

# Factors Associated with Maternal Near-Miss (MNM) Among Women in Eastern Province, Rwanda

\*<sup>1</sup>Theogene Uwizeyimana; <sup>2</sup>Mojeed Gbadamosi

<sup>1</sup>Student, Department of Public Health, Mount Kenya University, Rwanda

<sup>2</sup>Lecturer, School of Public Health, University of Rwanda

\*Email of the Corresponding Author: [uwizeyimanatheogene@gmail.com](mailto:uwizeyimanatheogene@gmail.com)

DOI: 10.47760/cognizance.2023.v03i11.004

## Abstract:

The World Health Organization (WHO) defines Maternal Near-Miss (MNM) as a situation where a woman nearly dies but survives a life-threatening condition during pregnancy and childbirth. Maternal mortality rate, used to gauge obstetric care quality globally, can aid in achieving the SDG target 3.1, which aims to lower the global maternal mortality ratio below 70 per 100,000 live births. A retrospective cross-sectional design was employed to assess the prevalence and factors associated with MNM at Kirehe District Hospital in Rwanda. 350 women admitted to the hospital's maternity units from January to December 2020 were sampled. Data from patients' medical records was extracted, focusing on demographics, MNM characteristics based on WHO criteria, and clinical outcomes. Statistical analysis was performed with SPSS version 21. Women aged 20-29 constituted the majority, primarily with primary education and working in agriculture. From the 350, 6.3% encountered severe postpartum haemorrhage, 3.1% severe preeclampsia, and 2% uterine rupture. 53.7% underwent cesarean section, 38.9% had vaginal deliveries, and 4.9% experienced abortion. The MNM prevalence for 2020 was 10.2%. Age and marital status correlated with MNM; younger, married, or widowed women exhibited higher MNM rates. Among maternal factors, only labor duration significantly related to MNM. The MNM rate at Kirehe District Hospital remains a concern. Cesarean section was predominant. Age and marital status played pivotal roles in MNM occurrences. Access to enhanced maternal healthcare and improved labor monitoring can mitigate severe complications.

**Keywords:** *Maternal Near-Miss Women Eastern Province, Rwanda*

## 1.0 Background

During pregnancy and childbirth, the World Health Organization (WHO) defines maternal near-miss (MNM) as a woman who nearly died but survived a life-threatening condition (WHO, 2012). The majority of MNM cases occur during the intrapartum and postpartum periods and are primarily caused by preventable or treatable conditions such as hemorrhages, infections, and eclampsia, among others (Kalisa et al., 2016). Maternal mortality rate is one of the metrics used to assess the quality of a country's maternity care system. The World Health Organization (WHO) defines maternal near-miss (MNM) as a medical condition that affects pregnant mothers and their unborn children. The Maternal-Newborn Medicine (MNM) system standardizes the classification of medical conditions that affect pregnant mothers and their babies. This system can help to monitor and improve the overall quality of obstetric care for patients (Say et al., 2009). The MNM concept was born out of the urgent need for pregnant women with serious complications to receive the best possible care. All maternal deaths are thought to be caused by at least one life-threatening illness or organ malfunction. As of 2020, Rwanda's maternal mortality rate was 203 deaths per 100,000 women, down from 1071 deaths per 100,000 in 1992 (Benimana et al., 2018). This achievement was made possible by strong government investment in a well-organized community-based health program, performance-based funding, and innovation and technological integration in health services (Kalisa et al., 2016).

The WHO/MNM method has been adopted into standard practice and is used by researchers to measure the quality of obstetric care in various hospitals throughout the nation (Benimana et al., 2018; Kalisa et al., 2016). A study investigating the preventability of MNM at University Teaching Hospital of Kigali (CHUK) revealed that delayed or missing blood supply was mainly accountable for 5.8 percent of preventable MNM cases and 2.5 percent of preventable deaths. It also indicated that the most common diseases linked to MNM and death were severe systemic infection, postpartum hemorrhage, and hypertensive disorders (severe preeclampsia/eclampsia) (Benimana et al., 2018). Other studies have found that hemorrhage and hypertension are the most common MNM conditions in a Ruhengeri district hospital, followed by eclampsia, which is the leading cause of maternal mortality, and sepsis/peritonitis following cesarean section has a high mortality index (Kalisa et al., 2016). Available studies have been assessing maternal mortality and the quality of obstetric care using MNM characteristics in different hospitals in Rwanda (Benimana et al., 2018; Kalisa et al., 2016; Rulisa et al., 2015; Rwabizi et al., 2016). However, no available study has been done to assess the MNM characteristics and associated factors at Kirehe district hospitals.

These two hospitals have been following the WHO/MNM approach in implementing obstetric care services, and hence the results of this study will be helpful to the hospital administrations, Ministry of Health, and other partnering organizations to evaluate quality of obstetric care at these hospitals using MNM approach. The aim of this study is to assess the prevalence and factors associated with maternal near-miss (MNM) at Kirehe District hospital in eastern province of Rwanda. The results of this study will be helpful to the hospital administration, ministry of health, and other partnering organizations to evaluate the quality of obstetric care at this hospital using the MNM approach.

## 2.0 Methodology

The study on Maternal Near-Miss (MNM) complications in women admitted to Kirehe district hospital's maternity units in 2020 employs a retrospective cross-sectional design and a quantitative methodology. The hospital in Rwanda's Eastern Province was chosen for its effective information management system. The target population consists of 3,517 women, mostly from rural areas, who used maternity services. 359 women were chosen at random as the study sample, with a focus on those who met WHO criteria for MNM complications such as obstructed labor and hemorrhage. Data was collected electronically using a structured extraction form completed by a trained nurse and the researcher. The data analysis was thorough, with IBM SPSS software used for various statistical analyses. Descriptive statistics summarized demographics and MNM characteristics, whereas more complex tests, such as Chi-square and binary logistic regression, were used to assess associations and identify contributing factors to MNM. The standard for statistical significance was a p-value less than 0.05. This methodical approach to data collection and analysis ensures a high level of reliability and validity, making the study an important contribution to our understanding of MNM complications in maternity care.

## 3.0 Findings and Discussion

This study recruited a total of 350 women. The average age of the participants was 27.81, with a maximum age of 57 and a minimum age of 16. 7.36 was the standard deviation. The majority of study participants (53.4%) were between the ages of 20 and 29 years old, had a primary level of education (66.3%), and were married (86.6%). Eighty-eight percent of those who took part in the study were farmers or laborers.

**Table 1: Socio-Demographic Characteristics of Women**

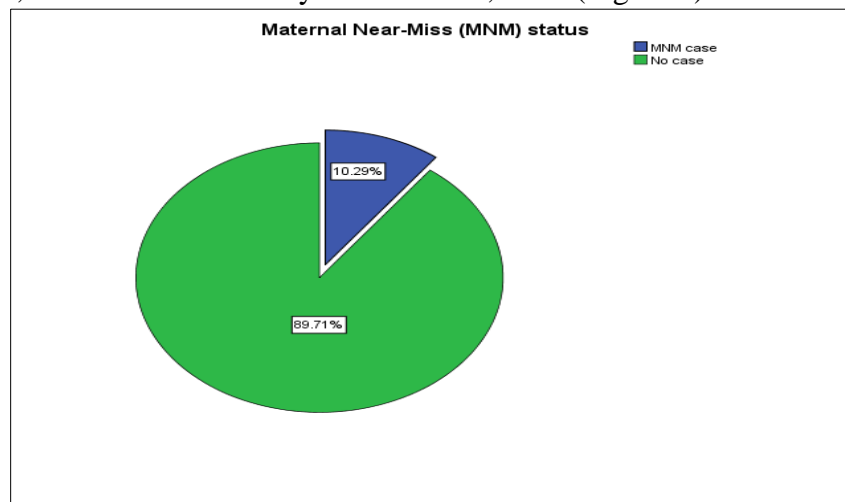
Variables	Frequency (n=350)	Percentage (%)
Age		
Less than 19	38	10.9
20-29	187	53.4
Greater than 30	125	35.7
Education		
No formal education	50	14.3
Primary	232	66.3
Secondary	63	18
University and above	5	1.4
Marital Status		
Single	47	13.4
Married	302	86.3
Widowed	1	0.3

Occupational Status		
Farmer/Laborer	308	88
Government Officer/Private	1	0.3
Other	41	11.7

In the 350 women who participated in the study, 22 (6.3%) experienced severe post-partum hemorrhage, 11 (3.1%) experienced severe preeclampsia, 7 (2%) experienced uterus rupture during or before delivery, 6 (1.7%) and 4 (1.1%) had sepsis and eclampsia, respectively. For the organ dysfunction and/or life-threatening conditions, 4% (n=14) of women experienced cardiovascular dysfunction, followed by 3.7% (n=13) who had respiratory dysfunction. A total number of 12 (3.4%) had hematological dysfunction, with 2.9% (n=10) having both liver and neurologic dysfunctions, and 2.6% (n=9) presented with uterine dysfunction. Obstetric hemorrhage was experienced by 13 (3.7%) women, hypertensive disorder 7(2%), pregnancy related infection 10 (2.9%), while other obstetrical complication accounted for 0.6% (n=2) of the MNM events. Additionally, 5.4% of women were HIV positive, 1.7% had malaria and 2.9% experienced prolonged obstetric labor.

### Prevalence of MNM cases among women delivered at Kirehe District Hospital, Rwanda, January to December 2020.

The prevalence of maternal near miss among women was presented by the percentage of women who experienced any of the MNM events, that includes severe maternal complications and/or organ dysfunction during pregnancy or with 42 days after delivery. The results are presented in figure 4.1 below. Based on diseases specific/or severe complications and/or organ dysfunction complications experienced by women, the prevalence of MNM is 10.2% (n=36) in Kirehe District hospital, Rwanda from January to December, 2020 (Figure 1).



**Figure 1: Prevalence of MNM cases among women delivered at Kirehe District hospital, Rwanda, January – December 2020.**

**Table 2. Distribution of Maternal Near-Miss**

Variable	Maternal Near Miss Status				Chi-square	p-value
	Near Miss		Non-Near Miss			
	n	%	n	%		
<b>Age (years) (n= 350)</b>					12.563	<b>0.002</b>
<19	3	7.9	35	92.1		
20 - 29	29	15.5	158	84.5		
≥30	4	3.2	121	96.8		
<b>Education (n=350)</b>					0.910	0.635
No former education	7	14.0	43	86.0		
Primary	22	9.5	210	90.5		
Secondary or higher	7	10.3	61	89.7		
<b>Marital status (n=350)</b>					3.916	<b>0.048</b>
Single	1	2.1	46	97.9		
Married/widowed	35	11.6	268	88.4		
<b>Occupation (n=350)</b>					0.828	0.363
Farmer/laborer	30	9.7	278	90.3		
Others	6	14.3	36	85.7		

Table 2 provides information on the distribution of maternal near miss status among different demographic factors. The proportion of maternal near miss was 7.9% among women aged <19 years, 15.5% among those aged 20-29 years, and 3.2% among those aged ≥30 years. Among women with no former education, 14.0% had maternal near miss, compared to 9.5% of those with primary education and 10.3% of those with secondary or higher education. Maternal near miss was found to be more common among women who were married or widowed (11.6%) than among single women (2.1%). Among women who were farmers or laborers, 9.7% had maternal near miss, compared to 14.3% with other occupations. However, these differences were not statistically significant except for marital status (Chi-square=3.916, *p*-value = 0.048) and age (Chi-square=12.563, *p*-value = 0.002).

**Table 3. Distribution of Maternal Near-Miss according to maternal factors of women in Kirehe District Hospital, Rwanda, January – December 2020.**

Variable	Near Miss		Non-Near Miss		Chi-square	p-value
	n	%	n	%		
Gravida					5.129	0.077
1	6	5.7	99	94.3		
2 - 4	28	13.3	183	86.7		
≥5	2	5.9	32	94.1		

Parity					4.013	0.134
0	2	6.9	27	93.1		
1	10	7	133	93		
≥2	24	13.5	154	86.5		
Gestational age (weeks)					3.342	0.068
<28	29	9.3	284	90.7		
≥28	7	18.9	30	81.1		
Number of ANC visit					0.015	0.902
1 - 3 visits	31	10.4	268	89.6		
≥4 visits	5	9.8	46	90.2		
Labour duration					9.652	0.002
5 hours	20	17.5	94	82.5		
≥5 hours	16	6.8	220	93.2		

Table 3. presents the distribution of maternal near miss based on various maternal factors including gravida, parity, gestational age, number of ANC visits, and labor duration. There is a statistically significant association between maternal near-miss and labor duration (Chi-square = 9.652,  $p$ -value = 0.002). However, there is no statistically significant association between maternal near miss status and gravida (Chi-square = 5.129,  $p$ -value = 0.077), parity (Chi-square = 4.013,  $p$ -value = 0.134), gestational age (Chi-square = 3.342,  $p$ -value = 0.068), or the number of ANC visits (Chi-square = 0.015,  $p$ -value = 0.902).

#### 4.0 Discussion

This study aimed to determine prevalence and maternal factors associated with maternal near-miss at Kirehe District hospital in eastern province of Rwanda. The present study findings show that most study participants were between the ages of 20 and 29 years (53.4%); had primary level education 232 (66.3%); and were married (86.6%). Eighty-eight per cent of the study participants were farmers or laborers. On severe complications/potentially life-threatening conditions, the study found that severe post-partum hemorrhage was the most common complication experienced by pregnant women in the present study, followed by severe preeclampsia and eclampsia. These findings are consistent with previous studies conducted in Africa that have reported that severe bleeding is a major contributor to maternal morbidity and mortality. For instance, a study conducted in Ghana by Mote *et al.* (2010) reported that hemorrhage was the leading cause of maternal death in the country (Mote *et al.*, 2010). Another study conducted in Nigeria found that post-partum hemorrhage was the most common cause of maternal morbidity and mortality (Ajenifuja *et al.*, 2010). These findings are consistent with a study conducted in Uganda that reported severe post-partum hemorrhage (5.5%) and severe preeclampsia (5.5%) as the most common complications (Nakimuli *et al.*, 2016). Additionally, the study showed that 2% of participants had a ruptured uterus during or before delivery, while



another study conducted in Ethiopia reported that 1.3% of participants had a ruptured uterus (Tiruneh *et al.*, 2016).

Regarding organ dysfunction and/or life-threatening conditions, the study reported that cardiovascular dysfunction (4%) and respiratory dysfunction (3.7%) were the most common, followed by hematological dysfunction (3.4%). These findings are consistent with a study conducted in Nigeria, which reported cardiovascular dysfunction (3.2%) and respiratory dysfunction (3.2%) as the most common (Olugbenga-Bello *et al.*, 2013). Furthermore, the study showed that 2.9% of participants had both liver and neurologic dysfunctions, while another study conducted in Nigeria reported that 3.2% of participants had liver dysfunction (Olugbenga-Bello *et al.*, 2013). Cesarean section delivery was the most common mode of delivery among the study participants in the present study, followed by vaginal delivery. This finding is consistent with other studies conducted in Rwanda, such as the study by Kibe *et al.* (2022) which reported that the majority of deliveries were through cesarean section. However, it is worth noting that the proportion of vaginal deliveries in this study was slightly higher than that reported in the Kibe *et al.* study (Kibe *et al.*, 2022). The primary reason for this discrepancy is that Kibe's study encompassed a broader range of health facilities, whereas our investigation specifically focused on the Kirehe District Hospital. Additionally, our study concentrated on data from the year 2020, while Kibe's study spanned a two-decade period from 2000 to 2020.

In comparison to other African countries, the prevalence of cesarean section delivery in Rwanda appears to be relatively high. For example, a study conducted in Nigeria reported that the proportion of cesarean section deliveries was 33.6%, which is significantly lower than that reported in this study (Adewuyi *et al.*, 2019). This may reflect differences in healthcare policies and practices between countries. It is important to note that the prevalence of abortion in this study was relatively low (4.9%), which may reflect the restrictive abortion laws in Rwanda. This finding is consistent with other studies conducted in Rwanda, which reported a low prevalence of abortion (Rulisa *et al.*, 2015). To compare the findings of the prevalence of MNM among women delivered at Kirehe District hospital with other studies, a systematic review and meta-analysis conducted by (Firoz *et al.*, 2022) on MNM on global and regions reported a pooled MNM prevalence rate of 1.4% (95% CI 0.4% to 2.5%) with Sub-Saharan Africa having the highest range, which is lower than the prevalence rate found in Kirehe District hospital (10.2%). However, it should be noted that the study by Firoz *et al.* included studies from different countries and health facilities with varying levels of care and case definitions for MNM.

Regarding the maternal factors associated with MNM status, a study conducted by Nkikabahizi *et al.* (2021) in Rwanda found similar results for parity and gestational age like the present study. The study reported no statistically significant association between parity and MNM ( $p$ -value=0.13), and gestational age ( $p$ -value=0.60). However, their study found a statistically significant association between ANC visits and MNM status ( $p$ -value<0.001), which was not found in the current study. The divergence in these findings can largely be attributed to methodological variations between the two studies. Specifically, Nkikabahizi's study employed a matched case-control design, whereas our research utilized a retrospective cross-sectional approach. Additionally, differences in the statistical analyses conducted may have also influenced the observed outcomes. Additionally, a study conducted by Wondie *et al.* (2020) in

Ethiopia found a significant association between the number of ANC visits and MNM ( $p$ -value=0.012), which is contradictory to the findings of both the current study and the study by Nkikabahizi *et al.* Therefore, while the prevalence of MNM among women delivered at Kirehe District hospital is higher than the pooled prevalence rate found in a systematic review and meta-analysis on MNM cases in Sub-Saharan Africa, the results should be interpreted with caution due to the differences in study settings and case definitions. The maternal factors associated with MNM status found in the current study are consistent with some studies conducted in Rwanda and elsewhere in the world, but there are also inconsistencies that need further investigation. While our study provides valuable insights into the prevalence and maternal factors associated with MNM at the Kirehe District Hospital, it bears certain limitations. Our investigation, based on a retrospective cross-sectional design, limits our capacity to establish causality. Furthermore, the study's geographical scope, confined to one district hospital, may not capture the variability across different health facilities or regions. Another consideration is the time frame of the study, which was concentrated on the year 2020, potentially not reflecting trends over a longer period. The results should also be interpreted with caution due to potential differences in healthcare practices and policies, which may affect the comparability with other studies. These factors may have contributed to observed discrepancies with other studies, such as the non-significant association between ANC visits and MNM status found in our study.

## 5.0 Conclusion

Based on the results of the study, the prevalence of maternal near-miss at Kirehe District hospital from January to December 2020 is 10.2%. This is indicated by the low percentages of severe post-partum hemorrhage, severe preeclampsia, uterus rupture, and obstetric hemorrhage. This study identified that women's age and labour duration were factors associated with a maternal near miss. Overall, the study highlights the importance of antenatal care visits during pregnancy in preventing severe pregnancy-related complications that can lead to maternal near-miss or mortality.

# REFERENCES

1. Adewuyi, E. O., Auta, A., Khanal, V., Tapshak, S. J., & Zhao, Y. (2019). Cesarean delivery in Nigeria: Prevalence and associated factors—a population-based cross-sectional study. *BMJ Open*, 9(6), e027273. <https://doi.org/10.1136/bmjopen-2018-027273>
2. Aduloju, O. P., Aduloju, T., & Ipinnimo, O. M. (2018). Profile of maternal near miss and determinant factors in a Teaching Hospital, Southwestern Nigeria. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*, 7(9), 3450–3458. <https://doi.org/10.18203/2320-1770.ijrcog20183752>
3. Ajenifuja, K., Adepiti, C., & Ogunniyi, S. (2010). Post-partum haemorrhage in a teaching hospital in Nigeria: A 5-year experience. *African Health Sciences*, 10(1), 71–74. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2895792/>
4. Al Omari, O., Khalaf, A., Al Hashmi, I., Al Qadire, M., Abu Shindi, Y., Al Sabei, S., Matani, N., & Jesudoss, D. (2022). A comparison of knowledge and attitude toward mental illness among secondary school students and teachers. *BMC Psychology*, 10(1), 109. <https://doi.org/10.1186/s40359-022-00820-w>
5. Ali, A. A., Khojali, A., Okud, A., Adam, G. K., & Adam, I. (2011). Maternal near-miss in a rural hospital in Sudan. *BMC Pregnancy and Childbirth*, 11(1), 48. <https://doi.org/10.1186/1471-2393-11-48>
6. Benimana, C., Small, M., & Rulisa, S. (2018). Preventability of maternal near miss and mortality in Rwanda: A case series from the University Teaching Hospital of Kigali (CHUK). *PLOS ONE*, 13(6), e0195711. <https://doi.org/10.1371/journal.pone.0195711>



7. Cammen, O. E. van der, Chobo, S. P., Kasitu, J. S., Mwampagatwa, I., Mooij, R., & Hulsbergen, M. H. (2021). Applicability and comparison of the sub-Saharan Africa and original WHO maternal near-miss criteria in a rural hospital in Western Tanzania. *Journal of Global Health Reports*, 5, e2021055. <https://doi.org/10.29392/001c.24357>
8. Chen, Y., Shi, J., Zhu, Y., Kong, X., Lu, Y., Chu, Y., & Mishu, M. M. (2021). Women with maternal near-miss in the intensive care unit in Yangzhou, China: A 5-year retrospective study. *BMC Pregnancy and Childbirth*, 21(1), 784. <https://doi.org/10.1186/s12884-021-04237-y>
9. Chikadaya, H., Madziyire, M. G., & Munjanja, S. P. (2018a). Incidence of maternal near miss in the public health sector of Harare, Zimbabwe: A prospective descriptive study. *BMC Pregnancy and Childbirth*, 18(1), 458. <https://doi.org/10.1186/s12884-018-2092-7>
10. Chikadaya, H., Madziyire, M. G., & Munjanja, S. P. (2018b). Incidence of maternal near miss in the public health sector of Harare, Zimbabwe: A prospective descriptive study. *BMC Pregnancy and Childbirth*, 18(1), 458. <https://doi.org/10.1186/s12884-018-2092-7>
11. Domingues, R. M. S. M., Dias, M. A. B., Schilithz, A. O. C., & Leal, M. do C. (2016). Factors associated with maternal near miss in childbirth and the postpartum period: Findings from the birth in Brazil National Survey, 2011–2012. *Reproductive Health*, 13(3), 115. <https://doi.org/10.1186/s12978-016-0232-y>
12. Filho, E. A. R., Costa, M. L., Cecatti, J. G., Parpinelli, M. A., Haddad, S. M., Sousa, M. H., Melo, E. F., Surita, F. G., & Souza, J. P. (2015). Contribution of antepartum and intrapartum hemorrhage to the burden of maternal near miss and death in a national surveillance study. *Acta Obstetrica et Gynecologica Scandinavica*, 94(1), 50–58. <https://doi.org/10.1111/aogs.12529>
13. Firoz, T., Romero, C. L. T., Leung, C., Souza, J. P., & Tunçalp, Ö. (2022). Global and regional estimates of maternal near miss: A systematic review, meta-analysis and experiences with application. *BMJ Global Health*, 7(4), e007077. <https://doi.org/10.1136/bmjgh-2021-007077>
14. Geller, S. E., Koch, A. R., Garland, C. E., MacDonald, E. J., Storey, F., & Lawton, B. (2018). A global view of severe maternal morbidity: Moving beyond maternal mortality. *Reproductive Health*, 15(1), 98. <https://doi.org/10.1186/s12978-018-0527-2>
15. Goldenberg, R. L., Saleem, S., Ali, S., Moore, J. L., Lokangako, A., Tshefu, A., Mwenechanya, M., Chomba, E., Garces, A., Figueroa, L., Goudar, S., Kodkany, B., Patel, A., Esamai, F., Nsyonge, P., Harrison, M. S., Bauserman, M., Bose, C. L., Krebs, N. F., ... McClure, E. M. (2017). Maternal near miss in low-resource areas. *International Journal of Gynaecology and Obstetrics: The Official Organ of the International Federation of Gynaecology and Obstetrics*, 138(3), 347–355. <https://doi.org/10.1002/ijgo.12219>
16. Heemelaar, S., Josef, M., Diener, Z., Chipeio, M., Stekelenburg, J., van den Akker, T., & Mackenzie, S. (2020). Maternal near-miss surveillance, Namibia. *Bulletin of the World Health Organization*, 98(8), 548–557. <https://doi.org/10.2471/BLT.20.251371>
17. Heemelaar, S., Kabongo, L., Ithindi, T., Luboya, C., Munetsi, F., Bauer, A.-K., Dammann, A., Drewes, A., Stekelenburg, J., van den Akker, T., & Mackenzie, S. (2019). Measuring maternal near-miss in a middle-income country: Assessing the use of WHO and sub-Saharan Africa maternal near-miss criteria in Namibia. *Global Health Action*, 12(1), 1646036. <https://doi.org/10.1080/16549716.2019.1646036>
18. Irangani, L., Prasanna, I. R., Gunarathne, S. P., Shanthapriya, S. H., Wickramasinghe, N. D., Agampodi, S. B., & Agampodi, T. C. (2022). Social determinants of health pave the path to maternal deaths in rural Sri Lanka: Reflections from social autopsies. *Reproductive Health*, 19(1), 221. <https://doi.org/10.1186/s12978-022-01527-2>
19. Iwuh, I. A., Fawcus, S., & Schoeman, L. (2018). Maternal near-miss audit in the Metro West maternity service, Cape Town, South Africa: A retrospective observational study. *South African Medical Journal*, 108(3), 171–175. <https://doi.org/10.7196/SAMJ.2018.v108i3.12876>
20. John, S. (2018). Postpartum Hemorrhage: Background, Problem, Epidemiology. *Medscape*. <https://emedicine.medscape.com/article/275038-overview#a4>
21. Kalisa, R., Rulisa, S., van den Akker, T., & van Roosmalen, J. (2016). Maternal Near Miss and quality of care in a rural Rwandan hospital. *BMC Pregnancy and Childbirth*, 16(1), 324. <https://doi.org/10.1186/s12884-016-1119-1>
22. Kibe, P. M., Mbuthia, G. W., Shikuku, D. N., Akoth, C., Oguta, J. O., Ng'ang'a, L., & Gatimu, S. M. (2022). Prevalence and factors associated with caesarean section in Rwanda: A trend analysis of Rwanda demographic and health survey 2000 to 2019-20. *BMC Pregnancy and Childbirth*, 22(1), 410. <https://doi.org/10.1186/s12884-022-04679-y>
23. Likis, F. E., Sathe, N. A., Morgans, A. K., Hartmann, K. E., Young, J. L., Carlson-Bremer, D., Schorn, M., Surawicz, T., & Andrews, J. (2015). Introduction. In *Management of Postpartum Hemorrhage [Internet]*. Agency for Healthcare Research and Quality (US). <https://www.ncbi.nlm.nih.gov/books/NBK294453/>
24. Liyew, E. F., Yalew, A. W., Afework, M. F., & Essén, B. (2017). Incidence and causes of maternal near-miss in selected hospitals of Addis Ababa, Ethiopia. *PLoS ONE*, 12(6), e0179013. <https://doi.org/10.1371/journal.pone.0179013>
25. Martins, A. C. S., & Silva, L. S. (2018). Epidemiological profile of maternal mortality. *evista Brasileira de Enfermagem*, 71, 677–683. <https://doi.org/10.1590/0034-7167-2017-0624>