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Original Research Article

Maternal near miss: as a tool for improving obstetric care: a 4.5-year audit from a tertiary referral centre in Sikkim

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ABSTRACT

Background: Maternal near-miss (MNM) audits are valuable tools for evaluating obstetric care and identifying gaps in the health system. Limited data are available from Sikkim, where a single tertiary centre caters to all six districts. This study aimed to assess the incidence of maternal near-miss and maternal mortality over a four and a half year period, and to implement the results for better maternal health.
Methods: A retrospective observational study was conducted at a tertiary referral hospital in Sikkim, reviewing all deliveries between [2021-2025]. Maternal near-miss cases were identified. Indicators including MNM incidence ratio (NMIR), MNM to mortality ratio (MNM:MD), mortality index, and maternal mortality ratio (MMR) were calculated.
Results: A total of 5,401 deliveries and 5,330 live births were recorded. There were 44 maternal near-miss cases and 8 maternal deaths. The NMIR was 8.25 per 1,000 live births, MNM:MD ratio was 5.5, and the mortality index was 15.4%. The calculated MMR was 150 per 100,000 live births. Compared to national figures (MMR ~93 per 100,000; NMIR ranging 3-17/1,000), the centre recorded a higher MMR and a moderate NMIR.
Conclusions: The elevated MMR reflects referral nature of the institution, with most women presenting in moribund condition. The relatively lower NMIR suggests possible early recognition and prevention, but high mortality index underscores need for strengthening critical care, timely referral, and district-level facilities. Focused improvements in emergency obstetric management and referral systems are essential to reduce maternal morbidity and mortality.

Keywords: Emergency obstetric care, Maternal near miss, Maternal mortality, Obstetric audit

INTRODUCTION

Maternal and child health remains a paramount public health priority in India, where women of reproductive age comprise of 30% of the population, with Maternal mortality ratio (MMR) being a vital measure of maternal healthcare quality and socio-economic status of a region.[1]

Millennium Development Goal 5 (MDG5) prioritized maternal health, aiming for a 75% reduction in the MMR between 1990 and 2015, alongside universal access to reproductive healthcare. Globally, MMR dropped by 45% from 2000 to 2015, though significant disparities persist. In India, MMR fell from 113 (2016-18) to 93 (2019-21), reflecting improvement by 17.7%, surpassing the NHP (National Health Policy) target of 100/100,000 and on track to meet the SDG (sustainable development goal) of 70/ 100,000 live births by 2030.[2]

Though maternal death audits are fundamental to evaluating maternal health, yet mortality metrics alone are insufficient as numerous women endure significant morbidity and chronic sequelae post-delivery. Recently, the appraisal of cases involving women who narrowly escaped death (during pregnancy, childbirth or within 42 days of MTP)-termed maternal near miss (MNM) or

severe acute maternal morbidity (SAMM) has augmented assessments of maternal healthcare quality as these women exhibit clinical and contextual parallels to those who succumb.[3]

This transition from mortality to morbidity surveillance has gained global acceptance due to the limited number of maternal deaths relative to the higher incidence of MNM cases, which generate more comprehensive data. Additionally, morbidity data are also more accessible and reliable, as survivors can provide firsthand accounts, and NMAs enjoy greater acceptance as death is averted. NMAs (near miss audits) deepen insights into the determinants of morbidity, expose deficiencies in care, assess referral system efficiency, and evaluate the availability of clinical interventions. This information is invaluable for clinicians and policymakers, informing the optimization of emergency obstetric care (EmOC) policies and practices. Therefore, WHO introduced MNM surveillance guidelines in 2009 and formalized it in 2011, establishing clinical, laboratory, and management-based criteria to identify cases, providing a standardized framework for identifying life-threatening maternal complications, facilitating robust international comparisons in maternal health care, underscoring their utility in maternal health surveillance.[4] Hence, this retrospective study aims to quantify the incidence of MNM cases within the target population and to elucidate the demographic, clinical, and obstetric risk factors and contribute to evidence based strategies, strengthen maternal health services and to mitigate preventable morbidity and mortality.

METHODS

It is a retrospective observational study conducted in the Department of Obstetrics and Gynecology, Sikkim Manipal Institute of medical sciences, from January 2021 to July 2025, to perform an audit of maternal near-miss cases. The initial step in operationalizing the NMA is the systematic identification of women experiencing severe pregnancy-related complications (WHO 2009 near miss criteria including clinical, laboratory and management criteria), either upon admission or arising during the course of hospitalization.[4]

However not all the components of criteria could be applied in our setting, hence, alongside the WHO near-miss tool and the national health mission MNM 2014, we used the Mantel and Waterstone criteria using clinical signs and organ dysfunction to identify cases.[5,6] Relevant data of all women registered for antenatal care and admitted during pregnancy were obtained from the hospital medical records system after approval from the ethics committee and all women fulfilling any one of these criteria were deemed eligible for inclusion.

For each maternal near-miss case, the primary obstetric complication precipitating severe acute maternal morbidity was identified, along with demographic characteristics, available laboratory parameters and details of medical and surgical interventions and data was entered in the Microsoft excel sheet. Cases were categorized based on final diagnosis into direct causes (hemorrhage, hypertension, sepsis) and indirect causes (anemia, thrombocytopenia, and other medical disorders) to facilitate comparison with the predominant causes of mortality. Furthermore, mortality during the study period were comprehensively reviewed and following near miss indices were calculated, identifying preventable factors and areas of improvement: 1) MNM incidence ratio (NMIR): number of maternal near miss cases per 1,000 livebirths (LB), 2) Maternal near miss: mortality ratio, 3) Mortality index: Number of maternal deaths divided by the number of women with life threatening conditions, expressed as a percentage, 4) Maternal mortality ratio (MMR).

RESULTS

In this study, out of 5,330 live births there were 44 MNM cases and 8 maternal deaths. This gives NMIR of 8.25 per 1,000 live births, a near-miss-to-mortality ratio of 5.5:1, a mortality index of 15.4%, and a MMR of 150 per 100,000 live births (per lakh live births) (Table 1).

Among the 52 women evaluated (44 NM cases and 8 maternal deaths), parity was evenly distributed in the NM group, whereas the majority of deaths occurred in primiparous women (75.0%). Near-miss cases were predominantly aged 30-35 years (40.9%), In contrast, maternal deaths primarily occurred in women aged 20-30 years (87.5%) with no mortality in extremes of age. Most pregnancies were singleton in both groups with two twin pregnancies reported only among near-miss cases. Regarding gestational age, near-miss events most frequently occurred at term (45.5%) comparable to maternal deaths (62.5%), with the remaining cases evenly distributed across earlier gestational periods (Table 1).

Table 1: Demographic characters of the near miss and mortality cases.

Variable	Category	Near miss (n=44)	Percent	Mortality (n=8)	Percent
Parity	Primi	22	50.0	6	75.0
	Multi	22	50.0	2	25.0
Age (years)	<20	0	0.0	0	0.0
	20-30	14	31.8	7	87.5
	31-35	18	40.9	1	12.5
	36-40	8	18.2	0	0.0

Continued.

Variable	Category	Near miss (n=44)	Percent	Mortality (n=8)	Percent
	>40	4	9.1	0	0.0
Type of pregnancy	Singleton	42	95.5	8	100.0
	Twins	2	4.5	0	0.0
	Triplets	0	0.0	0	0.0
Gestational age (weeks)	<12	1	2.3	1	12.5
	12-28	12	27.3	1	12.5
	28-37	11	25.0	1	12.5
	>37	20	45.5	5	62.5

Table 2: Antenatal medical disorders and obstetric complications.

Variable	Category	Near miss (n=44)	Percent	Mortality (n=8)	Percent
Hypertensive disorders	Chronic	9	20.5	0	0
	Gestational hypertension	4	9.1	0	0
	Pre-eclampsia	5	11.4	0	0
	Severe pre-eclampsia	4	9.1	1	12.5
Diabetes		3	6.8	0	0
Thyroid disorders	Hypothyroid	3	6.8	1	12.5
	Hyperthyroid	0	0	0	0
Anemia	Mild (10-11)	3	6.8	0	0
	Moderate (7.1-9.9)	8	18.2	4	50
	Severe (<7)	12	27.3	0	0
Other disorders	Congenital heart disease	1	2.3	0	0
	Seizure disorder	2	4.5	1	12.5
Previous LSCS		26	59.1	2	25
Placenta previa / accreta spectrum	Placenta previa	4	9.1	1	12.5
	Accreta	2	4.5	0	0
	Increta	0	0	0	0
	Percreta	1	2.3	0	0

Pre-existing medical conditions and obstetric complications were reported in both NM and mortality cases. Hypertensive disorders were the most common comorbidity among near-misses (20.5%), including chronic and gestational hypertension, as well as severe preeclampsia the latter accounting for one maternal death (12.5%).

Endocrine disorders, including diabetes mellitus and hypothyroidism were observed exclusively in NM cases. Anemia was prevalent in both groups, affecting 52.3% of NM mainly moderate and severe forms and 50.0% of maternal deaths.

Cardiac and neurological conditions were limited to the NM group, except for one death linked to a seizure disorder. A prior cesarean section was noted in 59.1% of NM and 25.0% of mortality cases indicating a potential underlying surgical risk factor.

Placental complications included placenta previa (9.1% NM; 12.5% mortality) and placenta accreta spectrum (4.5% NM; 12.5% mortality), with percreta associated with one death (Table 2).

Table 3: Immediate cause of death among near miss and mortality.

Causes	Category	Near miss (n=44)	NM, %	Mortality (n=8)	Mortality, %
Severe early pregnancy haemorrhage	Ectopic	8	18.2	1	12.5
	Abortion	2	4.5	1	12.5
Late pregnancy	Antepartum haemorrhage	3	6.8	1	12.5
Post partum haemorrhage	Atonic	9	20.5	1	12.5
	Traumatic	1	2.3	0	0
	Ruptured uterus	1	2.3	1	12.5
Shock	Hypovolemic	3	6.8	4	50

Continued.

Causes	Category	Near miss (n=44)	NM, %	Mortality (n=8)	Mortality, %
	Anaphylactic	2	4.5	0	0
	Septic	5 (abortion 1)	11.4	4	50
Hypertensive disorders of pregnancy	Severe preeclampsia	4	9.1	1	12.5
	Eclampsia	3	6.8	0	0
	HELLP syndrome	1	2.3	0	0
Respiratory	Pulmonary edema	10	22.7	1	12.5
	Pulmonary embolism	2	4.5	1	12.5
	Pleural effusion	5	11.4	1	12.5
Cardiac	Supraventricular tachycardia	2	4.5	0	0
Hepatic dysfunction		2	4.5	0	0
Renal dysfunction		1	2.3	2	25

Severe hemorrhage was the predominant immediate cause in both NM (38.6%) and mortality cases (37.5%). Within the NM cohort, postpartum hemorrhage accounted for the largest proportion (22.7%), followed by early pregnancy bleeding due to ectopic gestation or abortion (11.4%) and antepartum hemorrhage (6.8%). Among maternal deaths, hemorrhagic complications were similarly significant, with early pregnancy bleeding and antepartum hemorrhage responsible for 25.0% and 12.5% of deaths, respectively; a single mortality (12.5%) resulted from postpartum hemorrhage.

Shock was another major contributor, implicated in 22.7% of NM cases and half of all maternal deaths. Septic shock emerged as the most frequent subtype across both groups, while hypovolemic shock was notably more prominent among fatalities. Anaphylactic shock was reported exclusively in the NM group.

Hypertensive disorders of pregnancy were observed in 18.2% of NM cases and in 12.5% of deaths, with severe preeclampsia being the principal contributor.

Respiratory complications were reported in 22.7% of NM cases and in 12.5% of deaths. Pleural effusion and pulmonary embolism were more frequently observed in survivors.

Less frequently, cardiac arrhythmias (4.5%), hepatic dysfunction (4.5%), and acute renal impairment (2.3%) were identified among NM cases. Notably, renal failure was implicated in 25.0% of maternal deaths, highlighting its severity when present (Table 3).

Table 4: Interventions among the near miss and maternal mortality cases.

Intervention	Category	Near-miss (n=44)	NM %	Mortality (n=8)	Mortality %
Critical care unit	ICU	10	22.7	8	100
	SICU	14	31.8	0	0
	MICU	4	9.1	0	0
	HDU	16	36.4	0	0
Intubation		10	22.7	8	100
Vasopressor support		5	11.4	8	100
Oxygen support		8	18.2	8	100
Peripartum hysterectomy		5	11.4	0	0
Blood products transfusion	PRBC 1 unit	9	20.5	0	0
	PRBC 2 unit	4	9.1	4	50
	PRBC 3 unit	9	20.5	0	0
	PRBC >4 unit	4	9.1	4	50
	FFP 1 unit	2	4.5	0	0
	FFP 2 unit	6	13.6	0	0
	FFP >/-3 unit	8	18.2	4	50
Dialysis		0	0	1	12.5
CPR		0	0	8	100
Higher antibiotics		44	100	8	100

Among the 44 NM cases, 45.5% required critical care. In contrast, all deaths necessitated intensive support, including universal intubation and vasopressor use.

11.4% among the NM required major intervention like hysterectomy. Endotracheal intubation was needed in 22.7% of NM versus 100% of deaths, while vasopressor therapy was administered to 34% of survivors and all fatalities (Table 4).

Blood transfusions were commonly employed across both groups, with higher volumes more frequent among maternal deaths. Dialysis was required in one fatal case underscoring renal dysfunction as a late and poor prognostic sign. Broad-spectrum antibiotics were universally administered.

DISCUSSION

In the present study, we evaluated 52 women who experienced severe maternal complications, comprising 44 maternal NM events and 8 deaths, more than half of which were referred from various districts. The comparative analysis between these two groups provided valuable insights into demographic characteristics, comorbidities, causes, and interventions associated with maternal morbidity and mortality.

Demographic patterns showed that NM cases were equally distributed between primiparous and multiparous women, whereas deaths disproportionately affected primiparous women possibly due to unrecognized risk factors, delayed care-seeking, or lower thresholds for complications in primigravidas. This finding was inconsistent with previous studies[7] that have highlighted increased vulnerability to severe maternal outcomes with increasing parity. Age distribution further emphasizes this vulnerability, with the majority of deaths occurring in younger women (20-30 years), a trend also reported in study by Sunanda et al and Krishna et al, probably due to increased number of pregnancies in this age group.[8,9] Both events most frequently occurred at term gestation, underscoring the need for heightened vigilance even at the expected endpoint of pregnancy.

Medical and obstetric comorbidities were common, with hypertensive disorders emerging as the leading underlying echoing global evidence that hypertensive disorders remain a major cause of adverse outcomes despite improved antenatal detection strategies.[10] Anemia being frequent comorbidity in both groups reinforces the persistent challenge of addressing nutritional deficiencies and delayed detection of anemia during pregnancy.[11] Other conditions such as diabetes, hypothyroidism, and cardiac or neurological disorders were confined to NM cases, suggesting that timely interventions may prevent progression to mortality in women with chronic illnesses. Prior cesarean section was common, indicating that women with previous surgical deliveries are at higher risk of obstetric complications requiring critical interventions. Placental complications, including previa and accreta spectrum, were observed in both groups, highlighting the lethal potential of abnormal placentation when diagnosis or surgical planning is delayed.[12]

Our findings align with the World Health Organization (WHO) near-miss approach, which identifies hemorrhage, hypertensive disorders, and sepsis as the “triad of major killers” in maternal health.[13] Postpartum hemorrhage was the leading contributor to NM cases similar to that seen in other studies while early pregnancy hemorrhage and APH were more frequently associated with maternal death most of which were referred cases underlining the importance of timely interventions to prevent catastrophic events.[14] Shock particularly septic and hypovolemic shock was strongly associated with mortality, with half of all deaths attributed to these conditions. Sepsis remains a preventable yet highly fatal cause, emphasizing the critical importance of provider education on its clinical presentation, early infection control measures, and timely administration of antibiotics.[15] Equally essential is public education discouraging the unsupervised use of abortifacients, which contributes significantly to both maternal NM events and mortality.

Hypertensive disorders were major contributors to near-miss suggesting that aggressive management strategies can be life-saving when promptly applied. Respiratory complications such as pulmonary embolism proved fatal in instances where delays in diagnosis and initiation of appropriate treatment occurred. Renal failure was infrequent but disproportionately life threatening, consistent with its role as a marker of multi-organ dysfunction and late-stage deterioration usually secondary to haemorrhage and sepsis.[16]

Interventions (medical, surgical and critical care) and health system response were a critical differentiator between survival and death.

Our institution functions as the sole tertiary referral center catering to all six districts of Sikkim, with the majority of cases presenting in a moribund condition at the time of referral which explains the higher MMR compared with the national average of 88.[17] The NMIR, though within the national range(3-17/1000), is relatively lower, which may indicate effective prevention and timely recognition of complications, or alternatively, stricter case definitions and possible underreporting.[18] The mortality index of 15% highlights that once severe morbidity occurs, outcomes remain poor with referral delays being a major determinant. The establishment of tertiary care facilities within each district is imperative. Contributing factors such as lack of vigilance post-delivery leading to delayed diagnosis, suboptimal resources including lack of blood banks and critical care unit support, unsatisfactory utilization of available resources and inappropriate transports may have accounted for the maternal morbidities and mortalities observed in our study.

This study has certain limitations. As a single-center study from the only tertiary referral hospital in Sikkim, the findings may not be generalizable. Referral bias was likely, as most patients arrived in advanced states, potentially overestimating NM incidence. Incomplete hospital records and exclusion of cases managed outside the facility may have led to under-reporting. Furthermore, while the audit highlights clinical causes, it was less equipped to explore broader systemic and sociocultural factors underlying delays in seeking, reaching, and receiving care.

CONCLUSION

Overall, our findings reaffirm that timely recognition, rapid escalation of care, and availability of critical interventions are central to preventing progression from severe maternal morbidity to mortality. The predominance of hemorrhage, hypertensive disorders, and sepsis as underlying causes mirrors global trends, particularly in resource-limited settings. However, the observation that many near-miss cases survived due to intensive interventions emphasizes the potential of strengthening obstetric emergency care systems, including blood bank services, ICU availability, and skilled obstetric teams. Addressing preventable factors such as anemia, improving antenatal risk screening, and ensuring timely referral pathways remain essential strategies to reduce maternal deaths. Equally crucial is the integration of maternal near-miss analyses and mortality reviews to guide necessary interventions aimed at strengthening healthcare delivery.

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