Research Article

Study of Maternal Near Miss by Near Miss: Mortality Ratio, Exploring Quality of Care

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Introduction: Near Miss being a proxy indicator of MMR, evaluation of facility services and Near Miss numbers was carried out in a teaching hospital in Central India. Sustainable Development Goal targets MMR less than 70 by year 2030. This study aims to report and evaluate causal factors of maternal near miss ratio, maternal death ratio as it is a sensitive indicator of medical care given by the facility. Critical care services were quantified in this study.

Methods: 4422 number of delivery files occurring over a period of 3 years were included in a retrospective manner. Maternal deaths were 21, Near Miss 170 and live births 4237. Variables studied were Maternal near miss ratio, Maternal near miss mortality ratio, mortality index and final diagnosis of each patient. The number of blood components, urgent surgery, ventilator, ICU stay, dialysis and number of fourth-generation antibiotics were studied for calculating risk factors against various diagnoses. Bi-variate analysis and percents were statistical tools used.

Results: Maternal near miss ratio was 40.12, the maternal near miss mortality ratio 8.09:1, and mortality index 10.99%. The findings included 85.3% blood transfusion use, 61.8% surgical intervention, 38.2% inotrope, 32.4% ventilator, 96% ICU and 96% fourth generation antibiotic use. Odds for comparison of services given for various different etiological conditions with respect to MNM ratio and MNM-Mortality ratio was statistically significant for our data; giving a positive and better ranking to services in this Institute.

Conclusion: The maternal near-miss ratio of 40.12, Mortality index of 10.99% and MNM – Mortality ratio 8:1 are the major findings of this study.Odds for comparative statements between other reports and others showed statistical significance.

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Keywords: Maternal near miss, MMR, Mortality index, Evaluation of facility.

Introduction

Maternal mortality remains a major challenge to health system worldwide.[1] As per WHO, maternal death is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of duration and site of pregnancy,from any cause related to or aggravated by pregnancy or its management but not from accidental or incidental causes.As we reached our goal of under 100 maternal mortality rates recently, our next target is to attain under 70 maternal mortality ratio (MMR) by 2030, one of our sustainable development goals.[2] To reduce the number of maternal deaths,it is important to assess the preventable causes leading to death. While many women die following a life-threatening event, many more women survive with morbidity and long-term sequelae. Such survivals are our focus to understand the events leading to maternal mortality. Maternal near miss (MNM) is a concept that deals with highly morbid cases that were saved with timely interventions. It refers to women who nearly died but survived a complication that occurred during pregnancy, childbirth, or within 42 days of termination of pregnancy as well as those who were brought dead to a facility.[1] It is a proxy indicator of the quality of healthcare services and helps better understand the healthcare system's pitfalls.[3] Learning more about near-miss cases will provide valuable insights into deadly causative factors such as hemorrhage, hypertensive disorders, sepsis, and obstructed labor.[4]

The delay in seeking help, delayed access to care, and poor quality of emergency obstetric services leads to undesirable outcomes. Among the three delays,

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delayed access to healthcare was found to be the leading cause followed by a lack of timely intervention.[5] Lack of awareness and seeking help on the verge of death is another curse leading to high mortality. Creating awareness by promoting health care programme and timely health-seeking behavior of women helps in reducing overall morbidity.

To find out the causative factors, exploring the events leading to it is necessary. As near-miss cases are alive to reveal problems experienced during the process of health care, they provide vital information on the sequence of events. Further, their review will likely yield useful information on the same pathways leading to severe morbidity and death. It is an important tool in evaluating the newer strategies to prevent maternal mortality and identifying health system failures. Near-miss indicators help assess and evaluate the quality of maternal health care.[6] High Maternal Near Miss: Maternal Death and low mortality Index indicate better quality of health care.[7] This study aims to identify various etiological factors leading to maternal near-misses and maternal mortality, exploring the quality of the health-providing system in Central India.

Methodology

It is a retrospective observational study of a 3-year duration conducted in the Department of Obstetrics and Gynaecology, RD Gardi Medical College, Ujjain from August 2020 to July 2023. We followed the "WHO near-miss approach for maternal Health" for the selection of study subjects. Women meeting the WHO inclusion criteria for maternal near-miss were included.

They are as follows.

Severe maternal complications: Severe postpartum hemorrhage, Severe pre-eclampsia, eclampsia, sepsis or severe systemic infection, ruptured uterus and severe complications of abortion.

Critical Interventions or ICU use: Admission to Intensive care unit, interventional radiology, laparotomy(includes hysterectomy, excludes cesarean section), use of blood products.

Life-Threatening Conditions (near miss criteria): Cardiovascular Dysfunction, Respiratory Dysfunction, Renal Dysfunction, Coagulation/Haematological Dysfunction, Hepatic Dysfunction, Neurological Dysfunction, Uterine Dysfunction.

Maternal Visit Status: women who were brought dead and probably died during transportation were also included.[1]

Women having the above-mentioned conditions were recruited in the study. All the maternal deaths during this 3-year duration were also included in the study to identify causative factors. Information during the study period was obtained from case records after obtaining consent from the Medical Superintendent. Data was collected to determine the cause and nature of obstetric complications, organ system dysfunction, interventions given, and timing of near-miss events concerning hospital admission. Fetal outcomes were also noted in the form of live or stillborn babies. Case records of all maternal deaths were reviewed to find out the cause in detail. The collected data was analyzed, and the results were compiled in percentages. Various Indices related to health care were calculated from the data obtained. Co-relationship of adequate critical care services to various causative factors was analyzed by bi-variate analysis. The odds ratio was considered for comparing the outcomes of other authors. The following definitions were used for various indices.

Maternal Near Miss Ratio =MNM cases per 1000 live births.(MNMR=MNM/LB)

Maternal Near Miss-Mortality Ratio=Ratio between MNM Cases and Maternal Deaths. (MNM/MD)

Mortality Index=Number of maternal deaths divided by the number of women with life-threatening conditions expressed as a percentage. {MI=MD / (MNM+MD) X 100}.[1]

Etiological factors for morbidity were noted like postpartum hemorrhage (PPH), ectopic pregnancy, severe anemia, sepsis, eclampsia, abortion, pulmonary embolism, antepartum hemorrhage, COVID, pregnancy with rheumatic heart disease, acute renal failure, severe asthma, and uterine rupture. The variables included were urgent operation theatre service (surgery within one hour of diagnosis of serious event), blood transfusion, ICU service, presence of critical care expert, inotrope support, ventilator and respiratory support modalities, and fourth-generation antibiotics.

The institutional Ethics Committee approved this study. Data was analysed in percentages and various indices were expressed in ratios. Bivariate analysis was used to co-relate quality of care and etiological factor by comparing reports of other studies. $P<0.05$ was considered significant.

Results

The majority of women were of age group 20 to 30 years and of low socio-economic status. A major share of MNM and maternal deaths were multiparous women, accounting for 76.5 and 68.4%, respectively. A total of 170 near-miss and 21 maternal deaths during the study period occurred and were included to calculate maternal near-miss indicators. Table 1 describes the distribution of various indices (Table 2).

Discussion

This study addresses the prevalence, etiology and backup of health care system in a teaching hospital in Central India. We identified major causative factors and emphasized timely interventions that saved lives. As per WHO, three phenotypes of near misses are defined based on status of the neonate.
class I=Near miss with healthy Infant,
class II=Near miss with feto-infant morbidity
class III=Near miss with fetal/infant death.[1]

In this study, we address fetal outcomes against the maternal near-miss ratio. This 3-year study comprised 170 maternal near-miss cases and 21 maternal mortality among a total of 4422 deliveries and 4237 live births in our Institution.. 81.2% of women were between the age group of 20 to 30 years, 58% belonged to lower socio-economic status and 82.4% were from rural background. 23.5% of maternal near-miss cases were primigravida, and 76.5% were multipara, whereas maternal deaths included 31.6% primigravida and 68.4% multipara. Various etiological factors are depicted in Table 3. From the above data, we calculated the maternal near-miss ratio to be 40.12, the maternal near-miss-mortality ratio to be 8.09:1, and the mortality index to be 10.99% (Table 4). Table 5 describes the comparison of our data and reports by others.

The highest etiological factor for maternal mortality and MNM in the present study is 47.6 and 27.2%, respectively in COVID pregnancies. We had all critical cases leading to higher COVID mortality. 2nd common cause is PPH, accounting for 13.6% of MNM and 14.2% of mortality which can be compared to the other studies.[4,8-11] A report in 2018 also has comparable findings: 40.6% having severe pre-eclampsia, 21.8% abruption placenta, and 12.5% severe sepsis[5]. Hemorrhage being the most common cause and hypertensive disorders 35% and infection 25% are reported by a researcher in 2021 [10]. Hemorrhage 40.5%, pre-eclampsia/ eclampsia 24.3%, sepsis 13.5%, severe anemia 8.10% and ruptured uterus 6.75% were findings by some other authors.[12]

Table 1: Results showing various indices

Parameters	*Data*
Maternal Near Miss	170
Maternal Deaths	21
Total live births	4237
Total Deliveries	4422
Maternal Near Miss Ratio	40.12
Maternal Near Miss Mortality Ratio	8.09:1
Mortality Index	10.99%

Etiological causes are described in Table 2.

Table 2: Etiological causes of maternal near miss and maternal mortality

Etiology	*Maternal near miss*	*Maternal mortality*
	N (%)	*N (%)*
COVID Pregnancy	46 (27.2)	10 (47.6)
PPH	23 (13.6)	3 (14.2)
Ectopic Pregnancy	19 (11.2)	0 (0)
Sepsis	13 (7.6)	2 (9.5)
Uterine Rupture	12 (7.1)	1 (4.7)
Severe Anemia	12 (7.1)	0 (0)
Hypertensive Disorders in Pregnancy	17 (10)	2 (9.4)
Abortion	8 (4.7)	0 (0)
Medical Conditions	5 (2.9)	1 (4.7)
Antepartum Haemorrhage	8 (4.6)	1 (4.7)
Pulmonary Embolism	1 (0.6)	1 (4.7)
Brought Dead	6 (3.5)	0 (0)
Total	170 (100)	21 (100)

The major contributing factor for Maternal Near Miss is COVID (27.2%) followed by PPH (13.6%)

Table 3: Life-saving interventions given to maternal near-miss

Life-saving interventions	*N (%)*
Blood transfusion and components	145 (85.3)
Urgent Surgical Interventions	105 (61.8)
Ionotropic Support	65 (38.2)
Ventilator Support	55 (32.4)
Critical Care and ICU service	164 (96)
Fourth generation antibiotics	164 (96)

96% of Near Miss cases needed critical care support and 85.3% needed a blood transfusion.

Table 4: Fetal outcome

Fetal outcome	*Percentage*
Near miss with healthy infant	41.05
Near miss with fetal/infant morbidity	28.9
Near miss with fetal/infant death	30

41.05% of near-miss had healthy infants.

Table 5: Causes of maternal near miss and maternal mortality reported by various authors

Etiology	*Maternal Near Miss (N=88) (%)*	*Maternal Mortality (N=26) (%)*	*Maternal Near Miss (N=100) (%)*	*Maternal Mortality (N=8) (%)*	*Maternal Near Miss (N=170) (%)*	*Maternal Mortality (N=21) (%)*
	Umadevi et al.[8]		*Varma et al.*[4]		*Present Study*	
COVID Pregnancy	-	-	-	-	27.2	47.6
PPH	52.2	15.3	16	6.8	13.6	14.2
Ectopic Pregnancy	1.13	0	3.2	3.4	11.2	0
Sepsis	9.09	7.6	4.8	3.4	7.6	9.5
Uterine Rupture	1.13	0	3.2	3.4	7.1	4.7
Severe Anemia	-	-	11.2	10.3	7.1	0
HELLP Syndrome	7.9	7.6	7.2	6.8	5.3	4.7
Eclampsia	2.2	7.6	12	3.4	4.7	4.7
Abortion	-	-	3.2	3.4	4.7	0
Medical Conditions	2.2	7.6	-	-	2.9	4.7
PAS Spectrum	-	-	6.4	0	2.3	4.7
Abruptio Placentae	5.6	7.6	7.2	0	2.3	0
Pulmonary Embolism	-	-	2.4	10.3	0.6	4.7
Brought Dead	-	-	-	-	3.5	0

Table 6: Comparison of MNM Indicators and Inter-relationship Significance

Near Miss Indicators		*WHO Report*[1]	*Umadevi*[8]	*Gupta*[12]	*Verschueren*[19]	*Present Study*
Maternal near miss ratio	per 1000	8.6	4.17	16.32	7.8	40.12
	Odds ratio	-	8.5	2.45	5.15	
	Significance level	-	p <0.0001	p <0.0001	p <0.0001	
Maternal near miss-mortality ratio		5.7:1	3.38:1	3.52:1	7.1:1	8.09:1
	Odds ratio	-	2.39	1.64	1.14	
	Significance level	-	p <0.0001	p = 0.175	p = 0.748	
Mortality index (%)		15	22.8	22.10	12	10.99

Considering the geographical locations, developing countries have more MNM and MMR compared to developed countries.[6] Hemorrhage being the leading cause for MNM in other studies in England, Malaysia, Sudan, Iraq, Nepal, Pakistan, and India.[13-18] All the above studies show the highest causative factor for MNM as obstetric hemorrhage, which can be prevented by adopting preventive measures like active management of 3rd stage of labor, correction of anemia before pregnancy and liberal use of oxytocin.

In the present study, near miss incidence ratio is high (40.12) as compared to 16.32 and 4.17 in other studies (Table 6).[8,12] Comparing the odds ratio with 3 other studies, our results are statistically significantly different than others [8,12,19] with respect to MNM ratio. This indicates our MNM ratio is at par than other Indian studies conducted from year 2017 to 2020. While addressing MNM- Mortality ratio results of this study are significantly different than a study [8]. The two others[12,19] have comparable values of MNM- Mortality ratios of ours. This is because our Institution is the only tertiary referral center within a radius of 200 km catering to most of the complicated cases. Maternal near miss mortality ratio is 8:1 which denotes 1 death per 8 women who survived the life-threatening condition.

The mortality index in the present study is 10.99% which is less compared to 22.10% and 16% in other facilities.[4,12] The MNM – mortality ratio of the present study can be compared to the WHO report of 5.7:1; that is almost 6 near-miss cases for one maternal death.[1] 40.12 of MNM in the present study can also be explained by the rural population's late referrals and delayed help-seeking behavior. This situation can be improved by creating awareness regarding timely referrals and prioritizing women's health in society.Maternal near-miss ratios were considerably higher in lower-middle-income countries than upper-middle-income countries (median: 15.9 versus 7.8 per 1000 live births). This is due to differences

Table 7: Comparison of life-saving interventions in different studies

Life-saving interventions in Near Miss	*Umadevi et al.[8] (%)*	*Agarwal et al.[10] (%)*	*Balachandran et al.[18] (%)*	*The present study (%)*
Blood transfusion and components	-	47	28.4	85.3* ~,≈
Urgent surgical interventions	44	32	9.2	61.8* !,~,≈
Ionotropic support		25	4.7	38.2*~,≈
Ventilatory support	29.5	44	21.1	32.4*~,≈
ICU stay and critical care	100	88	70.5	96
Dialysis	4.5	25	5	-
Fourth generation antibiotics	-	90	-	96

*- Significant at 5% level of significance
! Study of Umadevi *et al.*[8]
~Study of Agarwal *et al.*[10]
≈Study of Balachandran *et al.*[18]

in countries' resources, but it is an important finding about the validity of the MNM approach. Lower-middle-income countries also had considerably higher maternal mortality ratios and mortality indices than upper-middle-income countries.[20] A systematic metanalysis study by Kulkarni *et al.* in 2021 noted that the incidence of MNM cases showed a wide variation from 3.9 to 379.5 per 1000 LB, whereas it ranged between 7.6 and 60.4 per 1000 deliveries. The MNM: Maternal death ratio varied from 1.7:1 to 21.8:1 and the mortality index varied from 4.3 to 36.5%.[21]

The critical care services in form of blood and components, surgical interventions, inotropy support, ventilator, ICU stay, dialysis and fourth-generation antibiotics given to MNM in our Institute were found significantly correlated with various etiological factors compared to other studies, specialy recent reports in 2021 and 2022 (Table 7).[10,18] Life-saving surgeries like obstetric hysterectomy in cases of PPH, laparotomy for uterine rupture, and salpingectomy in cases of tubal ectopic could save many young lives in the era of modern obstetrics.Major surgical interventions like obstetric hysterectomy and laparotomy were required in 75% of MNM and 87.5% of women required a massive blood transfusion in another study;[5] while 42 and 32% urgent surgical interventions were major treatment in others [8,10]. An Indian study showed a laparotomy percentage of 12.15% in the MNM.[11] Ventilatory and ionotropic support was crucial in saving 32.4% and 38.25 women, respectively in this study, comparable to others.[8,10]

All MNM required ICU stay, including critical care in the present study, while it is 100, 88 and 70.5%, respectively in others.[8,10,18] It can be made out from the above studies that timely critical care by expert personnel is an essential part of saving the MNM. The introduction of the wide use of higher antibiotics, qualified anesthetist backup, and timely blood transfusions could save more lives than ever. The usage of fourth-generation antibiotics was essential in 96% of women in the present study. Wide use of laboratory investigations, identifying morbidity factors, and aggressive treatment were the key factors in saving the near-miss cases.

In the present study we had healthy infants in 41.05%, infant morbidity leading to NICU admission in 28.9%, and fetal or infant death in 30% of near-miss cases. This can be compared to the study of Agarwal *et al.* in 2021 in which 65.9% were healthy infants, the majority followed by 37% deaths and 12.5% for NICU admission.[10] A study in Namibia near-miss with healthy infants of 50.3% which is also comparable to the present study. They also had infant death of 14.1% and infant morbidity of 10.6%.[22]

The causes leading to MNM and maternal mortality are the same. They are like two edges of the same sword. Understanding and better management of these life-threatening causes can be a gateway to a better quality of life. As rightly pointed out by Maity *et al.* in 2022, Indian women lack health-seeking behavior when needed.[23] This can be improved by creating awareness through healthcare programs.

Implications

Obstetric care services in teaching hospitals are in a position to improve the maternal near-miss ratio. To achieve the highest maternal near-miss ratio, a team of backup services for blood transfusion and component services along with an aggressive approach of obstetric surgeons, anesthesiologists, and intensivists, is required. By increasing the number of quality teaching institutes, we in India may achieve a still higher ratio. Network of

PHC, CHC and District Hospitals are grassroots facilities. Strengthening the referral system is the only remedy in Low-income Countries. Locating a facility by GIS and identifying its standard are the solutions for reducing MNM.[24]

Conclusion

The maternal near-miss ratio for a teaching institute in central India is 40.12, indicating a better quality of care that resulted in saving maternal lives. Comparing odds for services given and various causes of MNM, ours has a significant difference than others ($p < 0.0001$) with respect to MNM ratio. The main-stay behind this scenario is the backup blood component services, the urgency of surgical interventions, and critical care support.

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Declarations

The study was approved by Ethical Committee at R. D. Gardi Medical College, Ujjain. We all authors, declare that we have no competing interest. We all authors, agree to the contents of this manuscript.

References

1. World Health Organization-Evaluating the quality of care for severe pregnancy complications: The WHO near miss approach for maternal health. WHO(2011).
2. Department of Economic and Social Affairs,UnitedNations. Transforming our world :The 2030 agenda for sustainable development.NewYork,NY:UN.(2015)
3. M MK,NaikG.Maternal near miss: reaching the last mile. JObstetGynaecol. 2021 Jul;41(5):675-683.doi:101080/01443615.2020 .1820467.Epub 2020 Dec 2.PMID: 33263266.
4. Varma P, Shelke S, Suman A. Comparison of causes of maternal near miss and maternal mortality in Mahatma Gandhi institute of medical sciences which is Tertiary care rural hospital (Januray 2016 to September 2017). *Indian J ObstetGynecol Res* 2021;8(4):486-491.
5. Reena RP, Radha KR. Factors associated with maternal near miss: A study from Kerala. Indian J Public Health. 2018 Jan-Mar;62(1):58-60. doi: 10.4103/ijph.IJPH_20_16. PMID: 29512568.
6. Chhabra P. Maternal near miss: an indicator for maternal health and maternal care. Indian J Community Med. 2014 Jul;39(3):132-7. doi: 10.4103/0970-0218.137145. PMID: 25136152; PMCID: PMC4134527.
7. Hill K,ThomasK,AbouZahrC.WalkerN,SayL,InouM,etal.Estimates of maternal mortality world wide between 1990 and 2005: an assessment of available data 2007;370:1311-1319.
8. Umadevi S, Ayesha S, Radha S, Nair ATS, Sulochana KD. Burden and causes of maternal mortality and near-miss in a tertiary care centre of Kerala, India. Int J Reprod Contracept ObstetGynecol2017;6:807-13.
9. Verma V, Kanti V, Vishwakarma S, Gupta UK, Shree P. "Near-Miss" Obstetric Events and Maternal Deaths in a Rural Tertiary Care Center in North India. Cureus. 2020 Dec 1;12(12):e11828. doi: 10.7759/cureus.11828. PMID: 33409070; PMCID: PMC7781506.
10. Agarwal N, Jain V, Bagga R, Sikka P, Chopra S, Jain K. Near miss: determinants of maternal near miss and perinatal outcomes: a prospective case control study from a tertiary care center of India. J MaternFetal Neonatal Med. 2022 Dec;35(25):5909-5916. doi: 10.1080/14767058.2021.1902497. Epub 2021 Mar 21. PMID: 33749485.
11. Wasim T, Raana GE, Wasim M, Mushtaq J, Amin Z, Asghar S. Maternal near-miss, mortality and their correlates at a tertiary care hospital. J Pak Med Assoc. 2021 Jul;71(7):1843-1848. doi: 10.47391/ JPMA.05-678. PMID: 34410259.
12. Gupta D, Nandi A, Noor N, Joshi T, Bhargava M. Incidence of maternal near miss and mortality cases in central India tertiary care centre and evaluation of various causes. The New Indian Journal of OBGYN. 2018; 4(2): 112-6
13. Jabir M, Abdul-Salam I, Suheil DM, Al-Hilli W, Abul-Hassan S, AlZuheiri, *et al.* Maternal near miss and quality of maternal health care in Baghdad. Iraq BMC pregnancy and childbirth. 2013;13(1):11–11.
14. Siddiqui SA, Soomro N, Hasnain FS. Severe obstetric morbidity and its outcome in patients presenting in a tertiary care hospital of Karachi. JPMA-Journal of the Pakistan Medical Association. 2012;62(3):226– 226.
15. Ps R, Verma S, Rai L, Kumar P, Pai MV, Shetty J. "Near miss" obstetric events and maternal deaths in a tertiary care hospital: an audit. J Pregnancy. 2013;2013:393758. doi: 10.1155/2013/393758. Epub 2013 Jun 26. PMID: 23878737; PMCID: PMC3710620.
16. Purandare C, Bhardwaj A, Malhotra M, Bhushan H, Chhabra S, Shivkumar P. Maternal near-miss reviews: lessons from a pilot programme in India. BJOG: An International Journal of Obstetrics & Gynaecology. 2014;121(s4):105–116.
17. Norhayati MN, Hazlina NH, Sulaiman Z, Azman MY. Severe maternal morbidity and near misses in tertiary hospitals. BMC Public Health vol. 16. Kelantan, Malaysia; 2016. p. 229–229.
18. Balachandran DM, Karuppusamy D, Maurya DK, Kar SS, Keepanasseril A. Indicators for maternal near miss: an observational study, India. Bull World Health Organ. 2022 Jul 1;100(7):436-446. doi: 10.2471/BLT.21.287737. Epub 2022 Jun 2. PMID: 35813510; PMCID: PMC9243687.
19. Verschueren KJC, Kodan LR, Paidin RR, Samijadi SM, Paidin RR, Rijken MJ, *et al.* Applicability of the WHO maternal near-miss tool: a nationwide surveillance study in Suriname. J Glob Health. 2020 Dec;10(2):020429. doi: http://dx.doi.org/10.7189/ jogh.10.020429 PMID: 33214899
20. Heitkamp A, Meulenbroek A, van Roosmalen J, Gebhardt S, Vollmer L, de Vries JI, Theron G, van den Akker T. Maternal mortality: near-miss events in middle-income countries, a systematic review. Bull World Health Organ. 2021 Oct 1;99(10):693-707F. doi: 10.2471/BLT.21.285945. Epub 2021 Aug 30. PMID: 34621087; PMCID: PMC8477432.
21. Kulkarni R, Kshirsagar H, Begum S, Patil A, Chauhan S. Maternal near miss events in India. Indian J Med Res. 2021 Apr;154(4):573-582. doi: 10.4103/ijmr.IJMR_928_19. PMID: 35435342; PMCID: PMC9205009.
22. Heemelaar S, Josef M, Diener Z, Chipeio M, Stekelenburg J, van

den Akker T, Mackenzie S. Maternal near-miss surveillance, Namibia. Bull World Health Organ. 2020 Aug 1;98(8):548-557. doi: 10.2471/BLT.20.251371. Epub 2020 Jul 1. PMID: 32773900; PMCID: PMC7411319.

23. Maity S, Chaudhuri S. An observational study on maternal mortality and maternal near miss in a selected facility of West Bengal. Indian J Public Health. 2022 Jul-Sep;66(3):371-374. doi: 10.4103/ijph.ijph_211_22. PMID: 36149126.
24. Singh V, Barik A. Maternal Near-Miss as a Surrogate Indicator of the Quality of Obstetric Care: A Study in a Tertiary Care Hospital in Eastern India. Cureus. 2021 Jan 7;13(1):e12548. doi: 10.7759/cureus.12548. PMID: 33564542; PMCID: PMC7863078.