

## Evaluation of Severe Maternal Outcomes to Assess Quality of Maternal Health Care at a Tertiary Center

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repute.

### Abstract

**Background** Maternal mortality and near-miss index reflect the quality of care provided by a health facility. The World Health Organization recently published near-miss approach where strict near-miss criteria based on markers of organ dysfunction are defined.

**Objectives** The aim of the study was to determine the frequency of severe maternal complications, maternal near-miss cases and maternal deaths, to analyze causes of near-miss and maternal mortality and to determine the values of maternal near-miss indicators.

**Methods** This was a prospective observational study conducted at a tertiary care centre in North India from January 2012 – March 2013. WHO’s near-miss approach was implemented for evaluation of severe maternal outcomes and to assess the quality of maternal health care.

**Results** The number of women attending our facility with severe maternal complications was low (205 in 6,767 live births); as a result maternal near-miss ratio (MNMR) was low; 3.98/1,000 live births; Overall Maternal near-miss mortality ratio (MNM:1MD) was also low, 3.37:1, because of strict criterion of labeling near-miss and delay in referral

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to the hospital. Hypertensive disorder (37.5 %) was the commonest underlying cause for maternal mortality.

**Conclusion** Basic implementation of WHO near-miss approach helped in the systematic identification and evidence-based management of severe maternal complications thereby improving the quality of maternal health in a developing country.

**Keywords** Maternal morbidity · WHO near-miss approach · Severe maternal outcomes

## Introduction

Since the declaration of the Millennium Development Goals (MDGs) in 2000, the 5th MDG goal, reproductive health, has been recognized as fundamental for human development. Maternal health status is assessed through measurement of mortality and morbidity.

Maternal mortality is just the tip of iceberg; there is a vast base in the form of severe acute maternal morbidity (SAMM). Out of all the women who develop severe acute complications during pregnancy some die, but a certain proportion of them narrowly escape death (Near Miss). Evaluation of these cases helps us in monitoring the quality of hospital-based obstetric care and also complement in the investigation of maternal deaths. Timely identification of women with severe maternal complications and corrective actions for identified problems during their management can help in reducing maternal mortality and morbidity.

A maternal near-miss case is “a woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy.” [1, 2]. In practical terms, women are considered near-miss cases when they survive life-threatening conditions (i.e., organ dysfunction). Since near-miss/SAMM cases occur more frequently than maternal deaths and share common causes, they directly inform about the obstacles that had to be overcome after the onset of an acute complication.

In the guidance document of for quality-of-care assessments related to severe maternal morbidity and near miss [3], there are recommendations to use a broader set of criteria, which includes severe maternal complications (e.g., severe pre-eclampsia, ruptured uterus), critical interventions (e.g., laparotomy, use of blood products), and the strict near-miss criteria. These Strict criteria are related to organ dysfunctions and useful for quantitative assessments and international comparisons [4, 5].

In recent years, evidence from developing countries, analyzing the near-miss cases help in understanding health system failures in relation to obstetric care [6].

The purpose of this study is to improve clinical practice and to reduce preventable morbidity and mortality by implementing WHO near-miss approach for maternal health care.

## Material and Methods

This was a prospective study conducted at a tertiary care center over a period of 15 months (January 2012–March 2013). The study was conducted by implementing WHO near-miss basic approach for maternal health. All women who were pregnant, in labor, or who delivered or aborted up to 42 days ago arriving at the facility with potentially life-threatening conditions, and/or received critical interventions, or who came to the facility in life-threatening condition were included in the study.

### Eligibility Criteria

#### *Potential Life-Threatening Conditions (PLTC)*

**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 Intensive Care Unit Use** Admission to intensive care unit: Interventional radiology, Laparotomy (includes hysterectomy, excludes caesarean section), and Use of blood product. In our study, we have taken into consideration minimum two units of blood transfusion.

#### *Life-Threatening Conditions (Near-Miss Criteria)*

**Cardiovascular Dysfunction** Shock, cardiac arrest (the absence of pulse/heart beat and loss of consciousness), use of continuous vasoactive drugs, cardiopulmonary resuscitation, severe hypoperfusion (lactate  $>5$  mmol/l or  $>45$  mg/dl), and severe acidosis (pH  $<7.1$ ).

**Respiratory Dysfunction** Acute cyanosis, gasping, severe tachypnoea (respiratory rate  $>40$  breaths/min), severe bradypnea (respiratory rate  $<6$  breaths/min), intubation and ventilation not related to anesthesia, and severe hypoxemia ( $O_2 <90$  % for  $\geq 60$  min or  $PAO_2/FiO_2 <200$ ).

**Renal Dysfunction** Oliguria nonresponsive to fluids or diuretics, dialysis for acute renal failure, and severe acute azotemia (creatinine  $\geq 300$   $\mu\text{mol/ml}$  or  $\geq 3.5$  mg/dl).

**Coagulation/Hematological Dysfunction** Failure to form clots, massive transfusion of blood or red cells ( $\geq 5$  units), and severe acute thrombocytopenia ( $<50,000$  platelets/ml).

**Hepatic Dysfunction** Jaundice in the presence of pre-eclampsia, and severe acute hyperbilirubinemia (bilirubin >100  $\mu\text{mol/l}$  or >6.0 mg/dl).

**Neurological Dysfunction** Prolonged unconsciousness (lasting  $\geq 12$  h)/coma (including metabolic), stroke, uncontrollable fits/status epilepticus, and total paralysis.

**Uterine dysfunction** Uterine hemorrhage or infection leading to hysterectomy.

#### Maternal Vital Status: Maternal Death

Eligible women were identified either at the time of admission or on visit to obstetric ward, labor room and ICU. Records of all women with potentially life-threatening condition (PLTC) or who developed life-threatening conditions (LTC) during their hospital stay or died were analyzed.

The relevant contributory/associated conditions were also identified and noted. The final maternal outcomes were noted in all women.

Data collection of eligible women was done in the form designed by WHO, which was filled either at the time of admission or when they developed organ dysfunction. The data were also collected for critical intervention. Using the collected data various maternal near-miss indicators, i.e., maternal near-miss ratio (MNMR), severe maternal outcome ratio (SMOR), maternal near-miss mortality ratio (MNM:1MD), mortality index (MI) were calculated. The study was approved by the institutional ethical committee.

**Maternal near-miss ratio** is the number of near-miss cases per 1,000 live births. **MNMR** is the ratio between maternal near-miss cases and maternal deaths. For this indicator, higher ratios indicate better care, meaning more women survived as a near miss rather than becoming maternal deaths. Also, **mortality index (MI)** was calculated, where the number of maternal deaths was divided by the number of women with life-threatening conditions (maternal near-miss and maternal deaths) and was expressed as a percentage. Higher indices indicate that more women with life-threatening conditions die (low quality of care), whereas lower indices signify better quality of care. **SMOR** is the number of women with life-threatening conditions per 1,000 live births. This indicator gives an estimation of the amount of care and resources that would be needed in an area or facility [3].

## Results

During the 15 months of study from January 2012 to March 2013, there were a total of 6,892 deliveries and

6,767 live births. 205 patients fulfilled the eligibility criteria, out of these, 35(17 %) women had severe maternal outcomes (27 near-miss and 8 maternal deaths). Cases were analyzed according to complication with which they had presented to the facility, critical intervention, organ system dysfunction, and underlying causes of morbidity as shown in Tables 1, 2, and 3 respectively.

Severe pre-eclampsia 26 (12.7 %) was the commonest severe maternal complication followed by severe PPH 17 (8.3 %). The commonest critical intervention was blood transfusion, 2 or more units 150 (73 %), followed by laparotomy 59 (28.8 %) and admission to ICU was 44 (21.5 %) (Table 1).

The most commonest organ dysfunctions observed in women with severe maternal outcome (35) was coagulation and hematological dysfunction 26 (74 %). Uterine dysfunction was seen in 13 (37 %) and with timely effective intervention, i.e., hysterectomy, all were saved (near miss). Respiratory organ dysfunction was seen in 7 (20 %) in women with severe maternal outcome out of which six died. Three women (8.6 %) had multiple organ dysfunction at the time of admission, and all of them died within 12 h (Table 2).

Underlying causes were similar in potentially life-threatening conditions and near-miss case, most commonest being obstetric hemorrhage. Hypertensive disorder (37.5 %) was the commonest underlying cause for maternal mortality. The commonest contributory cause was anemia in all the three groups. Previous cesarean leading to morbidly adherent placenta was significant contributory cause in near-miss cases. Dengue fever was associated in one patient who ultimately died (Table 3).

In our study, MI was 22.8 %; and intrahospital MI was 14.2 %; MNMR was 3.98/1,000 live births, maternal near-miss mortality ratio (MNM:1MD) was 3.37:1: low, because

**Table 1** Morbidity conditions in eligible women ( $n = 205$ )

Morbidity condition	Number	Percentage
Women with severe complications	68	33
Severe postpartum hemorrhage	17	9
Severe pre-eclampsia	26	12.6
Eclampsia	2	1
Sepsis	3	1.46
Ruptured uterus	3	1.46
Other complications associated with severe maternal outcomes	11	5.36
Critical interventions	172	84
Use of blood products	150	73
Interventional radiology	Nil	0
Laparotomy	46	22.4
Admission to ICU	44	21.5

**Table 2** Organ dysfunction in severe maternal outcome ( $n = 35$ )

Organ dysfunction	Severe maternal outcome (35)	Near miss (27)	Maternal death (8)
Cardiovascular	4 (11.5 %)	1 (2.8 %)	3 (8.5 %)
Respiratory dysfunction	7 (20 %)	1 (2.8 %)	6 (17 %)
Renal dysfunction	6 (17 %)	3 (8.5 %)	3 (8.5 %)
Coagulation/hematological dysfunction	26 (74 %)	21 (60 %)	5 (14.2 %)
Hepatic dysfunction	3 (8.5 %)	2 (5.7 %)	1 (2.8 %)
Neurological dysfunction	1 (2.8 %)	nil	1 (2.8 %)
Uterine dysfunction	13 (37 %)	13 (37 %)	nil
Multiple organ dysfunction	3 (8.5 %)	nil	3 (8.5 %)

**Table 3** Underlying causes & associated conditions of PLTC & severe maternal outcome

Underlying causes and assoc conditions	Women with PLTC $n = 170$	Maternal near-miss cases $n = 27$	Maternal deaths $n = 8$
Pregnancy with abortive outcome	46 (27 %)	2 (7.4 %)	–
Obstetric hemorrhage	48 (28 %)	11 (40.7 %)	1 (12.5 %)
Hypertensive	35 (20.5 %)	7 (26 %)	3 (37.5 %)
Pregnancy related infection	6 (3.5 %)	2 (7.4 %)	1 (12.5 %)
Medical/Surgical/mental Complications	33 (19.4 %)	5 (18.5 %)	2 (25 %)
Unanticipated complications of management	–	–	–
Coincidental conditions	2 (1.17 %)	–	–
Unknown	2 (1.17 %)	–	1 (12.5 %)
Other Obstetrics disease & Complication	30 (17.6 %)	–	1 (12.5 %)
Contributory causes			
Anemia	134 (79 %)	20 (74 %)	5 (62.5 %)
HIV	2 (1.17 %)	–	–
Previous cesarean	34 (20 %)	12 (44.4 %)	2 (25 %)
Prolonged & obstructed labor	–	–	–
Dengue fever	–	–	1 (12.5 %)

of strict criteria of labeling near miss and delay in referral to the hospital.

The organ-wise highest Maternal near-miss mortality ratio was for uterine dysfunction (13;0), followed by coagulation/hematologic (21;5) and Renal (3;1) disorders.

In our study SMOR was 35/6767 i.e. 5.17 %.

## Discussion

During the 1990s and early 2000s, there was a multitude of operational definitions of maternal near miss (MNM), and it was impossible to obtain overall estimates based on those definitions [4]. WHO (2007–2009) developed strict criteria based on clinical, laboratory, and management-based markers of organ dysfunction [5]. Accordingly, survival to any of the selected organ dysfunction markers constitutes a near-miss event. In addition, implementing a surveillance strategy on women with life-threatening conditions being

managed at health care facility can foster a culture of early identification of complications and promote better preparedness for acute morbidities [7].

A study by Roopa et al. [8] evaluated near-miss obstetric events as per WHO 2009 criterion and maternal deaths in a tertiary care center in a developing country. There were 7,330 live births, 755 PLTC cases, out of which, there were 131 maternal near-miss cases and 23 maternal deaths. The Maternal near-miss incidence ratio was 17.8/1,000 live births, maternal near miss to mortality ratio was 5.6:1, and MI was 14.9 % [8].

In our study, MNMR was 3.98/1,000 live births which was low as the number of eligible women was low (205), although the number of deliveries were the same as in the above mentioned study. This is because only the insured group of patients can avail our hospital facility, and to them, effective basic health services are provided at peripheral level. Being a prospective study, PLTC cases were identified at the time of admission and managed

promptly by evidence-based medicine. Out of 27 near-miss cases, 21 women suffered organ dysfunction after being diagnosed as PLTC in our hospital set-up and six near-miss cases were admitted directly, who were also saved at our facility. Out of eight maternal deaths three were referred cases from outside in critical condition and died within 12 h of admission.

Our intrahospital maternal near-miss: MD ratio was 5.4:1, comparable with other studies [8, 9].

This indicates that for every 5–6 life-threatening condition there was one maternal death. Study done in Nepal showed a ratio of 7.2:1. The increase in ratio over a period of time reflects improved maternal care [10, 11].

SMOR was 35/6767, i.e., 5.17. This indicator gives an estimate of the amount of care and resources that would be needed in an area or facility. The patients who presented with severe maternal complications did not have severe maternal outcome in the form of maternal death unless they had organ dysfunction (LTC).

Intrahospital MI was 14.28 %. Overall MI was 22.8 %. The higher the index the more the women with life-threatening conditions die (low quality of care), whereas the lower the index the fewer the women with life-threatening conditions die (better quality of care). Overall, the index is higher in our study due to strict WHO criteria for identification of near-miss cases, and out of eight maternal deaths, three presented late at our facility with multiple organ dysfunction at admission and died within 12 h. In under-resourced settings, there is a need to separate the near-miss cases on arrival to hospital from those that develop in the hospital setting, as the former indicates a failure in access to the facilities and/or to the referral chain where such hospitals would need adequate resources and organization to deal with such emergencies [12].

In 2011, Cecatti et al. [13] studied 673 women admitted in ICU with severe maternal morbidity and could identify 194 cases of MNM and 18 maternal deaths by WHO criteria. They concluded that with the WHO criteria for MNM, they were able to identify almost all the cases of death and organ failure; whereas in our study, 21.5 % of women with severe maternal complications needed ICU admission.

Comparing the major causes of severe maternal outcomes, obstetric hemorrhage and hypertension were the most commonest underlying causes, which is comparable to other studies in developing countries [14, 15]. In our study, medical diseases like heart disease and respiratory dysfunction associated with pregnancy contributed significantly in severe maternal outcomes. Anemia was major contributory factor in 75 % of cases of severe maternal outcome. Similarly Jabir et al. found anemia in more than 50 % of women with severe maternal outcomes [9].

## Conclusion

There is growing evidence that the application of the WHO maternal near-miss approach helps in improving the quality of maternal health care. An early identification of potentially life-threatening conditions and the use of evidence-based interventions for severe maternal complications, can significantly reduce the number of severe maternal outcomes. In low-resource settings, interventions must be developed keeping the local context in mind.

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