

# Ten Year Study of Maternal Mortality at a Teaching Hospital to Assess “What More Can be Done”

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## ABSTRACT

**Background:** Our country has achieved 77% reduction in maternal mortality rate (MMR) over last three decades. Most of the tertiary care institutions record high MMR because they face the influx of women in critical condition needing caesarean deliveries as well as intensive care unit (ICU)-care; thereby increasing the burden of mortality as well as near miss morbidity. The present study is an effort to evaluate the changing needs at the tertiary level of care. **Aims and Objectives:** Evaluate MMR for the past 10 years, assess causes of death, trend over 10 years against resource up gradation and suggest areas of improvement. **Methods:** Case records of all maternal deaths over 10 years (2010–2019) at our institute were studied (age, parity, residence, antenatal care booking, causes of death, and admission to death interval). Hospital statistics were obtained for total vaginal births, caesarean sections, high dependency unit-ICU admissions, and resource up gradation over past 10 years. **Results:** Total live births over 10 year's period were 106,872 and maternal deaths were 311. Average MMR during 10 years was 291. Maximum deaths occurred in 21–25 years (56.27%), primiparas (58.19%), women from rural areas (68.16%), unbooked/referred cases (91.64%), and postpartum cases (81.67%). Direct causes were responsible for 78.77% and indirect causes for 21.22% deaths. Majority of deaths (80.38%) occurred within 24 h of admission. **Conclusion:** Upgradation of resources, encouraging early referrals from rural areas, arranging critical care ambulances, and training of manpower in obstetric critical care may bring down MMR at tertiary care hospitals.

**Keywords:** Direct maternal deaths, Maternal mortality rate, Maternal mortality, Millennium development goals, Tertiary care  
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## INTRODUCTION

Reducing maternal mortality rate (MMR) in India once seemed a difficult goal. However, our country has made tremendous advances in improving the access to quality healthcare for mothers in remote areas.

The World Health Organization (WHO) commended India for ground breaking reduction in MMR by 77%, from 556 in 1990 to 130/1 lac live births (LB) in 2016 so that present Indian MMR is below the millennium development goal target and puts the country on track to achieve the sustainable development goal target of MMR below 70 by 2030. This milestone was achieved first by the inception of Janani Suraksha Yojana in 2005, which increased institutional deliveries in public facilities to triple, from 18% in 2005 to 52% in 2016. Second, Janani Shishu Suraksha Karyakram (JSSK) started in 2011, allowed free transport and delivery, which closed the urban-rural divide so that 75% births in rural areas also are now being supervised.<sup>[1]</sup>

Finally, Pradhan Mantri Surakshit Matrutva Abhiyan (PMSMA), started on June 9, 2016, allowed women, access to free of cost antenatal care (ANC) on 9<sup>th</sup> of every month.<sup>[2]</sup>

Many other programs such as National Rural Health Mission, Mother and Child Track System, and maternal death review policy (which provides feedback and insight into the factors leading to death of each mother) have resulted in declining MMR in India. However, these national averages hide great level of inequalities existing in different institutions and regions of our country with regard to the access and quality of care received.<sup>[3]</sup>

The MMR at each institution and the causes there of depend upon availability of quality ANC, the human resources, infrastructure (labor room, operation theater, and critical care high dependency unit-intensive care unit (HDU-ICU), blood and component facility, and super specialty services).

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Availability of free transportation facility has enabled many critically ill mothers to reach tertiary care institutions thus reducing overall maternal mortality but simultaneously increasing the burden of critical care obstetrics and near miss morbidity thereof. We present a 10 years study of maternal mortality at our tertiary care institute to find out the steps to further reduce the maternal mortality.

## METHODS

A retrospective descriptive study of maternal deaths at our institution over the past 10 years was done to assess the age, parity, ANC booking status, urban/rural residence, cause of death, and admission to death interval.

Maternal deaths were considered as per definition by the WHO – “the death of a woman while pregnant or within 42 days of termination of pregnancy irrespective of the duration and site of pregnancy, from any cause related to or aggravated by pregnancy or its management, but not from accidental or incidental causes.”<sup>[4]</sup>

MMR was defined as number of maternal deaths during a given time period per 1 Lac LBs during the same time period.<sup>[4]</sup>

Hospital statistics obtained – total LB, vaginal deliveries and caesarean sections, admission to HDU and ICU, the number of medical and paramedical staff and the upgradation of HDU-ICU equipment's. Upgradation of institutional resources over 10 years period was studied in relation to the institutional MMR, percentage of operative deliveries, and the number of patients requiring critical care. Data were presented as percentages and averages.

## RESULTS

Total deliveries at our institution over the past 10 years were 112,258, total LBs were 106,872, and total maternal deaths were 311. Hence, average MMR during study period is 291.

Maximum maternal deaths occurred in age group of 21–25 years 175 (56.27%); primiparas 181 (58.19%); women from rural areas 212 (68.16%); and unbooked or referred cases 285 (91.64%). Of total deaths, 254 (81.67%) died in postpartum period, 35 (11.25%) were undelivered, 15 (4.82%) had abortions; and 7 (2.25%) were ectopic pregnancies [Table 1].

Direct obstetric causes resulted in 245 (78.77%) deaths and indirect causes 66 (21.22%) deaths [Table 2].

Majority of women 250 (80.38%) expired within 24 h of admission [Table 3].

Tables 4 and 5 show trend of total vaginal births, caesarean sections, LBs, maternal deaths, MMR, and HDU/ICU admissions over the last decade. Percentage of caesarean sections has almost doubled from 26% to 46.30 [Figure 1].

Table 6 summarizes overall improvement of resources at our institution over the past 10 years.

MMR at our hospital increased up to 2016 and then declined by 30% (from 372.97 to 257.35/1 lac LB) after ICU was started. Number of patients needing HDU-ICU care has almost doubled from 528 in 2012 to 959 in 2019. Resource upgradation in terms of both manpower and equipment, availability of blood components in 2016 and ICU set up in 2017 brought about 30% decline in MMR [Figure 2].

**Table 1:** Distribution of maternal deaths among various factors

Factor	No. of deaths	Percentage (n=311)
Age group		
≤0	28	09.00
21–25	175	56.27
26–30	78	25.08
>30	30	09.64
Parity		
Para 1	181	58.19
Para 2	72	23.15
Para 3 or more	58	18.64
Residence		
Rural	212	68.16
Urban	99	31.83
ANC Booking		
Booked	26	08.36
Unbooked/Referred	285	91.64
Status of pregnancy at death		
Postpartum	254	81.67
Antepartum	35	11.25
Abortion	15	04.82
Ectopic	07	02.25

## DISCUSSION

The average MMR of our institution during the past decade was 291, while the average MMR of our country from 2007 to 2017 was 167. MMR varies significantly from one institution to another depending on the resources thereof. Most tertiary care institutions report high MMR due to the handling of large number of referred cases, namely, Shobha *et al.* (2019) – 234.6,<sup>[5]</sup> Singla *et al.* (2017) – 554.7,<sup>[6]</sup> Sethi *et al.* (2017) – 302,<sup>[7]</sup> and Hazarika *et al.* (2017) – 490.<sup>[8]</sup> However, Tiwari *et al.* (2015) reported 106.15 which was lesser than national MMR.<sup>[9]</sup> Maximum maternal deaths 253 (81.35%) occurred in women of 21–30 years of age which correlates well with other studies 56 (91.80%),<sup>[5]</sup> 34 (58.5%),<sup>[9]</sup> 445 (68.7%)<sup>[6]</sup> whereas few studies have quoted more deaths in younger women 15–20 years, that is, 20 (41.6%).<sup>[8]</sup> This difference is possibly related to earlier age of marriage in women in the last study. According to the WHO South East Asia Statement, June 2018, women in India are more literate than before (68%) and

**Table 2:** Causes of maternal deaths

Cause of deaths	Total direct	Percentage (n=311)
Direct	245	78.77
Antepartum hemorrhage	20	06.43
Postpartum hemorrhage	74	23.79
Eclampsia/HDP*	65	20.90
Septicemia	33	10.61
Unsafe abortion	15	04.82
Rupture uterus	04	01.28
Obstructed labor	06	01.92
Ectopic pregnancy	07	02.25
Embolism	21	06.75
Indirect	66	21.22
Anemia	29	09.32
Heart disease	16	05.14
Aspiration	04	01.28
Stroke	03	00.96
Acute renal failure	03	00.96
Swine flu	04	01.28
Hepatic Failure	07	02.25

(\*): Hypertensive disease in pregnancy

**Table 3:** Admission to death interval

No. of hours	n	% (n=311)
<1	57	18.32
1–6	97	31.18
7–24	96	30.86
25–48	41	13.18
>48	20	06.43
Total	311	

**Table 4:** Hospital statistics

Year	New ANC registration	Total deliveries	Vaginal births	Caesarean sections	% of caesarean sections
2010	11266	9215	6819	2396	26.00
2011	12183	9100	6336	2764	30.37
2012	13616	10329	6788	3541	34.28
2013	14800	11928	7234	4694	39.35
2014	16347	13128	8530	4598	35.02
2015	16044	12030	7606	4424	36.77
2016	12034	12087	7483	4604	38.09
2017	10990	11920	7147	4773	40.04
2018	11352	11217	6169	5048	45.00
2019	10251	11304	6070	5234	46.30

ANC: Antenatal care

**Table 5:** Hospital statistics

Year	LB	Maternal deaths	MMR	HDU	ICU	Total critically ill
2010	8958	27	301.40	-	-	*
2011	8635	21	243.20	-	-	*
2012	9772	20	204.67	528	-	528
2013	11274	33	292.70	652	-	652
2014	11991	35	291.89	769	-	769
2015	11651	30	257.49	819	-	819
2016	11529	43	372.97	884	-	884
2017	11325	39	344.37	620	227	847
2018	10857	35	322.37	665	223	888
2019	10880	28	257.35	676	283	959

(\*): Before HDU was established all critically ill patients were transferred to ICU of medicine department, hence exact no. could not be obtained, MMR: Maternal mortality rate, LB: Live births, HDU: High dependency unit, ICU: Intensive care unit

**Table 6:** Resource upgradation over 10 years

Resources	2010	2019
No. of doctors	14	67
No. of staff nurse	70	144
No. of paramedics	15	36
Blood bank	Only whole blood	Components started in 2016
Ventilators	-	6
Multipara monitors	-	13
Infusion pumps	-	14
ECG machines	1	3
Central oxygen	-	Started in 2017
Central suction	-	Started in 2017
HDU	-	Started in 2012
ICU	-	Started in 2017

HDU: High dependency unit, ICU: Intensive care unit

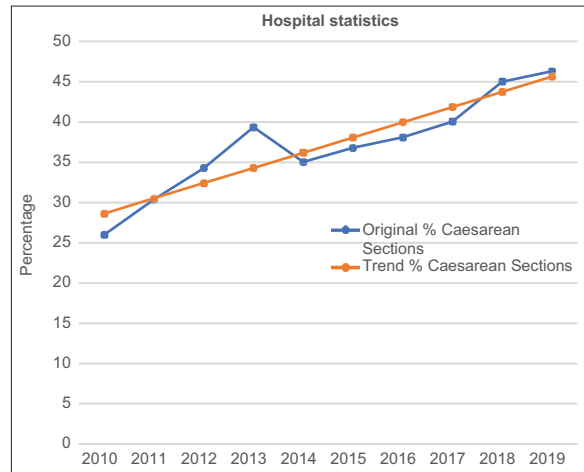
are also entering marriage at an older age, with just 27% now wedded before the age of 18.<sup>[1]</sup>

Maternal deaths occurred with greater frequency 212 (68.16%) among women from the rural areas and correlates well with other studies 20 (90%)<sup>[7]</sup> and 39 (81.20%).<sup>[8]</sup> Chavan *et al.*<sup>[10]</sup> reported 167 (81.06%) deaths in urban population but 168 (82%) of them were unbooked/single ANC visit. In the present study, 285 (91.64%) cases were unbooked/referred. This fact correlates with most of the studies 52 (85.24%),<sup>[5]</sup> 55 (94.8%),<sup>[9]</sup> 608 (93.9%),<sup>[6]</sup> 18 (82%),<sup>[7]</sup> and 168 (82%).<sup>[10]</sup> Poor ANC is the single most important association with maternal deaths found in most of the studies. Hence, providing quality ANC and encouraging women from rural background to have at least three proper antenatal visits may be an important tool for reducing maternal deaths. The PMSMA (2016) provides free of cost ANC by obstetrician to rural women on 9<sup>th</sup> of every month.

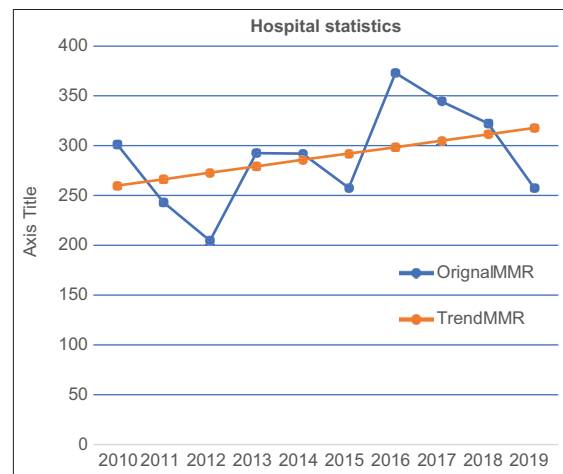
Direct obstetric causes were responsible for 245 (78.77%) deaths, among which antepartum hemorrhage 20 (6.43%), postpartum hemorrhage 74 (23.79%), Eclampsia 65 (20.90%), and septicemia 33 (10.61%) were more common and indirect causes resulted in 66 (21.22%) deaths among which anemia 29 (9.32%) was most common, followed by heart diseases 16 (5.14%). Apart from this anemia was an underlying cause in 72% women who died due to other causes. These findings correlate well with other studies.<sup>[5-10]</sup>

Obstetric hemorrhage, pre-eclampsia/eclampsia, and sepsis as common direct causes and anemia as most common indirect cause are well correlated with other studies.<sup>[5-10]</sup>

Majority of women 250 (80.38%) expired within 24 h, 41 (13.18%) survived for 24–48 h, and only 20 (6.43%) survived for >48 h.



**Figure 1:** Trend Line for Caesarean Sections,  $Y_t = 36.18 + 1.89 X$ , Where  $Y_t$  is maternal mortality rate and  $X$  is Year, (Base year is 2014 so  $X$  calculated as 2014 year, that is, for 2020 it is 6, 2021 it is 7)



**Figure 2:** Trend Line for maternal mortality rate,  $Y_t = 285.62 + 6.44 X$ , Where  $Y_t$  is MMR and  $X$  is Year, (Base year is 2014 so  $X$  calculated as 2014+ year, that is, for 2020 it is 6, 2021 it is 7)

Percentage of women expired within 24 h is variable in other studies such as -13 (21.31%),<sup>[5]</sup> 14 (24.1%),<sup>[9]</sup> 307 (47.4%),<sup>[6]</sup> 15 (68%),<sup>[7]</sup> 21 (43.8%),<sup>[8]</sup> and 91 (44.17%).<sup>[10]</sup> High mortality in first 24 h at our institution reflects late recognition of risk factors at peripheral institutions and late referral. This correlates with 91% of our women being unbooked and referred.

Hospital statistics in Table 4 reveals an increase in total deliveries from 2010 to 2014 which correlates with initiation of JSSK in 2011 after which the number of total deliveries showed slight decrease but the percentage of caesarean sections steadily increased from 26% in 2010 to 46.30% in 2019. Upgradation of PHCs, CHCs and district hospitals have resulted in the conduct of uncomplicated vaginal deliveries and caesarean sections there, but all complicated and high risk deliveries, caesarean sections, and postpartum cases are referred to tertiary care centers. Similarly, many patients decided for caesarean section at private hospitals shift to government hospitals to avail free of cost facility thereby increasing the percentage of caesarean sections.

Trends observed over 10 years at our institution

1. The rate of caesarean sections has almost doubled in 10 years from 26% to 46%
2. Women needing critical care have increased from 528 in 2012 to 959 in 2019
3. Maternal mortality ratio was highest in 2016 (372.97) and has reduced by 30% (to 257.35) after ICU was started and blood components became available.

## CONCLUSION

Tertiary care institutions record a high MMR despite ongoing up gradation of resources; and reducing this is a challenge. Women reach tertiary centers due to better transfer facility but still too late to be in time for the process to be reversible. Hence, earlier identification of high risk factors by better antenatal and intranatal care at periphery and on the way availability of critical care ambulance with medical attendant may save a few lives. Evaluating each tertiary care institution for its deficiencies and fulfilling them is the need of the hour. Training of health-care personnel in obstetric critical care will definitely help in saving many lives; because as yet most of the ICU-HDU are managed by obstetricians, general nursing staff, and on call anesthetists.

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