
Background indicators				
Mean age (SE)	27 (0.2)	26 (0.2)	0.99 (0.98 to 1.00)	0.17
Median no of pregnancies (IQR)	3 (2–6)	3 (2–5)	0.99 (0.97 to 1.01)	0.48
HIV status¶				
Negative	69 (56 to 79)	70 (56 to 82)	Ref	
Positive	4 (3 to 8)	5 (3 to 9)	1.10 (0.83 to 1.45)	0.52
Timing of complications				
At arrival or within 12 hours	98 (96 to 99)	95 (92 to 97)	Ref	
Developed after 12 hours	2 (1 to 4)	5 (3 to 8)	1.37 (1.07 to 1.76)	0.01
Referral status				
Not referred	82 (73 to 88)	79 (68 to 86)	Ref	
Referred	18 (12 to 27)	21 (14 to 32)	1.11 (0.87 to 1.42)	0.40
Type of health facility				
Hospital	44 (24 to 66)	52 (28 to 75)	Ref	
Health centre	56 (34 to 76)	48 (25 to 72)	0.85 (0.61 to 1.18)	0.32
Ownership of health facility				
Public	85 (69 to 94)	87 (84 to 90)	Ref	
Private	15 (6 to 31)	13 (5 to 29)	0.92 (0.74 to 1.14)	0.44
Complications and outcome				
Infection	15 (8 to 24)	17 (10 to 27)	1.08 (0.86 to 1.37)	0.49
Organ dysfunction	80 (68 to 88)	78 (68 to 86)	0.96 (0.80 to 1.16)	0.66
Management options				
Types of uterine evacuation				
Spontaneous expulsion	37 (20 to 59)	53 (37 to 69)	Ref	
Evacuation/MVA	62 (41 to 80)	45 (31 to 60)	0.69 (0.51 to 0.93)	0.02
Medical	0 (0 to 2)	2 (0 to 7)	1.49 (0.96 to 2.30)	0.07
Uterotonics administered				
Misoprostol	40 (27 to 55)	43 (29 to 59)	Ref	
Oxytocin	57 (43 to 70)	55 (39 to 70)	0.94 (0.78 to 1.15)	0.55
Other uterotonics	3 (1 to 10)	2 (1 to 5)	0.86 (0.53 to 1.39)	0.53
Laparotomy(n=27)				
Done <3 hours from admission	25 (3 to 76)	33 (4 to 85)	Ref	
Done 3–12 hours from admission	50 (9 to 91)	50 (10 to 90)	0.90 (0.25 to 3.23)	0.85
Performed after 12 hours of admission	25 (3 to 76)	17 (3 to 60)	0.75 (0.12 to 4.85)	0.73

*These are unadjusted prevalence ratio estimates for generalised linear models with binomial family and loglink.

†P value of the prevalence ratio when the null hypothesis of no difference between ANM in first and second trimester for the characteristic is true as extracted from the generalised model.

‡Proportion of near-miss cases in the first trimester with row characteristic.

§Proportion of near-miss cases in the second trimester with row characteristic.

¶HIV status missing for 32% (487/1507) of the near-miss cases.

MVA, manual vacuum aspiration.

critical in removing uterine contents to control bleeding following an abortion. In the event of referral, facilities in the Eastern region are less likely to have motorised

transport or a trained health provider accompany the referred woman to a higher health facility. Kananura *et al* report a profound lack of abortion services and MVA

Table 5 Health facility readiness for postabortion care (PAC) in 43 health facilities in central and eastern Uganda

Indicator	All health facilities n(%) N=43	Region n(%)		P value*
		Central N=28	Eastern N=15	
Uterotonics				
Misoprostol	18 (41.9)	9 (32.1)	9 (60.0)	0.075
Oxytocin	37 (86.1)	23 (82.1)	14 (93.3)	0.304
Manual vacuum aspirators	30 (69.8)	24 (85.7)	6 (40.0)	0.003
Intravenous fluids	40 (93.0)	25 (89.3)	15(100)	0.541
Parenteral antibiotics	37 (86.1)	25 (89.3)	12 (80.0)	0.647
Provision of PAC services 24/7	43 (100)	28 (100)	15 (100)	–
Motorised transport for referral	32 (74.4)	25 (89.3)	7 (46.7)	0.004
Health provider accompanying referral	18 (41.9)	15 (53.6)	3 (20.0)	0.034
Communication means	17 (39.5)	13 (46.4)	4 (26.7)	0.207
Blood transfusion services†	25 (64.1)	19 (67.9)	6 (54.6)	0.297
Surgical/laparotomy capability†	33 (84.6)	25 (89.3)	8 (72.7)	0.323

The indicators were measured for all 43 health facilities unless otherwise stated.

* χ^2 or Fischer's exact test done to compare PAC health facility readiness between the central and eastern regions.

†Only assessed for 39 health facilities that offer comprehensive emergency obstetric care services.

sets in 40 health facilities, ranging from Health Centre IIIs to hospitals, from three districts in the same region.³³ Inability to obtain EmOC at nearby health facilities due to lack of supplies and commodities, non-accompaniment to the next referral site using non-motorised means on bad terrain road infrastructure increases complication rates or death due to delay in accessing appropriate critical care.^{33–35}

SAM cases were 42% in first trimester and 31% in the second trimester; 2% of the women with SAM died in second trimester and 0.3% in the first trimester. The former could reflect the higher frequencies of pregnancies ending in the first trimester than in the second trimester; while the latter agrees with previous studies which show that mortality from abortion complications like bleeding and infection increases with gestation age.^{36–38} The Uganda national reproductive guidelines recommend use of surgical techniques, under general anaesthesia or heavy sedation by doctors for second trimester evacuations. It is worth noting that second trimester near-miss cases were less likely to have uterine evacuation compared with spontaneous expulsion. One possible explanation could be that second trimester abortions tend to be spontaneous hence the complete expulsion. However, it might as well reflect a gap in accessing surgical services overall for abortion cases. Only 85% of comprehensive EmOC facilities had surgical/laparotomy capability, this may delay patients to receive appropriate surgical care further increasing the severity of the complications with some ending as maternal deaths.

ANM is increased among referrals, who can be identified as high risk cases that require close monitoring. Unlike other studies where majority of maternal near-misses develop either before or at admission,³⁹ ANM mainly occurred

after 12 hours of admission showing that the cascade of near-miss and mortality can be disrupted if the quality of care is improved and the health facility/providers respond promptly to women who are already in their care.

Despite blood transfusion being a core component of the near-miss classification particularly in a condition such as abortion where massive haemorrhage occurs, over 39% of transfused patients were discharged with an Hb less than 70 g/L denoting severe anaemia according to WHO recommendations.⁴⁰ With only 64% of the comprehensive EmOC facilities able to offer blood transfusion services, this study and others in similar settings demonstrate the scarcity of blood products in low and middle income countries.^{14 26 41 42} We did not perform a comparative analysis using the WHO near-miss definition of massive transfusion of 5 blood units due to the small number of 17 cases that got a massive transfusion. We had done some more analysis on the cut-off in another paper published from this database.²⁷

Strengths and limitations

A strength of the study is a large data set of over 12800 women from the primary trial with severe maternal morbidity and mortality from 43 health facilities in 18 districts of the country, from which eligible records of those with 3315 severe abortion complications were extracted, enhancing the generalisability of the results. We used the WHO maternal near-miss tool. We modified the data collection tool to include severe abortion complications,⁴³ and amended the definition to include all those who received at least two units of blood transfusion.^{26 41 42} We acknowledge that some researchers cite discrepancies in reporting using modified WHO near-miss tool, however, with a clear reporting of the

methodology,⁴⁴ we believe that comparison with other studies should be possible. It is the first study to give a detailed description of sociodemographic, reproductive characteristics, clinical presentation and management options for ANM cases by pregnancy trimester. The data collection process lasted a period of 15 months negating effects of variations by seasons unlike most abortion morbidity studies that take a shorter duration, hence more accurate estimates.

The study had some limitations. Data abstraction from patient files may miss some information due to incomplete clinical records, for example, gestation age and HIV status, as cited in other studies. Regular supervision visits were done to provide constant reminders to staff on complete documentation and perform verification with the clinical records and ward registers for the filled tools with subsequent inclusion of the missing information. The data were prospectively collected to reduce risk of missing data. We did not collect information on all abortion cases admitted at these health facilities, so could not ascertain the total number of pregnancies that terminated in the first and second trimesters, and whether the abortions were spontaneous or induced. However, it is worth noting that the recommended standard of reporting ANM is per live births.²⁴

Interpretation

ANM and mortality evidence can be captured using the adapted WHO maternal near-miss criteria particularly in low-income settings. Women with second trimester abortion complications need urgent attention to avert severe abortion-related complications and deaths. Provision of essential drugs and supplies is crucial to averting abortion-related near-miss and deaths. We cannot infer causality as the prospective near-miss and the health facility data come from two different cross-sectional surveys. Still, our analysis indicates that the differences observed between the two settings underscore the importance of quality PAC services to address abortion-related mortality. Appropriately defined studies may further investigate into these associations.

CONCLUSION

We report an overall high ANMR and AMR, particularly in the Eastern region of the country; and a greater proportion of abortion-related deaths in second trimester. However, mortality is lower compared with studies done in similar settings. ANM is more likely among referrals. The second trimester near-miss is more likely to occur after 12 hours of admission, and less likely to have surgical uterine evacuation. Only three-quarters of health facilities in Uganda that provide comprehensive EmOC have functional blood transfusion services. This coupled with the moderate number of transfused patients at discharge still having severe anaemia shows that use of the adapted WHO near-miss criteria in low-income settings may be more applicable than the strict criteria.²⁷ There's a lack

of key supplies and commodities, for example, MVA kits, parenteral antibiotics and uterotonics like misoprostol which impede access to appropriate care. Policy-makers should strengthen primary prevention strategies like family planning and harm reduction strategies to reduce the burden of unintended pregnancy and resulting abortion complications. Life-saving drugs and supplies should be available in the health system and referral pathways strengthened to ensure patients access emergency appropriate care early. Finally, abortion maternal death and ANM audit should be implemented and arising recommendations instituted to curtail the vicious cycle of abortion morbidity and mortality.

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Author note Uganda has abortion severe morbidity, near-miss, and mortality ratios of 2063, 938 and 23 per 100 000 live births, respectively.

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