Abortion-related infections across 11 countries in Sub-Saharan Africa: Prevalence, severity, and management

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Abstract

Objective: To estimate the prevalence of infection among abortion-related complications in health facilities, describe their management, and identify sociodemographic and clinical factors associated with abortion-related infections.

Methods: A secondary analysis of the WHO Multi-Country Survey on Abortion-related morbidity (MCS-A) conducted in 210 health facilities of 11 Sub-Saharan African countries between 2017 and 2018. The outcome variable was abortion-related infections, categorized into three mutually exclusive groups of abortion-related complications: infections only, infection with other complications, and other complications without infection. We described the sociodemographic and clinical characteristics and the management of abortion-related infection and identified the factors associated with abortion-related infections using a multinomial logistic model.

Results: A total of 9232 women with abortion-related complications were included, with infection occurring among 10.6% of women (n = 974). Infection was involved in 47.4% (n = 153) of severe maternal outcomes with a case fatality rate of 27.4% (n = 42). The most common management approach was antibiotics, uterine evacuation, and uterotonic combined: 43.2% (n = 384) in the group of women with infection only and 48.6% (n = 4235) among those with infection and other complications. In addition, 85.9% (n = 7095) of women without infection also received therapeutic antibiotics. Factors associated with an increased odds of infection only compared with complications without infection were age younger than 20 years compared with those aged over 30 (aOR 1.84; 95% CI,1.24–2.74), not living in a couple (aOR 2.05, 95% CI,1.52–2.76), and gestational age of 13 weeks or more (aOR 1.70, 95% CI,1.27–2.26). The same factors were associated with infection and other complications.

Conclusion: Infection is frequent among severe abortion-related complications, and its case fatality rate is high. Further research to assess the relationship between abortion-related infections and outcomes is needed. There is also a need to question the quality of postabortion care and improve adequate use of antibiotics.

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1 | INTRODUCTION

In Sub-Saharan Africa, 75.6% of abortions are considered unsafe.\textsuperscript{1,2} Although unsafe abortions are more prone to complications, these can also arise from spontaneous or induced safe abortion. Abortion-related complications account for nearly 10% of maternal deaths in Africa.\textsuperscript{3} They usually include infections, hemorrhage, uterine perforation, and injuries.\textsuperscript{4,5} A global facility-based study found that post-abortion infection represents 9.5% of the global burden of maternal infections and 22.1% of complicated maternal infections.\textsuperscript{6}

Previous studies have been published on abortion-related severe maternal outcomes. For instance, in a cross-sectional study conducted in three provinces in Zambia, Owolabi et al.\textsuperscript{7} reported that 10% of near-miss cases had a septic shock. A hospital-based cross-sectional study in Central and Eastern Uganda also found that 16% of the severe cases had an infection.\textsuperscript{8} Furthermore, a study that included countries from Latin America, Asia, and Africa—with different levels of restriction in abortion-related laws and policies—found that infection was involved in 15.6% (7.8% infection and 7.8% infection and hemorrhage) of abortion-related severe maternal outcomes and 66.6% (for infection only or associated with hemorrhage) of abortion-related maternal deaths. Overall, according to the pooled estimate, infection was the most common cause of abortion-related maternal death.\textsuperscript{9} Although there are studies already published, the current body of evidence on postabortion maternal near miss and deaths in Sub-Saharan Africa is from a limited number of countries and used various designs or definitions of the concepts. The present study will contribute to improve the evidence to inform adequate management of postabortion infection.

The lack of evidence on abortion morbidity and mortality in Sub-Saharan Africa is due to measurement challenges related to reporting bias, stigma, and restrictive laws and policies in most countries.\textsuperscript{10} In addition, there is a need for standardization of the definitions used in the studies to assess the burden of abortion-related infections.\textsuperscript{11} The present analysis sought to contribute to bridging these gaps, especially in Sub-Saharan Africa, because previous studies have shown that complications, mainly infections, are more frequent in settings where access to abortion services is restricted.\textsuperscript{12,13} Consequently, the availability of Sub-Saharan Africa-specific data can improve the body of evidence on the burden of abortion-related infections in these settings where restrictive laws and policies do not facilitate reliable data collection.\textsuperscript{2,14} The aim of the present study was to estimate the prevalence of infections among abortion-related complications, identify factors associated with abortion-related infections, and describe the management using the World Health Organization Multi-Country Study on Abortion-related morbidity (MCS-A) dataset.

2 | MATERIALS AND METHODS

We carried out a secondary analysis of the MCS-A, a cross-sectional survey conducted in 210 health facilities in 11 Sub-Saharan African countries (Benin, Burkina Faso, Chad, the Democratic Republic of the Congo, Ghana, Kenya, Malawi, Mozambique, Niger, Nigeria, and Uganda). Data collection took place between February 2017 and April 2018.

Data on women seeking care for abortion-related complications (sociodemographic data, clinical information, obstetrics characteristics, signs and symptoms due to abortion-related complication, medical procedures, clinical outcomes, and vital status at discharge) including ectopic and molar pregnancies at the time of facility admission were abstracted from medical records, which were then entered into a web-based platform by research assistants at each facility. The procedures of the study are explained in more detail elsewhere.\textsuperscript{15} For the current analysis, only women with abortion-related complications were included. All participants were categorized into three groups, based on the levels of severity of the complications: severe maternal outcome (maternal deaths and near miss per the WHO definition),\textsuperscript{16,17} potentially life-threatening condition (severe hemorrhage, systemic infection, or uterine perforation), and moderate complications (bleeding, suspected intra-abdominal injury, and infection).\textsuperscript{15}

Women were classified based on their infection status within the severity categories. For moderate complications, infections were defined based on chills, fever, sweat, or a foul-smelling vaginal discharge with no life-threatening condition. For potentially life-threatening conditions, infections were based on the presence of systemic infection, which was defined in this study as fever, confirmed or suspected infection (septic abortion or endometritis), new/worsened altered mentation, respiratory rate of 22 or above, and systolic blood pressure less than or equal to 100.

Mild cases are presented in Annex IX of the paper by Qureshi et al.\textsuperscript{15} They were excluded from this analysis because they did not include infections or any of the other complications (they were based on abnormal signs from an initial physical examination).\textsuperscript{15} Abortion-related infections among women in the group of severe maternal outcomes were based on any of the infection signs or symptoms described above and death or the WHO criteria of near miss (cardiovascular, respiratory, renal, coagulation, hepatic, neurologic, or uterine dysfunction).\textsuperscript{15}

Our outcome of interest in this study was the presence of infection. However, the presence of infection only or in combination with other abortion-related complications might not have the same clinical outcomes. Therefore, we created an infection variable with three mutually exclusive categories based on the severity categories: (1) infection only; (2) infection and other complications; and (3) other complications only without infection. The other complications were either hemorrhage, uterine perforation, or intra-abdominal injury.
Less than 0.5% of medical record information indicated that the complications occurred after 24 h of facility stay. Consequently, complications in this study are considered to have occurred before admission or within 24 h of facility stay.\textsuperscript{15}

Sociodemographic characteristics of the women included age categorized into three groups (≥19, 20–29, and ≥30 years), living in a couple (with partner or spouse: yes or no), education level (none/preprimary, primary/secondary, and tertiary), and gainful occupation (yes or no). Obstetric history variables were the number of previous pregnancies (1, 2–3, and ≥4) and previous abortions (none and at least one).

Clinical characteristics were the following: the expulsion of product of conception before arrival to health facility (no or yes), gestational age (<13 or ≥13 weeks), length of hospital stay (≥2 or >2 days), and any chronic conditions (including hypertension, diabetes, HIV/AIDS, obesity, anemia, mental illness, heart disease, lung disease, and renal disease).

For management-related variables, we first computed a variable treatment with mutually exclusive categories to assess the utilization of therapeutic antibiotics, uterotonics, and uterine evacuation. The different categories were antibiotic only, uterotonics and antibiotic, uterine evacuation, antibiotics, all three, and other procedures. In addition, the following variables were coded as “yes” or “no”: transfusion of blood products, hysterectomy, exploratory laparotomy, and intensive care unit (ICU) admission.

We used descriptive statistics (percentages) to explore sociodemographic and clinical characteristics and the management in the different infection groups. The $\chi^2$ test was used to compute the $P$ values and assess the association between the independent and outcome variables in the bivariate analysis.

The case fatality rate was computed as the percentage of deaths among the severe maternal outcomes among women with and without infection. Sociodemographic and clinical factors associated with abortion-related infections were identified using a multivariate multinomial logistic regression model to determine adjusted odds ratios (aOR). We used a stepwise approach in the modelling process by considering all variables of $P < 0.20$, except for education level, which was removed owing to the high proportion of missing observations and correlation with gainful occupation. Place of residence was forced into the model because of information available in the literature, and it improved the goodness of fit. Variables with high $P$ values were then removed from the model one by one, and the fitness was assessed using Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC). The most parsimonious model with the lowest AIC and BIC was considered as the final model and is presented in the results section.

We compared infection only and infection with other complications categories with other complications only as the reference category of the outcome variable. All the estimates were adjusted for country, and the standard errors were also estimated with an adjustment for facility-level data clustering, using the “cluster” option in Stata. All the analyses were performed using Stata 15.1 (StataCorp, College Station, TX, USA).

The protocol of the MCS-A was submitted to and approved by the WHO Ethical Review Committee. Each participating country also obtained ethical approval from their national or institutional review board before the start of the study.

3 | RESULTS

We analyzed data for 9232 women with abortion-related complications. Overall, 15.5% ($n = 1410$) and 49% ($n = 4468$) were younger than 20 years and between 20 and 30 years, respectively. Nearly three-quarters (73.4%, $n = 6343$) were living in a couple. The prevalence of infection was 10.6% ($n = 974$): 4.2% ($n = 384$) with infection only and 6.4% ($n = 590$) with infection and other types of complications (Table 1). The complications associated with infection in the group of the 590 women who were bleeding or severe hemorrhage (92.4%, $n = 545$), intra-abdominal injury (34.6%, $n = 204$), and uterine perforation (6.1%, $n = 36$).

The distribution by severity level presented in Figure 1 shows that 3.5% ($n = 323$) of women experienced severe maternal outcomes, and 10.4% ($n = 957$) had potentially life-threatening conditions. Infection (only or associated with other complications) represented 47.4% ($n = 153$) of the severe maternal outcomes, 34.2% ($n = 327$) of women who had potentially life-threatening conditions, and 6.2% ($n = 494$) of the moderate complications. Among the 153 severe maternal outcomes with infection, the case fatality rate was 27.4% ($n = 42$, 95% CI, 19.0–37.2). In contrast, among the 170 severe maternal outcomes without infection, the case fatality rate was 10% ($n = 17$, 95% CI, 5.6–16.1).

Table 2 describes the clinical factors; 52.2% ($n = 199$) of women with infection only and 49.8% ($n = 291$) of women with infection and other complications were admitted with the products of conception expelled before arrival. The gestational age was greater or equal to 13 weeks in 50.8% ($n = 162$) of those with infection only and 45.5% ($n = 207$) of those with infection and other complications. Overall, participants’ clinical characteristics were significantly different across the three groups (infection only, with other complications, and other complications only, $P < 0.001$) except for the presence of chronic conditions (Table 2).

Table 3 shows the sociodemographic characteristics associated with an increased odds of infection only. Age younger than 20 years compared with more than 30 years (aOR 1.84; 95% CI, 1.24–2.74) and not living in a couple (aOR 2.05; 95% CI, 1.52–2.76) were associated with increased odds of having infection only. Regarding clinical characteristics, women with a gestational age of 13 weeks or more (compared with less than 13 weeks) had 1.7 (aOR 1.70, 95% CI, 1.27–2.26) times higher odds of infection only and 1.6 (aOR 1.58; 95% CI, 1.25–1.99) times higher odds of infection with other complications, compared with women without infection.

Table 4 shows data on the management of abortion-related complications and statistical differences in management approaches across the different groups. Most women with infection only (91.4%, $n = 351$) and infection and other complications (90.7%, $n = 535$)
received therapeutic antibiotics. Although there was a statistical difference between infection groups and those without infection, even among women without infection, the majority (85.9%, n = 7095) received therapeutic antibiotics. The most common management approach combined antibiotics, uterine evacuation, and uterotonics for 43.2% (n = 384) of women with infection only and 48.6% (n = 4235) of women with infection and other complications. We also noted that uterotonics and uterine evacuation were mainly used for the group without infection: 71.2% (n = 5883) and 76.9% (n = 6350), respectively. Dilatation and curettage was utilized for 33.3% (n = 90) of women with infection only, 21.8% (n = 88) of women with infection associated with other complications, and 18.4% (n = 1165) of those without infection (P < 0.001). Manual vacuum aspiration was used for 60.4% (n = 163), 72.5% (n = 293), and 74.7% (n = 4739) of women with infection only, infection with other complications, and women without infection, respectively.

Blood transfusion was required for 19% (n = 72) of women with infection only, 33% (n = 195) of those with infection and other complications, and 9% (n = 741) of women without infection (P < 0.001).

4 | DISCUSSION

Overall, we found that one in 10 women presenting at facilities with abortion-related complications had an infection. The more severe the complication, the more likely the diagnosis of infections. The case fatality rate was higher among women with severe outcomes associated with infection (27.4%) than those without infection (10%). Women’s age, marital status, and gestational age were associated with postabortion infection. Furthermore, women received various forms of treatment for abortion-related infections. Almost half of them received a combination of antibiotics, uterotonics, and uterine evacuation, and nearly all women, including those without infection, received therapeutic antibiotics. Blood transfusion, hysterectomy, laparotomy, and ICU

| TABLE 1 Sociodemographic characteristics and obstetric history by type of abortion-related complications |
| --- |
| Characteristics | Total | Abortion-related infection only | Abortion-related infection and other complications | No abortion-related infection | P value |
| --- | --- | --- | --- | --- | --- |
| All women | 9232 | 384 (4.2) | 590 (6.4) | 8258 (89.4) |  |
| Place of residence |  |  |  |  |  |
| Urban | 6630 | 283 (4.3) | 418 (6.3) | 5929 (89.4) | 0.623 |
| Rural | 2602 | 101 (3.9) | 172 (6.6) | 2329 (89.5) |  |
| Age groups, years (n = 9125) |  |  |  |  |  |
| ≤19 | 1410 | 107 (7.6) | 106 (7.5) | 1197 (84.9) | <0.001 |
| 20–29 | 4468 | 174 (3.9) | 306 (6.8) | 3988 (89.3) |  |
| ≥30 | 3247 | 96 (3.0) | 173 (5.3) | 2978 (91.7) |  |
| Living in a couple (n = 8533) |  |  |  |  |  |
| No | 2190 | 152 (6.9) | 215 (9.8) | 1823 (83.2) | <0.001 |
| Yes | 6343 | 202 (3.2) | 339 (5.3) | 5802 (91.5) |  |
| Education level (n = 6956) |  |  |  |  |  |
| None/preprimary | 1260 | 53 (4.2) | 87 (6.9) | 1120 (88.9) | 0.129 |
| Primary/secondary | 4695 | 206 (4.4) | 320 (6.8) | 4169 (88.8) |  |
| Tertiary | 1001 | 28 (2.8) | 58 (5.8) | 915 (91.4) |  |
| Gainful occupation (n = 7923) |  |  |  |  |  |
| No | 4166 | 216 (5.2) | 317 (7.6) | 3633 (87.2) | <0.001 |
| Yes | 3757 | 113 (3.0) | 202 (5.4) | 3442 (91.6) |  |
| Number of previous pregnancies (n = 9025) |  |  |  |  |  |
| 1 | 2400 | 145 (6.0) | 167 (7.0) | 2088 (87.0) |  |
| 2–3 | 3373 | 116 (3.4) | 191 (5.7) | 3066 (90.9) | <0.001 |
| ≥4 | 3252 | 109 (3.4) | 225 (6.9) | 2918 (89.7) |  |
| Number of previous abortions (n = 6459) |  |  |  |  |  |
| None | 4108 | 140 (3.4) | 262 (6.4) | 3706 (90.2) | 0.968 |
| At least one | 2351 | 82 (3.5) | 147 (6.2) | 2122 (90.3) |  |

Other complications such as bleeding, severe hemorrhage, uterine perforation, and intra-abdominal injury, or organ dysfunction without infection.

The pregnancy that ended after the abortion is counted as a previous pregnancy.
admission were also mostly used in the groups of women with infection only and infection and other complications, compared with those without infection.

Although infection is not the leading postabortion complication, our results suggest that it is frequent in more severe abortion-related complications, including severe maternal outcomes and potentially life-threatening conditions. This is in line with findings from previous studies on maternal morbidity. It is also consistent with the management of complications; the more invasive options (blood transfusion, hysterectomy, laparotomy, and ICU) were mostly used in the groups with infection only and with other complications.

The variety of definitions of complications, including infection, across the literature, limits the comparability of the estimates of...

TABLE 2 Clinical characteristics of the participants by type of abortion-related complications

| Clinical characteristics | Total | Abortion-related infection only | Abortion-related infection and other complications | No abortion-related infection | P value |
|--------------------------|-------|---------------------------------|--------------------------------------------------|-----------------------------|---------|
|                          |       | No. (%)                         | No. (%)                                         | No. (%)                     |         |
| Expulsion of the product of conception before arrival (n = 9204) |       |                                 |                                                 |                             |         |
| No                       | 4447  | 148 (3.3)                       | 239 (5.4)                                       | 4060 (91.3)                 | <0.001  |
| Yes                      | 3987  | 199 (5.0)                       | 291 (7.3)                                       | 3497 (87.7)                 |         |
| Unknown                  | 770   | 34 (4.4)                        | 54 (7.0)                                        | 682 (88.6)                  |         |
| Gestational age, weeks (n = 7483) |       |                                 |                                                 |                             |         |
| <13                      | 4779  | 157 (3.3)                       | 248 (5.2)                                       | 4374 (91.5)                 | <0.001  |
| ≥13                      | 2704  | 162 (6.0)                       | 207 (7.7)                                       | 2335 (86.3)                 |         |
| Length of hospital stay, d (n = 9126) |       |                                 |                                                 |                             |         |
| ≤2                       | 7361  | 209 (2.8)                       | 334 (4.5)                                       | 6818 (92.6)                 | <0.001  |
| >2                       | 1765  | 170 (9.6)                       | 253 (14.3)                                      | 1342 (76.0)                 |         |
| Any chronic conditionb (n = 9232) |       |                                 |                                                 |                             | 0.104   |
| No                       | 8725  | 360 (4.1)                       | 547 (6.3)                                       | 7818 (89.6)                 |         |
| Yes                      | 507   | 24 (4.7)                        | 43 (8.5)                                        | 440 (86.8)                  |         |

*a*Other complications include bleeding, severe hemorrhage, uterine perforation, and intra-abdominal injury, or organ dysfunction without infection.

*b*Any of HIV/AIDS, hypertension, diabetes, obesity, lung disease, heart disease, and anemia.
the percentage of infection among abortion-related complications and across severity groups. A review by Calvert et al. showed the heterogeneity between studies on abortion-related complications due to infection. Nevertheless, they reported that 2.8%, 17%, and 18.3% of hospital admissions with complications were due to near miss infection, severe infection, and unspecified or not a severe infection, respectively. This variety of definitions used in measuring the burden of abortion-related infection suggests a need for standardization. The following studies also illustrate the difficulties in comparing findings. Atuhairwe et al. defined severe abortion complications as organ dysfunction, severe sepsis, blood transfusion, or laparotomy. They found that infection represented 7% of all complications and 16% of near miss in Uganda. Meanwhile, Ratovoson et al. reported from a household survey that 29.1% of abortions in Madagascar presented signs of potential infection, which was defined as the presence of foul-smelling vaginal discharge, fever, or chills. While the definition used for infection at the level of moderate complication is similar, the data sources are different, and our prevalence across multiple countries is much lower. Furthermore, Kalliani-Phiiri et al. reported that sepsis represented 13.7% of all abortion-related complications in Malawi. This could be comparable to the overall percentage of infection found in our study (10.6%), except that the infections included in our study, particularly in moderate complications, are not restricted to sepsis. Finally, Melese et al. showed that among the postabortion complications received in four hospitals in Botswana, offensive discharge, tender uterus, and septic shock represented 17.9%, 11.3%, and 3.9%, respectively. These studies have reported various prevalence measures of postabortion infections, partly because of the differences in the methods used. In addition, these estimates are mainly based on single facility study. Ensuring comparability through the adoption of standard measurement seems essential.

In terms of management, we noted that dilatation and curettage was utilized for one-third of women with infection only and 21.8% of women with infection associated with other complications. Meanwhile, manual vacuum aspiration was used for 60.4% and 72.5% of women with infection only and infection and other complications, respectively. These findings suggest that although dilatation and curettage is still used for many women with infection, overall, health professionals tend to utilize manual vacuum aspiration instead. This practice shows efforts toward compliance with the WHO recommendations and contributes to treating and preventing abortion-related infections. We also found inadequate use of antibiotics: many women without infection were treated with therapeutic antibiotics. The reasons for this systematic utilization of antibiotics should be explored and addressed to promote best practice and rational use, which will help avoid or delay antimicrobial resistance.

Evidence on the relationship between sociodemographic and clinical factors with abortion-related infections is scarce in the literature. Our study found that women of younger age, gestational

| Variable | Abortion-related infection only | Abortion-related infection and other complications |
|----------|--------------------------------|-----------------------------------------------|
|          | aOR<sup>c</sup> | 95% CI | P value | aOR<sup>c</sup> | 95% CI | P value |
| Location | Rural | ref |  |  |  |
|          | Urban | 1.39 | 0.86–2.25 | 0.181 | 0.88 | 0.58–1.34 | 0.552 |
| Age, years |  |  |  |  |  |  |  |
| 1≤19 | 1.84 | 1.24–2.74 | 0.002 | 1.26 | 0.89–1.79 | 0.192 |
| 20–29 | 1.20 | 0.89–1.62 | 0.228 | 1.36 | 1.08–1.71 | 0.009 |
| ≥30 | ref |  |  | ref |  |  |  |
| Living in couple |  |  |  |  |  |  |  |
| Yes | 2.05 | 1.53–2.76 | <0.001 | 1.85 | 1.39–2.45 | <0.001 |
| No | ref |  |  | ref |  |  |  |
| Any chronic disease<sup>d</sup> |  |  |  |  |  |  |  |
| Yes | 1.01 | 0.55–1.84 | 0.976 | 1.12 | 0.73–1.72 | 0.595 |
| No | ref |  |  | ref |  |  |  |
| Gestational age, weeks |  |  |  |  |  |  |  |
| <13 | ref |  |  | ref |  |  |  |
| ≥13 | 1.70 | 1.27–2.26 | 0.001 | 1.58 | 1.25–1.99 | <0.001 |

<sup>a</sup>The reference category of the outcome variable is the group of women with other complications.
<sup>b</sup>Other complications include bleeding, severe hemorrhage, uterine perforation, and intra-abdominal injury, or organ dysfunction without infection.
<sup>c</sup>Country included in the model for adjustment and standard errors was adjusted for hospital-level clustering using the cluster command in Stata.
<sup>d</sup>Any of HIV/AIDS, hypertension, diabetes, obesity, lung disease, heart disease, and anemia.
The differences in the clinical practices could have introduced biases in classifying the participants in the severity and infection groups. Finally, the information on whether the abortion was spontaneous or induced and the variable on the methods used for induced abortions were not used in this study. Women’s self-reports on abortion to healthcare providers, as captured from medical records, are not reliable in a restrictive context where women may be reluctant to report an induced abortion.

While our results indicate that infection is not the leading complication, it is frequent among severe postabortion complications, and has a higher case fatality rate than other complications. In addition, therapeutic antibiotics appeared to be used for women without infection. These findings indicate a need to improve the prevention, early detection, and management of women with abortion-related infections in health facilities via evidence-based practices.

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**CONFLICT OF INTEREST**
AB received funding from the HRP Alliance to complete his PhD. Other authors declare no conflicts of interest.

**AUTHORS CONTRIBUTION**
AB, MB, HM, and SK conceptualized the study and outlined the methods. AB performed the analysis and proposed the first draft. HM and MB critically reviewed the methodology, analysis, and first draft. HM, MB, KA, RC, FAB, PG, ATM, CRK, and SK reviewed all manuscript versions.

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**REFERENCES**
1. Bearak J, Popinchalk A, Ganatra B, et al. Unintended pregnancy and abortion by income, region, and the legal status of abortion: estimates from a comprehensive model for 1990–2019. *Lancet Glob Health.* 2020;8:e1152-e1161.
2. Ganatra B, Gerdzs C, Rossier C, et al. Global, regional, and subregional classification of abortions by safety, 2010–14: estimates from a Bayesian hierarchical model. *Lancet.* 2017;390:2372-2381.
3. Say L, Chou D, Gemmill A, et al. Global causes of maternal death: a WHO systematic analysis. *Lancet Glob Health.* 2014;2:e323-e333.
4. Sajadi-Ernazarova KR, Martinez CL. *Abortion Complications.* StatPears Publishing; 2020.
5. Niinimäki M, Pouta A, Bloigu A, et al. Immediate complications after medical compared with surgical termination of pregnancy. *Obstet Gynecol.* 2009;114:795-804.
6. Bonet M, Brizuela V, Abalos E, et al. Frequency and management of maternal infection in health facilities in 52 countries (GLOSS): a 1-week inception cohort study. *Lancet Glob Health.* 2020;8:e661-e671.
7. Owolabi OO, Cresswell JA, Vwalika B, Osrim D, Filippi V. Incidence of abortion-related near-miss complications in Zambia: cross-sectional study in Central, Copperbelt and Lusaka Provinces. *Contraception.* 2017;95:167-174.
8. Atuhairwe S, Gemzell-Danielsson K, Byamugisha J, Kaharuza F, Tumwesigye NM, Hanson C. Abortion-related near-miss morbidity and mortality in 43 health facilities with differences in readiness to provide abortion care in Uganda. *BMJ Glob Health.* 2021;6:e003274.
9. Dragoman M, Sheldon W, Qureshi Z, et al. Overview of abortion cases with severe maternal outcomes in the WHO Multicountry Survey on Maternal and Newborn Health: a descriptive analysis. *BJOG.* 2014;121:25-31.
10. Redinger A, Nguyen H. *Incomplete abortions.* StatPears Publishing; 2021.
11. Filippi V, Dennis M, Calvert C, et al. Abortion metrics: a scoping review of abortion measures and indicators. *BMJ Glob Health.* 2021;6:e003813.
12. Calvert C, Owolabi OO, Yeung F, et al. The magnitude and severity of abortion-related morbidity in settings with limited access to abortion services: a systematic review and meta-regression. *BMJ Glob Health.* 2018;3:e000692.
13. Agnes G, Rossier C. Abortion around the world: an overview of legislation, measures, trends, and consequences. *Popul E.* 2018;72:217-306.
14. Rouse CE, Eckert LO, Muñoz FM, et al. Postpartum endometritis and infection following incomplete or complete abortion: case definition & guidelines for data collection, analysis, and presentation of maternal immunization safety data. *Vaccine.* 2019;37:7585-7595.
15. Qureshi Z, Mehrtash H, Kouanda S, et al. Understanding abortion-related complications in health facilities: results from WHO multicountry survey on abortion (MCS-A) across 11 Sub-Saharan African countries. *BMJ Glob Health.* 2021;6:e003702.
16. World Health Organization. *Evaluating the Quality of Care for Severe Pregnancy Complications: the WHO Near-Miss Approach for Maternal Health.* WHO; 2011.
17. Souza JP, Cecatti JG, Haddad SM, et al. The WHO Maternal Near-Miss Approach and the Maternal Severity Index Model (MSI): tools for assessing the management of severe maternal morbidity. *PLoS One.* 2012;7:e44129.
18. The Royal College of Obstetricians and Gynaecologists (RCOG). *The Care of Women Requesting Induced Abortion Evidence-based Clinical Guideline Number 7.* RCOG Press; 2011.
19. Adler AJ, Filippi V, Thomas SL, Ronsmans C. Incidence of severe acute maternal morbidity associated with abortion: a systematic review. *Trop Med Int Health.* 2012;17:177-190.
20. Ratovoson R, Kunkel A, Rakotovao JP, et al. Frequency, risk factors, and complications of induced abortion in ten districts of Madagascar: results from a cross-sectional household survey. *BMC Womens Health.* 2020;20:96.
21. Kailiaini-Phiri L, Gebreselasie H, Levandowski BA, Kachingale E, Kachale F, Kangaude G. The severity of abortion complications in Malawi. *Int J Gynecol Obstet.* 2015;128:160-164.
22. Melese T, Habte D, Tsima BM, et al. High levels of post-abortion complication in a setting where abortion service is not legalized. *PLoS One.* 2017;12:e0166287.
23. World Health Organization, editor. Safe Abortion: TECHNICAL and Policy Guidance for Health Systems, 2nd edn. WHO; 2012.
24. Udoh A, Effa EE, Oduwole O, Okusanya BO, Okafo O. Antibiotics for treating septic abortion. *Cochrane Database Syst Rev.* 2016;(7):CD011528.

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