

# ANALYSIS OF VARIOUS CRITERIA FOR IDENTIFICATION OF SEVERE ACUTE MATERNAL MORBIDITY IN A RURAL TERTIARY HEALTH CARE CENTRE: A PROSPECTIVE, ONE YEAR STUDY

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## ABSTRACT

**Background:** Maternal mortality has been the indicator of measurement of maternal health. Over the last decade, identification of severe acute maternal morbidity (SAMM) has emerged as a compliment or alternative to investigation of maternal deaths. A review of causes of SAMM will help to find out the potential problems which in turn will enable women to get the treatment on time. Recent researches have suggested that proper identification of SAMM cases can prove to be a better method to monitor the quality and effectiveness of obstetric care than mortality alone. Although there have been many criteria which have been introduced from time to time to identify these cases, because of vast variation of different level of facilities, these criteria cannot be applied across the regions. WHO has recently come up with certain set of criteria which could be more applicable to low resource settings.

**Aims & Objective:** Present study tried to identify SAMM cases through various criteria and compared the applicability of them in our setup which is resource poor setting catering mainly to a huge rural population.

**Materials and Methods:** It is a prospective study done over a period of one year, from September 2012 to August 2013. All severely morbid pregnant women or who had delivered or aborted within 42 days were included. Initial identification of these cases was done on the basis of general criteria and later on other criteria were applied according to the primary obstetric event, clinical features, Lab findings or management provided. A comparison was done amongst all criteria and their individual applicability was checked as per the facility available in our set up.

**Results:** During the study period total 7819 women delivered in the hospital out of which 6498 delivered vaginally and 1321 delivered through caesarian section. Total live births during this period were 5219. The present study found an incidence of severe maternal morbidity/near miss ranging from 5.56 to 40 per 1000 live births. Among 244 women suspected to be SAMM/MNM, 179(73%) met Waterstone's criteria, 48(20%) met Mantel's Criteria and 63(26%) met WHO criteria, 20% women met Mantel and Waterstone's criteria both while 17% met all three criteria.

**Conclusion:** The study of SAMM cases and their identification through suitable criteria can contribute to know its magnitude, as well as to identify most frequent characteristics and clinical conditions which will help to recognize the problems in antenatal services, peripheral health care facilities and referral system. The criteria which are available now cannot be applied uniformly, and need to be tailored to identify more specific criteria according to infrastructure of a particular setting in order to utilize resources effectively.

**Key Words:** Severe Acute Maternal Morbidity; Mantel's Criteria; Waterstone's Criteria; WHO Criteria

## Introduction

The world Health Organization (WHO) in the year 2004 estimated that 20 million women suffered from acute complications in pregnancy with the occurrence of 529,000 maternal deaths.<sup>[1-3]</sup> India accounted for about a quarter of these deaths. Each year in India, roughly 30 million women experience pregnancy and 27 million have a live birth.<sup>[4]</sup> An estimated 136,000 maternal deaths occur each year. There are numerous episodes of maternal morbidities for every maternal death. The range varies from 15 permanent disabilities to 100 acute episodes of morbidities for each maternal death.<sup>[5]</sup> These data clearly indicate that pregnancy related mortality and morbidity continues to take a huge toll on the lives of Indian women (Registrar General India, Survey of causes of death –rural 1998).

The concept of Severe Acute Maternal Morbidity (SAMM)/Maternal Near Miss (MNM) is relatively new in maternal care and has been proposed as a supplementary indicator for monitoring the quality of maternity care.<sup>[6-9]</sup> A pregnant or recently delivered woman who nearly died from a critical condition is often described as a "near miss" or "severe acute maternal morbidity". The WHO working group on maternal mortality and morbidity classifications proposed the term "maternal near miss" (MNM) which can be defined as "any woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy".<sup>[10]</sup>

The underestimation of maternal deaths and use of inaccurate database often hinders the analysis of determinants of maternal mortality and the development of targeted public policies.<sup>[11,12]</sup> The use of data collected on SAMM has been shown to be a mechanism for

identifying health system failures or priorities in maternal health care more rapidly than maternal deaths.<sup>[8]</sup> Severe maternal morbidity/near miss can be a more valuable indicator than maternal mortality as this condition has greater incidence and offers a good opportunity for data collection as the women herself can be a source of information. Its routine use as an indicator, however, is limited due to lack of uniform criteria for identification of cases. Lack of consensus can be in part attributed to a broad spectrum of clinical severity; it is difficult to set the point which characterizes severe maternal morbidity somewhere between a healthy pregnancy and maternal death.<sup>[13]</sup> Therefore, the study of SAMM is a key to advance knowledge about risk factors during pregnancy, and can be used as a valuable tool to identify priorities in maternal care more rapidly and monitor the delivery of obstetric care.<sup>[6]</sup>

Over the time three approaches based on different indicators have been proposed to identify severe maternal morbidity/near miss: (a) organ dysfunction<sup>[6]</sup>; (b) presence of condition or complications such as severe preeclampsia, uterine rupture, severe sepsis etc<sup>[14,15]</sup>; (c) level of care complexity such as blood transfusion or intensive care unit (ICU) admission<sup>[7,16]</sup>. The WHO working group on Maternal Mortality and Morbidity has recently developed a uniform set of criteria for case identification based on three established approaches with clinical, laboratory and management markers.<sup>[10,17]</sup>

The present study aimed to describe the epidemiological profile of severe maternal morbidity/near miss and its maternal outcomes in regional tertiary level health care centre. In addition, it also tried to compare applicability of most commonly used criteria to identify SAMM/MNM cases in a low resource setting.

**Materials and Methods**

A prospective cross-sectional study was conducted from September 2012 to august 2013 at Gandhi Memorial Hospital which is a Government affiliated regional tertiary health care centre and attached with a medical teaching institute. Study was approved by Institutional Ethical Review Committee (Human Studies). The catchment area of this hospital is around 24,278 km<sup>2</sup>, inhabiting 57,188,77 population (Census 2011).

**Inclusion Criteria:** All maternal deaths and suspected SAMM/MNM cases that were admitted during above mentioned period were included. In this study maternal death (MD) is defined as “The death of a woman while

pregnant or within 42 days of termination of pregnancy from any cause”. SAMM/MNM cases included “All women who during pregnancy or, childbirth or within 42 days postpartum showed any clinical signs that met the defining criteria of SAMM/MNM based on Mantel et al, Waterstone et al and WHO classification” (Table 1 to 3).

**Table-1: Waterstone et al. Criteria**

- Severe pre-eclampsia: BP = 170/110 mmHg twice, 4-hours apart or; BP >170/110 associated with 24-hour proteinuria greater than 0.3 g or ++ on a stick
- Eclampsia
- HELLP syndrome
- Severe hemorrhage (blood loss >1,500 mL)
- Severe sepsis
- Uterine rupture

**Table-2: Mantel et al. Criteria**

- Pulmonary edema
- Cardiopulmonary resuscitation
- Hypovolemia (requires 5 or more units of packed red blood cells)
- Admission to the Intensive Care Unit (ICU) for sepsis or other causes
- Emergency hysterectomy
- Ventilation for more than 60 minutes, except for general anaesthesia
- O2 saturation below 90% for more than 60 minutes
- Alveolar pressure of oxygen/inspired fraction of oxygen (PaO2/FiO2) ratio >300 mmHg
- Diuresis less than 400 mL/24 hours, refractory to hydration, furosemide or dopamine
- Acute deterioration of BUN and creatinine (> 15 mol and >400 mol)
- Jaundice with pre-eclampsia
- Diabetic ketoacidosis
- Thyroid storm
- Acute thrombocytopenia requiring platelet transfusion
- Coma for more than 12 hours
- Subarachnoid or intraparenchymal hemorrhage
- Anesthetic accident: severe hypotension after-blockade and failed intubation

**Table-3: WHO Criteria**

Clinical Criteria	Laboratory Criteria	Management Criteria
<ul style="list-style-type: none"> <li>• Acute cyanosis</li> <li>• Gaspings</li> <li>• AVC</li> <li>• Respiratory frequency &gt; 40 or &lt;6</li> <li>• Shock</li> <li>• Oliguria not responsive to fluids or diuretics</li> <li>• Coagulation disorders</li> <li>• Total paralysis</li> <li>• Loss of consciousness for ≥ 12h</li> <li>• Jaundice with pre-eclampsia</li> <li>• Unconsciousness and no pulse/heartbeat</li> </ul>	<ul style="list-style-type: none"> <li>• Oxygen saturation &lt;90% for ≥ 60% minutes</li> <li>• PaO2/FiO2 &lt; 200 mmHg</li> <li>• Creatinine ≥300 mmol/L or ≥ 3.5 mg/dL</li> <li>• Bilirubin &gt;100 mmol/L or &gt;6.0 mg/dL</li> <li>• pH &lt;7.1</li> <li>• Lactate &gt;5</li> <li>• Acute thrombocytopenia (&lt;50 000 platelets)</li> <li>• Loss of consciousness and ketoacidosis and glucose in urine</li> </ul>	<ul style="list-style-type: none"> <li>• Continued use of vasoactive drugs</li> <li>• Hysterectomy for postpartum hemorrhage or infection</li> <li>• Transfusion of ≥5 units of PRBCs</li> <li>• Dialysis for acute renal failure</li> <li>• Intubation and ventilation for ≥60 minutes not related to anaesthesia</li> <li>• Cardiopulmonary resuscitation (CPR)</li> </ul>

**Data Collection and Statistical Analysis:** Data were collected prospectively and suspected cases of SAMM/MNM were identified on daily basis by either of the authors during routine visits to Labour room, emergency wards and Intensive care unit. After initial identification, cases were further followed up to classify them according to different SAMM identifying criteria. The data collection

instrument was based on Mantel, Waterstone and WHO criteria. It consisted of a semi-structured questionnaire with open and closed questions. After completeness of data, they were entered into a database using Microsoft Excel 2003. The following data were collected: age; distance of residence; education level; prenatal visits; gestational age; parity; type of delivery; markers used to identify SMM and direct and indirect cause of death in case of Maternal death. A descriptive analysis was carried out comparing the different criteria of maternal morbidity. Measures of central tendency were estimated for continuous variables and measures of frequency for categorical variables. The assessment of indicators of maternal morbidity and mortality was done on the basis of formulas recommended by WHO were used.<sup>[10]</sup> Definition of each of these criteria is as follows:

- Absolute Number of near-miss cases: Number of near-miss cases diagnosed by particular criteria.
- Near miss rate: Number of near-miss cases per 1000 live births.
- Severe maternal outcome ratio (SMOR): Number of women in life threatening situation (MD+MNM) per 1000 live births.
- Maternal near miss/mortality ratio: Ratio between near miss and maternal deaths.
- Maternal mortality rate (Mortality Index): MD/MD+MNM (Percentage).

## Results

During the study period total 7819 women delivered in the hospital out of which 6498 delivered vaginally and 1321 delivered through caesarian section. Total live births during this period were 5219. The characteristics of the women diagnosed with severe acute maternal morbidity/near miss are presented in Table 4. Their mean age was 27 years, there were more cases in the age group 20-29 years, regarding education status, 66 women were illiterate while 108 had passed primary school, 67 passed high school and 3 were graduates. Eighty eight percent women were from rural area and, 74% of women was unbooked and only 12% was fully booked. Eighty one women were primigravida, 145 were second or third gravid while 18 were grand multigravida.

Table 5 shows the most commonly used criteria used to diagnose SMM cases and compares them with Waterstone's, Mantel's and WHO criteria. Among 244 women suspected to be SMM/MNM, 179(73%) met Waterstone's criteria, 48(20%) met Mantel's Criteria and 63(26%) met WHO criteria, 20% women met Mantel's and Waterstone's criteria both while 17% met all three criteria.

**Table-4: Characteristics of Women**

Characteristics	N	%	
Age in years	10-19	4	2
	20-29	213	87
	30-39	24	10
	≥40	3	1
Education status	Illiterate	66	27
	Primary	108	44
	High school	67	28
	Graduate	3	1
Type of residence	Rural	215	88
	Urban	29	12
Antenatal care	Booked (≥3 visits)	30	12
	Unbooked	180	74
	Partially Booked (<3 visits)	34	14
Gravidity	1	81	34
	2-3	145	59
	≥4	18	7

**Table-5: Comparison of number & percentage of SMM cases through different criteria**

Various criteria in use	General Waterstone's	Mantel's	WHO
<b>Disease based criteria</b>			
Severe preeclampsia	11		
Eclampsia	86		
HELLP Syndrome			
Severe Hemorrhage	59		
Severe Sepsis	5		
Uterine rupture	18		
<b>Clinical Criteria</b>			
Acute Cyanosis			
Gasping			
RR>40 OR <6/min	48		10
Shock	79		30
Oliguria nonresponsive to fluids or diuretics			
Coagulation dysfunction		1	1
Altered sensorium	4		
Total paralysis/uncontrollable fits	2		
Loss of consciousness >12 hrs			
Jaundice with preeclampsia		16	
Cardiac Arrest			
Pulmonary Edema	12		15
<b>Laboratory findings</b>			
Oxygen saturation<90% for ≥60 min	2		2
Pao2/fio2 < 200mmhg			
Creatinine≥ 300mmol/L or > 3.5 mg/dl			
Bilirubin > 100mmol/L or > 6 mg/dl	1		2
Ph <7.1			
Lactate >5			
Acute thrombocytopenia (plt <50,000)			
Loss of consciousness with lactoacidosis and glucose in urine			
<b>Management based criteria</b>			
Admission to ICU		1	
Em hysterectomy		15	15
Use of blood products	96		
Intubation ≥ 60min not related to anaesthesia			
CPR			
Continued use of vasoactive agents			3
Dialysis for acute renal failure			
Total	244	179 (73%)	48 (20%) 63 (26%)

**Table-6: Estimation of SMM indicators by different criteria**

SMM indicators	General	Waterstone's	Mantel's	WHO
Absolute number of Near-miss	244	179	48	63
Near-Miss Rate	41.38	29.70	5.56	6.83
Severe maternal outcome Ratio	46.75	34.29	9.19	12.07
Maternal Near-miss/Mortality ratio	7.7	6.46	1.52	1.33
Mortality Index (Mortality rate)	11.48%	13.40%	39.58%	42.85%

The most commonly associated primary obstetric event was hypertensive disorders of pregnancy (40%), followed by hemorrhage (24%) and 7.37% women of SMM had uterine rupture as associated primary obstetric event. As for clinical outcome, 198 women were discharged in good health, 15 had sequel and 3 were referred to higher institute in view of non-availability of blood components at our institute. Table 6 compares status of different WHO indicators estimated by different identifying criteria.

## Discussion

The present study found an incidence of severe maternal morbidity/near miss ranging from 5.56 to 40 per 1000 live births. These data are consistent with those reported in the literature.<sup>[18,19]</sup> Souza et al<sup>[20]</sup> found SMM rate of 15 to 42 cases per 1000 births, depending on criteria used. The mortality rate and ratio of SMM cases found in present study is comparable with other studies. Mantel observed a maternal mortality rate of about 20% and case fatality ratio of 4:1 which is comparable with our study using the same criteria.<sup>[6]</sup>

In present study Waterstone's criteria identified greater number of SMM cases and most of them (40%) had hypertensive disorders of pregnancy followed by complications of severe hemorrhage (24%), mainly due to Post-Partum Hemorrhage which was also contributed by incomplete abortion and ruptured ectopic pregnancy. Brazilian studies<sup>[20-22]</sup> also reported hypertensive syndromes as the most commonly associated causes with SMM Cases as much as 57% in Souza et al study<sup>[20]</sup>. Reichenheim et al<sup>[23]</sup> reviewed the literature for indicators of near miss and found ICU admission (54.9%), eclampsia and obstetric hemorrhage (52.9%) as the most commonly identified. Filippi et al<sup>[24]</sup> in a study in Africa, identified hemorrhage and hypertensive disorders as the most common conditions associated to SMM. In present study 59 cases of severe hemorrhage and 97 cases of hypertensive disorders were identified by Waterstone's criteria while only 17 cases of severe hemorrhage and 13 cases of hypertensive disorders were identified by WHO, as shock and pulmonary edema have been included in identifying criteria which are easier to recognize, although it recognized all case which eventually died, while Mantel's criteria identified even lesser cases (13 and 8 respectively), because of non-availability of extensive lab

investigations at institute round the clock and use of threshold of 5 units blood transfusion. Waterstone's criteria is an easy-to-use approach with good sensitivity but low specificity (mortality index lower than other two) which means that if only these criteria used to identify SMM cases there would be more chances of overburdening the already understaffed facilities in a resource poor setting. Therefore it is desirable that after identifying the primary obstetric event further triage should be done through clinical and laboratory criteria to maximize the utilization of high dependency units and ICU in a low resource setting.

The maximum units of blood received by hemorrhagic patients in study institute were 3 as blood bank is not very well supplied by blood and blood component therapy is not available. WHO and Mantel's criteria of receiving 5 or more units of blood seems to have lower applicability in resource poor institute. Several authors<sup>[18,22]</sup> have argued this high threshold and some authors set it at 1500mL (equivalent to three or more units) as reported in Ghana and Thailand.<sup>[20,25]</sup>

ICU admission is used as a marker in Mantel's criteria which doesn't seem to be useful criterion in low resource setting as we identified only one case on the basis of this criterion which could be identified by other criteria too. Availability of bed in ICU is a major determining factor in a low resource setting, therefore use of this criteria is questionable in identifying SMM cases.<sup>[26,27]</sup>

In present study 241 out of 244 total SMM cases were identified at admission while only 3 women were identified during admission this separation is a good indicator of effective emergency referral system and level of care provided to already admitted patients. Filipi et al<sup>[24]</sup> also suggested this kind of separation for the monitoring of timely referral of sick women and performance of obstetric care services at a particular facility.

## Conclusion

With abundant experiences in the field of maternal health it is understood by now that occurrence of complications during pregnancy is not only associated to the level of human development issues but also to difference in detection and management of obstetric complications. Prompt diagnosis and adequate management actually contribute to differences in maternal morbidity and mortality rates between countries and regions.<sup>[25]</sup>

In present study, Mantel's and WHO's criteria were able to identify comparable number of cases, although Mantel's



criteria were less applicable than WHO criteria as Mantel's criteria are more based on laboratory diagnosis while WHO criteria uses more of clinical criteria which were easier to apply as laboratory facilities are not available for all investigations round the clock, only basic investigations are being done during emergency hours due to lesser resources. Both of these criteria showed a very high threshold for identifying SAMM cases therefore making them more specific. In present study out of 244 cases of SAMM 156 showed improvement within 4 hours of primary treatment, therefore to utilize the resources more effectively it would be prudent to apply a triage system or stepwise exclusion of SAMM cases by using more broader criteria suggested by Waterstone on admission, followed by application of clinical criteria for confirmation of SAMM cases and finally performing elaborate lab investigations which are scarcely available, only on these patients. Present study highlights the fact that as SAMM cases places a significant burden on health resources and reflects the quality of health care available in rural tertiary care centre of our country, timely identification of these cases and a careful tailored monitoring will help to utilize our resources more effectively. Eclampsia, Severe pre eclampsia, Hemorrhage, Rupture uterus still remains main causes for SAMM and ultimately maternal deaths. As in present study, 98.77% SAMM cases were diagnosed at admission and had already had these complications because of inability to reach to the facility on time, further strengthening of antenatal care services at peripheral level and a robust referral system through better availability of transport facilities is needed to prevent delay in reaching higher level facility.

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