Hospital-Based Retrospective Cross-sectional Study to Analyse the Causes of Maternal Deaths at a Tertiary Health Care Facility

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ABSTRACT

Context: Maternal mortality is considered a key health indicator of Maternal and Child Health. Considering the fact that complications are preventable and most of them are modifiable, the study has been planned to analyse maternal deaths in order to suggest recommendations for preventing it. There are various delays according to the three-delay model at primary and secondary level; therefore, interventions are needed at those levels to prevent maternal deaths. Aims: To determine the various direct and indirect causes of maternal deaths, analyse the association of medical and social factors with maternal deaths and to determine the predictors of maternal deaths. Settings and Design: Hospital-based retrospective cross-sectional study of all the maternal deaths occurring in the last 4 years at a tertiary health care facility. Methods and Material: Data were collected from the Facility Based Maternal Death Review forms. Statistical Analysis Used: Data were entered and analysed by IBM SPSS version 25.0 software. Results: For maternal deaths, direct obstetric causes were responsible in 128 (74.4%) and indirect causes in 45 (26.2%) cases followed by unspecified causes in 78 (45.3%) and 1 (0.6%) coincidental cause. Statistically significant associations were observed between maternal death and period of gestation, mode of delivery and outcome of delivery ($P = 0.12$, $P = 0.04$ and $P < 0.001$, respectively). Conclusions: The health professionals of primary and secondary level should be well equipped to diagnose the complications and to manage it as early as possible. Thus, maternal mortality rates can be decreased to significant level.

Keywords: Direct and indirect causes, factors associated with maternal deaths, maternal mortality

Introduction

Maternal mortality is considered a key health indicator of Maternal and Child Health (MCH).[1] The direct causes of maternal deaths are well known and are largely preventable and treatable. Most of these complications develop during pregnancy. Other complications may exist before pregnancy but are worsened during pregnancy, especially if not managed as part of the antenatal care provided to pregnant women.[2,3] The major complications that account for nearly 75% of all maternal deaths are post-partum haemorrhage, anti-partum haemorrhage, post-partum septicaemia, pre-eclampsia and eclampsia.[4,5] The most significant contributor to maternal mortality is the time needed to provide adequate care. According to Thaddeus and Maine, the three-delay model can be applied to understand the causes of delays in emergency obstetric care which leads to maternal deaths, eventually calling for interventions to avoid those delays.[6,7]
A retrospective study by Ghumare et al. (2018)\(^9\) shows that 27% delays were in level 1 (decision to seek care by the patient), whereas 21% were delays in the level 3 (women who did not get emergency care at tertiary centre). Dayal et al. (2019)\(^6\) had conducted the retrospective study and found the haemorrhage (36.66%), hypertensive disorders (23.33%) and sepsis (12.5%) were the major direct causes, while anaemia (9.12.5%) was the major indirect cause. The study by Hamal et al. (2020)\(^9\) had highlighted the lack of accountability of the health system in India as a reason for failure to ensure proper essential obstetric care and therefore creating delays.

The government of India had launched several national programmes to decrease the maternal mortality rate and to encourage institutional deliveries such as Janani Suraksha Yojana and Janani Shishu Suraksha Karyakram which have enhanced women's access to maternal health service through conditional cash incentives.\(^8\)\(^11\) Despite all the efforts, maternal mortality rate in India continues to remain high as compared with other countries.\(^8\) There is still less awareness about services among beneficiaries, less deployment of healthcare workers and family physicians at primary levels and persistence of various social factors causing various delays as described in the three-delay model. Thus, there is a felt need to deeply assess the situation and to find out the gaps.

Considering the fact that complications are preventable and most of them are modifiable, the study was planned to analyse maternal deaths. This study tried to determine various direct and indirect causes as well as the predictors of maternal deaths and various medical and social factors associated with it. Further, this study had suggested the recommendations for preventing it.

**Subjects and Methods**

This study was a hospital-based retrospective cross-sectional study conducted at a tertiary health care facility. For the study, all the maternal deaths which occurred during the last 4 years were recorded. Ethical clearance from the Institutional Ethics Committee was obtained. The data were collected from the Facility Based Maternal Death Review Forms (FB-MDRF) which were maintained by the office of Chief Medical Officer, Etawah. A pre-designed and pre-tested working proforma was developed based on FB-MDRF and maternal mortality report register. All the filled FB-MDR forms were included which described the maternal death as per the functional definitions. To address the bias, those forms which were either incompletely filled or the maternal deaths due to causes unrelated to pregnancy were excluded. There was a total of 181 entries, after considering the exclusion criteria sample size arrived as 172 forms [Figure 1].

The working proforma consisted of five parts. The first part contained the social demographic details which included name, address, parity, date of admission and death. The second part had questions regarding gestation period at the time of admission/presentation, reasons for admission, condition on admission, referral information, antenatal check-up information, outcome of pregnancy, duration from onset of complication to admission, period of gestation at the time of death and duration from admission to onset of complication. The third part consisted of risk factors present at the time of pregnancy, complications during antenatal period and complications developed during labour, mode of delivery and details regarding postnatal period. It also consisted of the questions to find out the various interventions during early pregnancy, antenatal period, intrapartum, postpartum and anaesthesia given during labour/delivery. The fourth part consisted of questions to find out the direct obstetric causes and indirect causes along with other contributory causes of maternal death. The fifth part focused on the social factors responsible for the maternal deaths. The ‘Three-D’ delay model by Thaddeus and Maine to identify the gap for maternal death has divided the causes for delay into three subgroups. The first level is the delay in decision to seek care which is reflected by the problems related to family and personal in the proforma. These are refusal for treatment or admission in previous facility. The second level of delay occurs in identifying and reaching health facility which was assessed by the factors like lack of transport from home to home, healthcare facility and between healthcare facilities. There may be delay or breakdown of communication in between health services. The third level of delay is delay in receiving adequate and appropriate treatment. It was assessed by factors like lack of facilities equipment, blood, operation theatres and expertise. The information thus collected in the proforma was entered and scrutinized in the Microsoft Excel spreadsheet. The data were analysed using IBM SPSS version 25.0 software for the mean, median and other relevant statistical measures. Chi-square test and Fisher exact test were applied and P value less than 0.05 at 95% confidence interval (CI) was taken as statistically significant.

**Operational definitions\(^5\):**

**Maternal deaths**

The death of a woman during pregnancy or within 42 days of termination of pregnancy:
- Any site or any duration of pregnancy
- Any cause related to or aggravated by pregnancy or its management
- Death not from accidental or incidental cause
**Direct cause**
Deaths due to pregnancy including labour and postnatal period up to 6 weeks, due to any interventions, incorrect management or complications.

**Indirect cause**
Deaths due to diseases that were present prior to or developed during pregnancy.

**Results**

It was a retrospective cross-sectional study. Out of 172 women, 34 (19.8%) were referred from government facilities, 16 (9.2%) were referred from private hospitals and 122 (70.9%) were directly admitted to the tertiary care health facility. Most of the mothers belong to the age group 15 to 30 years (144, 4.3%) followed by 31 to 45 years (27, 15.7%). Majority (134, 77.9%) were primipara while 38 (22.1%) were multipara. The registered women for antenatal check-up were 63 (36.6%) while 109 (63.4%) were unregistered cases.

Table 1 depicts that among the various reasons for admission, maximum was due to anaemia (95, 55.2%). Medical conditions such as respiratory distress, congestive heart failure, pulmonary oedema, ascites, hypovolemic shock, fever, acute renal failure, pneumonitis etc., were seen in 76 (44.2%), Pre-eclampsia (PET)/eclampsia in 34 (19.8%), post-partum haemorrhage in 23 (13.4%), previous caesarean section in 22 (12.8%) and others (ante-partum haemorrhage, cephalo-pelvic disproportion, ectopic pregnancy, normal delivery and multiple pregnancy) were 46 (26.8%).

Most of the females admitted were medically unstable (94, 54.7%), whereas 78 (45.3%) were in stable condition. Majority (129, 75%) were admitted in postnatal period of pregnancy, followed by antenatal period (37, 21.5%) and least during intra-natal period (6, 3.5%). Most of them (112, 65.2%) were admitted either with complications or they developed complications during their stay in hospital while rest (60, 34.9%) did not have any complication. Complications which developed in the women were in the following descending order; anaemia (70, 40.7%), bleeding (35, 20.3%), eclampsia (21, 12.2%), while others such as preterm labour, surgical conditions, ectopic pregnancy, eclampsia, leaking membrane and heart disease were present in 31 (18.1%).

Majority (67, 39%) of women delivered spontaneously by normal vaginal delivery or by using vacuum and forceps, while 39 (22.7%) underwent caesarean section and among 66 (38.4%) women, dilation and curettage along with other procedures were performed. The outcome of the delivery for these 172 women was in the form of live birth in 80 (46.5%), ectopic, abortion and stillbirth among 63 (36.6%) and undelivered status for 29 (16.9%).

For all the maternal deaths, risk factors were anaemia (32, 18.6%), medical conditions (12, 6.9%), previous caesarean section (8, 4.7%), PET (8, 4.7%) and others such as short stature abortion multiple pregnancy and antepartum haemorrhage (8, 4.7%). Rest (104, 60.4%) of the females were found to have no such risk factors.

Table 2 shows that out of 172 females, postnatal period was eventful for 83 (48.2%) and uneventful for 89 (51.7%). The reasons for eventful postnatal period in maximum was sepsis (47, 27.4%), followed by anaemia (45, 26.2%), medical conditions (34, 20.3%), postpartum haemorrhage (32, 18.6%) and others (34, 20.3%) [Table 2]. Complications recorded during labour were preterm rupture of membrane (6, 3.5%), premature rupture of membrane (2, 1.2%), IP/sepsis (6, 3.5%), eclampsia (11, 6.4%), obstructed labour/ruptured uterus (6, 3.5%), anaemia (13, 7.6%) and others such as scar dehiscence, haemorrhage, dilation and curettage (31, 18%).

Table 3 depicts the interventions required during early pregnancy, antenatal, intrapartum and postpartum period. The maximum intervention done in the antenatal period was blood transfusion (18, 10.0%), during intrapartum was caesarean section (31, 4.3%) and in postpartum, it was transfusion (65, 38.1%).

| Table 1: Reasons for admission in tertiary care health facility (n=172) |
| Reasons for admission | Frequency (Percentage)* |
|-----------------------|------------------------|
| Abortion              | 12 (7.0)               |
| Anaemia               | 95 (55.2)              |
| Anti-partum Haemorrhage (APH) | 14 (8.1)          |
| Abnormal Presentation | 0 (0.0)                |
| Cephalo-Pelvic Disproportion (CPD) | 2 (1.2)            |
| Diabetes              | 0 (0.0)                |
| Ectopic Pregnancy     | 1 (0.6)                |
| Haemorrhage           | 0 (0.0)                |
| Medical Conditions    | 45 (26.2)              |
| Multiple Pregnancy    | 5 (2.9)                |
| Normal Delivery       | 12 (7.0)               |
| Pre-eclampsia (PET)/Eclampsia | 34 (19.8)       |
| Previous Section      | 22 (12.8)              |
| Post-partum Haemorrhage (PPH) | 23 (13.4)        |
| Vesicular Mole        | 0 (0.0)                |
| Others†               | 31 (18.0)              |

*Multiple response coded. †Others ‑Ante-partum haemorrhage, cephalo-pelvic disproportion, ectopic pregnancy, normal delivery and multiple pregnancy.

| Table 2: Description of events during postnatal period (n=172) |
| Variables | Subgroups | Frequency (percentage)* |
|-----------|-----------|------------------------|
| Postnatal period |         |                       |
| Uneventful | 89       | (51.7)                |
| Eventful   | 83       | (48.3)                |
| Reasons for eventful postnatal period (n=83) |       |
| PPH        | 30       | (36.1)                |
| Sepsis     | 47       | (56.6)                |
| CVA/PE     | 4        | (4.8)                 |
| Anaemia    | 43       | (51.8)                |
| Eclampsia  | 13       | (15.7)                |
| Post-partum Psychosis | 5 | (6.0) |
| Post-op complication | 11 | (13.3) |
| Medical conditions | 22  | (26.5) |
| Others†   | 16       | (19.3)                |

*Multiple response coded. †Others ‑Eclampsia, post-op complications, postpartum psychosis and pulmonary embolism/CVA.
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69.9%). Table 4 shows the social factors associated with delays resulting in maternal deaths. Among delays related to personal/family problem, the maximum reason for the delay was unavailability of help needed by women (106, 76.8%).

The mean ± SD interval between delivery-abortion and death was found to be 2.05 ± 0.85 days. The delivery-abortion -death interval was categorized into three groups and analysed for association with different variables like age group, parity, period of gestation at the time of death, reasons for admission referring status, antenatal check-up registration status, mode of delivery and outcome. The association was found to be statistically significant for the age-groups ($P = 0.04$), period of gestation at the time of death ($P = 0.012$), mode of delivery ($P = 0.004$) and outcome of delivery ($P = < 0.001$).

For maternal deaths, direct obstetric causes were responsible in 128 (74.4%) cases, while indirect obstetric causes were reported in 135 (78.4%) women. Figure 2 shows the maternal death due to direct causes. Out of all direct obstetric causes, most deaths were due to obstetric haemorrhage (53, 41.4%) followed by hypertensive disorders during pregnancy, childbirth and puerperium (38, 29.7%), and least for unanticipated complications of management (2, 1.6%). Figure 3 depicts the death caused by indirect obstetric causes (135, 78.4%) in which maximum deaths (90, 66.7%) were due to anaemia followed sepsis (23, 17%) which was not directly related to pregnancy, and, least deaths, in CNS conditions (1, 0.7%), endocrine (1, 0.7%) and auto immune disorders (1, 0.7%).

### Discussion

Pregnancy and labour, although a natural physiological phenomenon, if not kept under constant surveillance, can end in serious complications or even death of mother at any moment. The death is a tragedy and it carries a huge burden of grief and pain for the family, especially for the young ones that the mother leaves behind. In the industrialized world, avoidance of unwanted births, proper antenatal care by trained staff supported by institutional quality care and delivery coupled with the empowerment of women has made maternal deaths during pregnancy a rare phenomenon. In the developing world, however, it is still a commonly encountered phenomenon.

In this study, a higher number (144, 83.7%) of maternal deaths were recorded in the age group of 15 to 30 years. It was also found that for primipara, maternal deaths 134 (77.9%) were more than in comparison to multipara (38, 22.1%). This finding is almost similar to the study by Vanitha et al. (2019), in which maternal deaths of same age group were 49 (80.3%). It was also found that the maternal deaths were more in women having an

### Table 3: Distribution of various interventions done during pregnancy ($n=172$)

| Interventions                  | Frequency (percentage) |
|-------------------------------|------------------------|
| Early Pregnancy [$n=8 (2.9\%)^*$] | 1 (12.5)               |
| Evacuation                    | 1 (12.5)               |
| Transfusion                   | 5 (62.5)               |
| Laparotomy                    | 2 (25.0)               |
| Hysterectomy                  | 2 (25.0)               |
| Antenatal [$n=20 (7.3\%)^*$]  | 18 (90.0)              |
| Transfusion                   | 1 (5.0)                |
| Version                       | 1 (5.0)                |
| Other Surgeries               | 1 (5.0)                |
| Intrapartum [$n=63 (23.2\%)^*$]| 7 (11.1)               |
| Instrumental Delivery         | 31 (49.2)              |
| Caesarean Section             | 7 (11.1)               |
| Hysterectomy                  | 5 (7.9)                |
| Transfusion                   | 14 (22.2)              |
| Manual removal of Placenta    | 6 (9.5)                |
| Postpartum [$n=93 (34.3\%)^*$]| 8 (8.6)                |
| Removal of retained POC       | 9 (9.7)                |
| Laparotomy                    | 65 (69.9)              |
| Transfusion                   | 11 (11.8)              |
| Hysterectomy                  | 20 (19.0)              |
| Anaesthesia/ICU [$n=105 (38.7\%)^*$]| 7 (6.7)               |
| Spinal                        | 4 (3.8)                |
| Local                         | 1 (1.0)                |
| Epidural                      | 73 (69.5)              |

*Multiple response coded

### Table 4: Factors associated with delays in the search for, access to, and provision of adequate care (3-D Delay model) among study population ($n=172$)

| System                      | Example of delay                        | Frequency (percentage) |
|-----------------------------|----------------------------------------|------------------------|
| Problems due to Personal/Family [$n=138 (80.23\%)$] | Delay in Woman seeking help              | 106 (76.8)             |
| Family                      | Refusal of treatment                    | 18 (13)                |
| Logistical Problems [$n=16 (9.3\%)$] | Refusal of admission in previous facility | 14 (10.1)              |
| Problems related to lack of Facilities and Health Personnel [$n=10 (5.81\%)$] | Lack of transport from Home to Health Care Facility | 9 (56.3)               |
|                             | Lack of transport between Health Care Facilities | 4 (25)                 |
|                             | Health Service - Health Service Communication Breakdown | 3 (18.8)              |
|                             | Lack of facilities, equipment or consumables | 2 (20)                 |
|                             | Lack of Blood                           | 2 (20)                 |
|                             | Lack of OT availability                  | 2 (20)                 |
|                             | Lack of Human Resources (Anaesthetist/Obstetricians) | 1 (10)                |
|                             | Lack of Expertise, Training or Education | 3 (30)                 |
unregistered antenatal status (109, 63.4%) than in registered who were under vigilance in contrast to former. In a study by Dayal et al. (2019)\textsuperscript{[1]} similar results have been reported. The booked cases, good antenatal care with backup investigative facilities for early diagnosis of any risk factor and consultancy for its management should be available for high-risk pregnancies.

Findings of the study reveal that there were more deaths among the women who were referred from the primary and secondary government facility (34, 19.8%) in comparison to the private hospital (16, 9.2%), which shows that there is still lack of expertise and health professionals in the health care centres at primary and secondary level. The females who were being admitted and were not in stable condition had higher death rates (94, 54.7%). Probably the lack of trained health care professionals at the primary level is the barrier in providing adequate and appropriate primary management to the pregnant women before referring to higher centre and this seems to be directly proportional to the maternal mortality.

Surprisingly, the common reasons for admission of pregnant women at the tertiary health care facility were anaemia followed by eclampsia, which for sure could be easily managed at the primary and secondary level. Also, the screening is a critical step for early diagnosis and treatment.

The maximum risk factor found in this study during admission was anaemia (32, 18.6%), followed by medical conditions (12,
6.9%), previous caesarean section (8, 4.7%), PET (8.4.7%) and others such as short stature abortion multiple pregnancy and antepartum haemorrhage were present (8,4.7%). Rest of the females (104, 60.4%) were found to have no such risk factors. Similarly, in a retrospective 4 years study by Mukherjee et al. (2014),[12] the anaemia was found as a contributory factor.

It is evident from the study that in postnatal period, anaemia and sepsis was found in 45 (26.2%) and 47 (27.4%) women, respectively, which are avoidable and preventable. The social factors are very impactful and delay in early help, treatment, referral, lack of transport, health services, equipment or trained health personnel leads to increase in maternal death. It was observed in this study that the delivery/abortion and maternal death interval was higher among women who delivered by normal vaginal delivery. This finding is contradictory of the article by Fahmy et al.[13] The reason for this finding could be that even the normal delivery cases are being referred to higher centres very late when the severe complications have developed and situation becomes critical for the women.

In this study, the hypertensive disorder in pregnancy and childbirths were related to (38, 29.7%) maternal mortality. This finding was similar to the study conducted by Dayal et al. (2019), Ghumare et al. (2018) and Murthy et al. (2012).[14] This study showed that the obstetric complication (11, 8.6%) (rupture uterus and pulmonary embolism) was one of the direct maternal cause of death. This finding was similar to the study conducted by Dayal et al. (2019).[11] The direct causes (128, 74.4%) found in this study is similar to the study conducted by Vanitha et al. (2019) and Baharuddin et al. (2019).[18]

Maternal deaths are avoidable and preventable by definitive measures at primary or secondary level. It is evident from the observations depicting the 3-D delay model that the delays at every step had increased the probability of maternal deaths, which is a dreadful scenario. For the prevention of level I delay, the efficient health professionals are needed to diagnose and prevent the complications during intra and postpartum period. The same is also expected from the family physicians. This can be done by a quality Antenatal Care (ANC) visit as it will give opportunity to detect and to treat. Therefore, the primary health centres should also be well-equipped to screen the risk factors earlier and manage it at an early phase of pregnancy.[8]

For the prevention of level II delay, it is essential for the health professionals at the primary and secondary level to have the knowledge when to refer the case without any delay for its proper management at the tertiary care centre. Thus, it could combat the need of primary management of pregnant women. The government and institutions should strengthen their policies to avoid any delay in transportation either from home to hospital or from one institution to other.

The level III delay constitutes the non-access to primary health care facility and lack of expertise at different levels. The lack of blood and others (10, 5.81%) is also a huge issue which should be taken care. The study conducted by Khan et al. (2013)[16] has also highlighted the same.

**Conclusion**

Thus to decrease the maternal deaths, it is crucial to work from grassroots level. There should be proper training and retraining of primary care providers and family physicians to identify the risk factors to recognise the danger signs and acquaint them with up-to-date knowledge regarding its management. Most deaths could have been prevented with the help of early referral, quick efficient transport facilities and availability of blood.[17]

**Key message**

Most of the causes are avoidable and preventable; thus, necessary steps should be taken at early stages at primary and secondary levels to reduce the maternal mortality rate.

Regular screening and proper antenatal check-up is important for maternal health. Most deaths could have been prevented with the help of early referral, quick efficient transport facilities and availability of blood.

**Limitations**

As this study is a retrospective cross-sectional study, there are chances of missing data. So, there might be variation in results as compared with other studies. A prospective study will be better to find out the definitive causes of maternal mortality. Our country being a developing nation, the findings may vary, therefore there is less external validity.

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**Conflicts of interest**

There are no conflicts of interest.

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