

**AN ANALYSIS OF MATERNAL DEATH IN A TERTIARY CARE CENTRE AT CHENNAI**

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**ABSTRACT**

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**BACKGROUND**

Maternal mortality is a reflection of the care given to women by its society. It is tragic that deaths occur during the natural process of child birth and most of them are preventable. This study was done to evaluate the maternal mortality in our hospital, to assess causes of maternal mortality, and to suggest recommendations for improvement.

**OBJECTIVE**

We sought to examine aetiology and preventability of maternal death in a series of 15093 deliveries at a tertiary care centre in Chennai from 1<sup>st</sup> January 2015 to 31<sup>st</sup> December 2015.

**STUDY DESIGN**

This is a retrospective study based on medical records of all maternal deaths in this time period combined with verbal autopsy of the relatives of the victims and audit meetings conducted in the institution.

**RESULTS**

31 maternal deaths occurred among 15093 live births (205/1,00,000 live births). Leading causes of maternal deaths were complications of pre-eclampsia (33%), cardiac diseases complicating pregnancies (19%), obstetrical haemorrhage (16%), thromboembolism (10%) and others including anaemia and its complication, sepsis and non-obstetric infection.

**CONCLUSION**

Timely monitoring/ management during antenatal and intra-natal period would substantially reduce maternal mortality.

**KEYWORDS**

Maternal Mortality Ratio, Maternal Mortality, Prevention.

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**INTRODUCTION:** An estimated 300,000 women died globally in 2015 as a result of pregnancy related conditions.<sup>1</sup> Reduction of maternal mortality has long been a global health priority and is the target of UN Millennium Development Goal-5 for Improving Maternal Health launched by the UN Secretary- General in September 2010.<sup>2</sup> To reach the target of the Millennium Development Goal-5, a decrease of maternal mortality ratio by three quarters between 1990 and 2015 is needed.<sup>3</sup> This translates to reducing the MMR from 560 in 1990 to 140 in 2015 for India.

Sample registration service (SRS) report published by the Registrar General of India (RGI) in 2013 states Tamilnadu MMR as 79/100,000 live births.<sup>4</sup> Some progress in the target has been reported in various studies but further improvements are needed.<sup>5,6,7</sup> Factors associated with reduction of maternal mortality include the promotion of

policies to reduce anaemia and malnutrition, prevent malaria in pregnancy, provide calcium and micronutrient supplementation, encourage deliveries in facilities properly resourced for emergency obstetric care, discourage early motherhood, and reduce unsafe pregnancy termination. Reduction in maternal mortality has also been attributed to reduction in the total fertility rate, increase in maternal education, and increased access to skilled birth attendants.<sup>5</sup>

**DEFINITIONS:** The International Code of Diseases (ICD-10) definitions for maternal death and its subclassifications are as follows.<sup>8,9</sup>

**Maternal Death:** The death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes. Among estimated 3,00,000 women who died globally in 2015 as a result of pregnancy related conditions most of the maternal deaths occurred in Sub-Saharan Africa (1,79,000 deaths).<sup>10</sup> Nearly a third of maternal deaths worldwide occurred in two countries: 17% in India and 14% in Nigeria.

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**Maternal Mortality Ratio:** Maternal Mortality Ratio (MMR) refers to the number of maternal deaths during a given time period per 100,000 live births. This is the most commonly used measure of maternal mortality and serves as an indicator of the risk for death once a woman has become pregnant.

The denominator is live births rather than all pregnancies because of the difficulty in ascertaining the number of miscarriages and abortions in the population.

**Maternal Mortality Rate:** It is defined as the number of maternal deaths in a given period per 100,000 women of reproductive age (15-49 years of age) during the same period. Since the frequency of pregnancy in women of child bearing age is a factor in calculating the rate, it is altered by differences in the frequency of pregnancy or birth in the population even though the risk of maternal death per pregnancy/birth remains unchanged.

**Direct Obstetric:** Direct obstetric death results from obstetric complications of pregnancy, from interventions, omissions, incorrect treatment, or from chain of events resulting from pregnancy, labour, delivery, or postpartum conditions. About 75% of maternal deaths worldwide between 2003 and 2009 were due to direct obstetric causes. Haemorrhage accounted for 27.1%, hypertensive disorders 14.0% and sepsis 10.7% of maternal deaths, with the remainder due to abortion (7.9%), embolism (3.2%), all other direct causes of death (9.6%).<sup>11</sup> Direct obstetric deaths accounted for about the same proportion of maternal deaths in both resource-rich and resource-limited settings. However, embolism was a more common cause of death than sepsis in resource-rich settings. Additionally, regional estimates show substantial variation.<sup>12</sup>

**Indirect Obstetric Death:** The terms non-maternal, non-obstetrical, and indirect maternal death are used interchangeably with indirect obstetric death. An indirect obstetric death results from pre-existing disease (e.g. diabetes, cardiac disease, malaria, tuberculosis, HIV) or a new disease that develops during pregnancy and is unrelated to pregnancy-related conditions, but is aggravated by the physiologic effects of pregnancy (e.g. influenza). Maternal deaths from indirect causes, or conditions antedating pregnancy, but aggravated by pregnancy, account for about 25% of maternal deaths.<sup>11</sup> while conditions such as asthma and systemic lupus erythematosus are relatively common diseases in women, death during pregnancy from these conditions is uncommon unless associated with hypertension-related complications.

Various methods for conducting review includes medical certification in vital registration, household surveys (Including sisterhood method), census records, and reproductive age mortality studies (RAMOS). Although many of these methods are imprecise, they provide some baseline information on the causes and magnitude of maternal deaths. Resource poor countries often apply their limited resources towards implementation of processes to decrease

maternal mortality, rather than toward improvement of surveillance programs. Analysis of near miss maternal morbidities represent events that would have resulted in a maternal death during pregnancy and childbirth if significant medical intervention was not instituted.<sup>13</sup>

Delay in seeking and receiving care-The "Three Delays" model has been widely applied in the global context to understand and investigate complex social, cultural and medical events contributing to maternal deaths. Delays include:

- Delay in the decision to seek care.
- Delay in arrival to an appropriate medical facility.
- Delay in receiving adequate care once a woman arrives to medical facility (e.g. unrecognised or undertreated life threatening condition, inadequate facilities for severity of disease).<sup>14</sup>

Maternal deaths in Tamilnadu has been drastically decreasing over decades but of recent years it is remaining more or less constant due to stagnation in quality improvement or masking of decreasing MMR due to streamlining of referral of patients from primary and secondary care centres, thus preventing under-reporting. The occurrence of newer diseases or more virulent forms of established disease contributes to the plateau of the MMR. Alternatively improved overall quality of maternal care may be masked by the rising rate of caesarean delivery given the known association of these procedures with increased rate of maternal deaths.

1. We sought to analyse the causes of maternal deaths in the year 2015.
2. To what extent are the events preventable by improved individual quality of care.
3. Has systemic changes in the delivery of obstetric health care impacted the maternal death in our institution?

**MATERIAL AND METHODS:** We conducted retrospective study of all the maternal deaths based on medical records of the individuals, reports of verbal autopsy, and audit reports of all the maternal deaths in our institution between 1<sup>st</sup> January and 31<sup>st</sup> December 2015. When necessary to clarify the chain of events leading to death the health care providers were interviewed. The data was collected using standardised proforma. Causal relationship regarding mode of delivery was also conducted. Judgement was made regarding the appropriateness of the route of delivery in an individual case. This analysis was carried out as part of a quality improvement initiative, aimed at identifying causes of maternal deaths within our system and development of improved process to prevent such events.

**Inclusion Criteria:** All maternal deaths in our hospital between 1st January to 31st December 2015 were included in the study.

**RESULTS:** There were 31 maternal deaths among 15093 live births (205/1,00,000 live births). Median maternal age of women who died of pregnancy complication in the study group was 26 years, (Range 20-45 years). Median parity was 1 (Range 0-6).

**Maternal Deaths According To Gestational Age:** Most of the deaths (71%) occurred in the third trimester followed by the second trimester with 26% of the deaths.

Only one death occurred in the first trimester in the time period of the study (Table 1). Among third trimester deaths, incidence increased with advancing gestational age.

| Gestational Age | No. of Patients | Percentage |
|-----------------|-----------------|------------|
| <14 weeks       | 1               | 3%         |
| 14-28           | 8               | 26%        |
| 28-36           | 5               | 16%        |
| >36 weeks       | 17              | 55%        |

**Table 1: Maternal Deaths Based on Gestational Age**

**Causes of Maternal Death:** 31 deaths were classified into direct or obstetric cause which attributed for 65% of the deaths and indirect or non-obstetric cause attributing for 35%. Major contributors to maternal death were pre-eclampsia and its complication in 10 deaths. Haemorrhagic shock in 5 and heart disease complicating pregnancy in 6 deaths. Pulmonary embolism accounted for 3 maternal deaths with anaemia and sepsis following abortion each contributing to one death (Table 2).

| Causes of Maternal Death  | Number    | Percentage (%) |
|---------------------------|-----------|----------------|
| Pre-eclampsia             | 10        | 32             |
| Obstetric haemorrhage     | 5         | 16             |
| Thromboembolism           | 3         | 10             |
| Cardiac disease           | 6         | 20             |
| Jaundice                  | 1         | 3              |
| TB                        | 1         | 3              |
| Anaemia with failure      | 1         | 3              |
| Sickle cell crisis        | 1         | 3              |
| Sepsis following abortion | 1         | 3              |
| Febrile illness           | 2         | 7              |
| <b>Total</b>              | <b>31</b> | <b>100%</b>    |

**Table 2: Causes of Maternal Death**

**Obstetric Haemorrhage as a Cause of Maternal Death:** Among the 5 maternal deaths due to obstetric haemorrhage, all were due to postpartum haemorrhage (PPH). All 3 atonic PPH were delivered by LSCS and of the two traumatic PPHs, one was after LSCS and one after labour natural.

**Preeclampsia and its Complications as a Cause of Maternal Death:** Of 10 deaths (33%) due to complications of preeclampsia, 4 were due to antepartum Eclampsia and 3 due to Postpartum Eclampsia. Pulmonary oedema as a consequence of hypertensive crisis was found in 5 cases in addition to eclampsia and intraventricular haemorrhage in 1 and cortical vein thrombosis in 1 case. HELLP syndrome was found in one and Abruptio placenta grade III in one case.

**Timing of Maternal Deaths:** 6 maternal deaths occurred in antenatal period. (Febrile illness-1, cardiac disease in 3 cases, sickle cell crisis-1, anaemia with failure-1). All the other maternal deaths occurred in the intrapartum and postpartum periods.

**Mode of Delivery and Maternal Death:** Among the Intra-natal and Postnatal maternal deaths, on analysing the mode of deliveries, 4 cases were delivered by labour natural while the rest were delivered by caesarean section. Two maternal deaths due to pulmonary embolism were both delivered by LSCS. One patient with cortical vein thrombosis in postnatal period was delivered by labour natural. There was a causal relationship between operative delivery and maternal deaths where operative delivery preceded 4 cases of PPH and 2 cases of pulmonary embolism.

**Medical Conditions Contributing to Maternal Death:** In 35% of cases, pre-existing medical conditions were identified. Thus, most deaths occur in women who are classified as low risk at the beginning of pregnancy. Underlying cardiac disease contributed to maternal death in 6 patients with anaemia and Tuberculosis contributing to one death each. Non-obstetric febrile illness was associated with two maternal deaths in our study.

**DISCUSSION:** In the study by Steven L Clark et al on analysing the causes based on outcome of pregnancies, he has stated.<sup>15</sup>

- Most (60%) maternal deaths occurred after a live birth. For women who died after live birth, the leading causes of death were pulmonary embolism (21%), hypertension (19%), and "other medical conditions" (17%).
- The leading causes of maternal mortality after stillbirths were haemorrhage (21%), hypertension (20%), and infection (19%).
- After spontaneous or induced abortion, the leading causes of maternal death were infection (34%), haemorrhage (22%), and "Other Medical Conditions" (16%).

Undelivered women were most likely to die from "Other medical conditions" (34%) and pulmonary embolism (25%). In our study, major contributors to maternal death were Preeclampsia and its complication in 10 deaths. Haemorrhagic shock in 5 and heart disease complicating pregnancy in 6 deaths. In the study by Say L et al, Haemorrhage was the leading cause and preeclampsia

next.<sup>11</sup> About 25 percent of maternal deaths worldwide occurred antepartum, another 25 percent occurred intrapartum and immediately postpartum, about a third were subacute and delayed postpartum deaths, and the remainder were late deaths. In our study population, 20% of maternal deaths occurred in antepartum, 10% intrapartum and immediate postpartum and 65% in postpartum period and 5% were late maternal deaths.

Preventable error in haemorrhagic shock involved inadequate haemostasis in all these cases; however, prompt attention to clinical signs of haemorrhage and associated hypovolaemia could have avoided death. For example, deaths from obstetric haemorrhage can be reduced through development of protocols, drills, and teamwork. Errors in preeclampsia management leading to maternal death involved inattention to blood pressure control and signs and symptoms of pulmonary oedema. Cardiac patients with availability of better treatment options are able to undergo pregnancy. Patients' education regarding use of proper dosage of drugs without fear of teratogenicity and continuous monitoring by health care providers throughout pregnancy with a multidisciplinary approach will help to prevent mortality in this group.

Ensuring patient has completed the treatment particularly in Tuberculosis prevents the sequelae of the disease and the complications being exacerbated during pregnancy. Anaemia, though given importance and being treated from adolescence itself from various programmes, was still a contributor of maternal death. Timely recognition of anaemia and prompt treatment can help in decreasing the morbidity and mortality due to anaemia. This finding emphasises the need for increasing vigilance even in apparently normal pregnancies and supports the current practice of increased frequency of prenatal visits in late pregnancy from the standpoint of maternal health, irrespective of foetal considerations.

Efforts to reduce MMR have focused on team and individual training; simulations and drills; development of protocols, guidelines and checklists; use of information technology; and education. Death from post-caesarean pulmonary embolus may be reduced by routine use of pneumatic compression devices or other methods of thromboprophylaxis. Caesarean delivery is only rarely causative, deaths were related to the indications for caesarean rather than the procedure itself in our study. If thromboprophylaxis either medical or mechanical is used for patients undergoing LSCS, there could be 70% reduction in death due to pulmonary embolism which occurs at increased rate when compared to vaginal delivery.

In various studies of maternal deaths over last decades, the leading causes of maternal deaths were haemorrhage followed by preeclampsia and related complications. In our study, haemorrhage was reduced to a great extent but preeclampsia and its complications have contributed to the bulk of the deaths. As the pathogenesis of preeclampsia remains unclear, a lot of research needs to be done in this field and management aspects need to be reviewed.

**CONCLUSION:** Establishing good communication between all members of the health care delivery system as well as the patient, and the patient's family is essential. Recognising underlying medical conditions in the individuals, discussion and counselling in preconceptional period regarding the risks of pregnancy and discussion regarding the use of appropriate contraception helps in large number of individuals.

Timely referral of high-risk patients to obstetricians with expertise in caring for these patients and with access to a broad range of specialised services would reduce the mortality rates. Training health care providers in common scenarios like management of severe hypertension or hypotension, treatment of pulmonary oedema in preeclampsia, and early response to postpartum haemorrhage is very much instrumental in reducing the catastrophes in our practice.

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