



MATERNAL DEATH AND ITS CAUSES: A RETROSPECTIVE EVALUATION AT ASSAM MEDICAL COLLEGE AND HOSPITAL, DIBRUGARH, ASSAM: INDIA

Obstetrics & Gynaecology

Milan Kumar Taye	Associate Professor, Department of Obstetrics and Gynaecology, Assam Medical College & Hospital, Dibrugarh, Assam
Long Teron	Assistant Professor, Department of Obstetrics and Gynaecology, Assam Medical College & Hospital, Dibrugarh, Assam
Runjun Doley	Associate Professor, Department of Obstetrics and Gynaecology, Assam Medical College & Hospital, Dibrugarh, Assam
Saranya Devi L	Post Graduate Trainee, Department of Obstetrics and Gynaecology, Assam Medical College & Hospital, Dibrugarh, Assam
Abinaya MC	Post Graduate Trainee, Department of Obstetrics and Gynaecology, Assam Medical College & Hospital, Dibrugarh, Assam
Sibani Das	Resident surgeon, Department of Obstetrics and Gynaecology, Assam Medical College & Hospital, Dibrugarh, Assam
Dr Mohsina Ahmed	Registrar Assam Medical College and Hospital, Dibrugarh.

ABSTRACT

Introduction: Reduction of maternal mortality ratio to achieve the target set for MMR for SDG is a global challenge. Maternal death has devastating impact on the newborn, family as well as in the society in long run. Most of the developing countries could not achieve the target MMR for MDG and are now far away from the target set for Sustainable Development Goal for maternal mortality ratio because of its gradual reduction. There are great differences in MMR in developed and developing countries as well as within the countries, states, districts depending upon the education, socioeconomic status and provision of quality health care and its accessibility. This study was conducted to estimate the MMR, evaluate the causes of maternal deaths at Obstetrics and Gynaecology department of Assam Medical college and Hospital, Dibrugarh Assam, India. **Aim:** To find out the MMR and to evaluate the risk factors and causes of maternal deaths. **Materials And Methods:** A retrospective study of risk factors and causes of maternal deaths from 1st January 2019 to 31st December 2020 at Obstetrics and Gynaecology Department of Assam Medical College and Hospital Dibrugarh, Assam, India. The data were collected from Maternal Death Surveillance and Response Records, Facility Based Maternal Death Review Form and Bed head tickets and analysis were made to find out causes of death and MMR. MDSR meetings were conducted for all the maternal deaths at community, facility and CMO levels. The risk factors and causes responsible for maternal deaths were expressed in percentage. **Results:** Results and Observations: There were 174 maternal deaths out of 22,209 live births resulting MMR of 783. Hypertensive disorders of pregnancy (37.93%) followed by Puerperal sepsis (12.64%) and Post partum haemorrhage (8.04%) were the leading direct causes and severe Anemia (10.92%) and Jaundice (5.17%) were the leading indirect causes of maternal death in our study. **Conclusion:** Reduction of maternal death is a global challenge to achieve the MMR target of SDG. Causes of maternal death are multifactorial. Though pregnancy and labour is a physiological condition, rapid deterioration occurs when complication arises. Targeted approach to the socioeconomically poorer section of the society is the need of the hour.

KEYWORDS

Maternal mortality ratio, sepsis, anemia in pregnancy, postpartum haemorrhage, antepartum haemorrhage.

INTRODUCTION:

Maternal death is defined as "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 the pregnancy or its management but not from accidental or incidental causes."¹ Maternal Mortality Ratio (MMR) is defined as the number of maternal deaths during a given time period per 100,000 live births during the same time period thus it quantifies the risk of maternal death relative to number of live births.¹ The maternal mortality ratio is calculated by dividing recorded maternal deaths by total recorded live births in the same period and multiplying by 100,000. Direct obstetric deaths (or direct maternal deaths) are resulting from obstetric complications of pregnant state (pregnancy, labour and puerperium), from interventions, omissions, incorrect treatment, or from chain of events resulting from any of the above. Indirect obstetric deaths (or indirect maternal deaths) are those resulting from previous existing disease or disease that developed during pregnancy and which was not due to direct obstetric causes, but which was aggravated by physiological effects of pregnancy.

A woman is most vulnerable at the post-partum period. About 50-70% of maternal deaths occur in the post-partum period of which 40% death occur in the first 24 hours after delivery and more than two thirds during the first week. Between 11-17 % maternal death occur during child birth itself.²

For every woman who dies from causes related to pregnancy or childbirth, it is estimated that there are 20 others who suffer from

pregnancy related illness or experience other severe consequence. Children orphaned by early maternal deaths had only 51.54% chance of surviving to their first birthday, compared to a 94.42 % of probability for children of surviving mothers.³

There had been 43% decline in maternal deaths worldwide from 1990 to 2015 which translated into an average annual decline of just 2.3% but to achieve the MDG 5:target 6 there should had been 75% decline in maternal deaths and the decline rate should had been 5.5%.⁴ Most of the developing countries could not achieve MDG -5: Target 6 and are now far away from the target set for Sustainable Development Goal for maternal mortality ratio because of its gradual reduction. An estimated 295,000 maternal deaths occurred globally in 2017, yielding an overall MMR of 211.¹ The EPMM (Ending Preventable Maternal Mortality) target of WHO and its partners for reducing global maternal mortality ratio by 2030 was adopted as SDG target 3.1: reduce global MMR to less than 70 per 1 lakh live birth by 2030. The Maternal Mortality Estimation Interagency Group (MMEIG) of WHO, UNICEF, UNFPA, The United Nations Population Division and the World Bank Group is tasked with generating internationally comparable estimates of maternal mortality ratio for the purpose of global monitoring. The methodology employed by the MMEIG to estimate 1990 -2015 MMR followed by an improved approach referred as Bayesian maternal mortality estimation model or B Mat model.¹

MMR strongly reflects the overall quality of maternity services. MMR in the World's least developed countries is high, estimated as 415 maternal deaths per 100,000 live births which is more than 40 times

higher than MMR in Europe (10), and almost 60 times higher than in Australia and New Zealand.⁵ South Sudan (1150), Chad (1140) and Sierra Leone fall under extremely high MMR in 2017. Nigeria (67000) and India (35000) had highest estimated number of maternal deaths accounting for approximately 35% of estimated global maternal deaths in 2017.¹ The global adult life time risk of maternal mortality is approximately 1 in 190 for the year 2017.¹ The life time risk of maternal death in least developed countries is 1 in 56, Sub Saharan Africa is the only region with very high MMR for 2017, estimated at 542 with life time risk of maternal death at 1 in 37.¹ The MMR of India is decreasing gradually. It was 212 (2007-2009), 178 (2010-2012), 167 (2011-2013), 130 (2014-2016), 113 (2016-2018), 103 (2017-2019).^{6,7,8} The 17 points declined in MMR from 2014-2016 to 2016-2018 translates to 2500 additional mothers saved annually in 2018 as compared to 2016. Total estimated annual maternal deaths declined from 33800 in 2016 to 26437 deaths in 2018.⁹

It was very much encouraging that a few states of India like Kerala (61), Maharashtra (68), Tamilnadu (79), Andhrapradesh (92) and Telangana (93) had achieved the goal of MDG set for MMR.⁶ Along with the above states Jharkhand and Gujarat also has already achieved the goal set for SDG (Kerala 30, Maharashtra 38, Telangana 56, Tamil Nadu 58, Andhra Pradesh 58, Jharkhand 61, Gujarat 70). Another four states also had achieved MMR goal (100) of NHP 2017 of India (Haryana 91, Karnataka 92, West-Bengal 98 and Uttarakhand 99).⁸ The MMR in Assam was 480 (2004-2006), 390 (2007-2009), 328 (2010-2012), 300 (2011-2013), 237 (2014-2016), 229 (2015-2017), 215 (2016-2018) and 205 (2017-2019).^{6,8}

Assam tops the list of MMR for more than a decade in India. The life time risk of maternal death in the age group 15-49 was 1.6% compared to 0.2% in Kerala during 2001-2003 which decreased to 0.5% for Assam and 0.1 in Kerala during the period of 2016-2018.^{10,11} As most of the deaths of Dibrugarh district and a few of nearby districts and adjoining states occur at Assam Medical College and Hospital, it is very important to do a critical analysis of causes and risk factors of maternal deaths of this institution.

METHODOLOGY:

This is a retrospective study to analyze the causes and risk factors of 174 maternal deaths from January 2019 to December 2020 at Assam Medical College, Dibrugarh, Assam. During this period there were 22,209 live births yielding MMR of 783. The data were collected from Maternal death surveillance and response records and bed head tickets of the deceased after taking permission from the Head of the department and the Superintendent of the institution. MDSR meeting were conducted for all the maternal deaths at community, facility and CMO level to find out the exact cause of maternal death for each case and prevention of such death in future.

RESULT AND OBSERVATION:

There were 174 maternal deaths during this period. Analysis of the causes showed that among the direct obstetric causes hypertensive disorders of pregnancy 66 (37.93%) was the commonest followed by infection 29 (16.66%) [puerperal sepsis 22 (12.64%) + septic abortion 7 (4.02%)], hemorrhage 18 (10.30%) [postpartum hemorrhage 14 (8.04%), APH 3 (1.72%), ectopic pregnancy 1], rupture uterus 7 (4.02%), anaesthetic complications- 2, and severe anemia 19 (10.92%), jaundice in pregnancy 9 (5.17%) and heart disease in pregnancy 6 (3.45%) were the common indirect obstetric causes. The other causes of maternal deaths were Epilepsy -3, Tuberculosis-3, ARDS-2, Covid 19-2, CNS-2, Acute gastroenteritis with dyselectrolytemia- 2, intestinal obstruction -1, chronic myeloid leukemia with jaundice -1 and unknown-1.

Out of the 66 maternal deaths due to hypertension 29 patients had pulmonary oedema, 9 patients had severe anemia, 14 patients had CVA, 04 patients had sepsis, 03 patients had jaundice, 03 patients had hypothyroidism, 04 cases had twin pregnancy and 03 patients had abruptio placenta. Multiple causes like anemia, jaundice and hypothyroidism were associated in 6 cases of hypertensive disorders of pregnancy.

Twenty two (22) cases died of puerperal sepsis, out of which 1 case had home delivery, 15 cases were referred from other health institutions and 6 cases from the AMCH itself of which two (2) were associated with TB and (1) one had prolonged rupture of membranes. There were 14 cases of vaginal delivery and 8 cases of LSCS. There were 17 live births, 4 cases of IUFD and one still birth. Out of these 22 cases, 6 cases were associated with severe anemia.

Seven (7) cases died of septic abortion, out of which four (4) were spontaneous abortions and 2 were followed by medical termination of pregnancy done outside. One case of mid trimester spontaneous abortion came in a state of gasping with history of severe bleeding per vagina.

Fourteen cases died due to PPH of which ten (10) had Atonic PPH and four (4) traumatic PPH. Out of the ten (10) atonic PPH, one had inversion of uterus and one had coagulopathy. There were 9 vaginal delivery cases and 5 LSCS. There were two cases of home delivery and three cases of retained placenta.

All the cases (3) of APH were due to abruptio placentae, out of which one was associated with preeclampsia, one with fourth gravid and severe anemia and one with IUFD at term.

Nine (9) patients died of severe anemia out of which two (2) were associated with sickle cell disease with crisis during labour. Three cases came in a state of shock at 32-36 weeks of pregnancy and three cases had hemoglobin less than 5 gm%.

Nine (9) patients died of jaundice in pregnancy out of which 4 cases had IUFD with coagulopathy, one patient had 10 days postdated pregnancy, one had 28 weeks of pregnancy, one with obstructive jaundice with pancreatic growth, one had chronic liver disease and one died on day 4 of LSCS.

Six patients died due to heart disease in pregnancy out of which 4 had Rheumatic heart disease with MS, MR, AR and two developed peripartum cardiomyopathy.

Table 1:

DIRECT CAUSES 123	INDIRECT CAUSES 51
HYPERTENSION – 66	SEVERE ANEMIA 19
APE 44	JAUNDICE 09
PPE 09	CARDIOVASCULAR 06
HTN 13	CNS DISORDER
INFECTION 29	EPILEPSY 03
PUERPERAL SEPSIS 22	GUILLAIN BARRE
SEPTIC ABORTION 07	SYNDROME 01
HEMORRHAGE 18	GLIOBLASTOMA 01
PPH 14	ARDS 02
APH 03	CML 01
ECTOPIC 01	COVID19 02
RUPTURED UTERUS 07	INTESTINAL
EMBOLISM 01	OBSTRUCTIONS 01
ANAESTHETIC	AGE 02
COMPLICATION 02	TB 03
	UNKNOWN 01

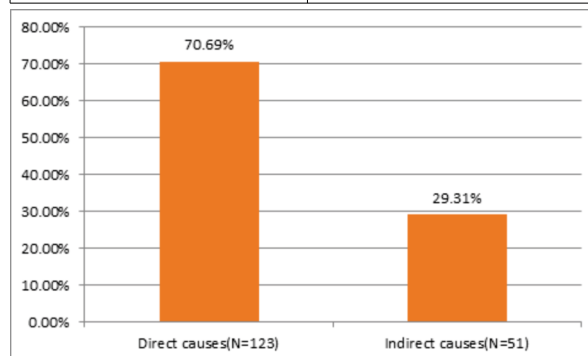


Figure 1:

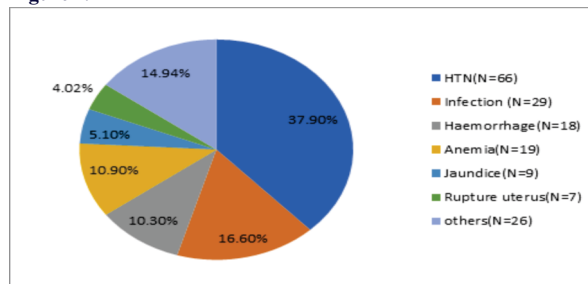


Figure 2:

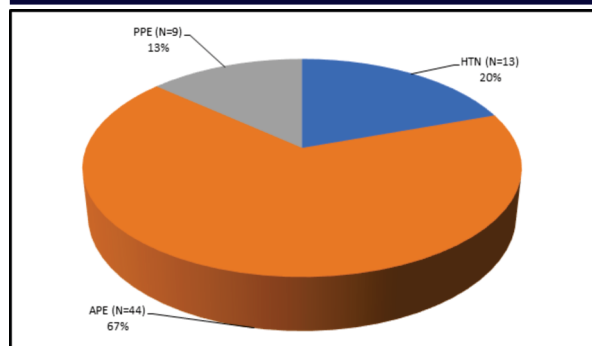


Figure 3: Maternal deaths due to Hypertension (distribution of total 66 maternal deaths)

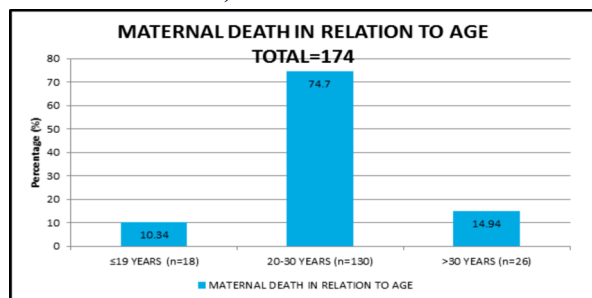


Figure 4:

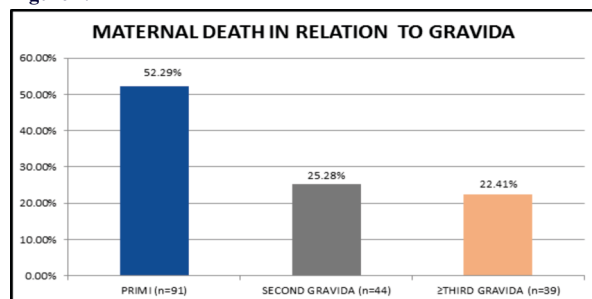


Figure 5:

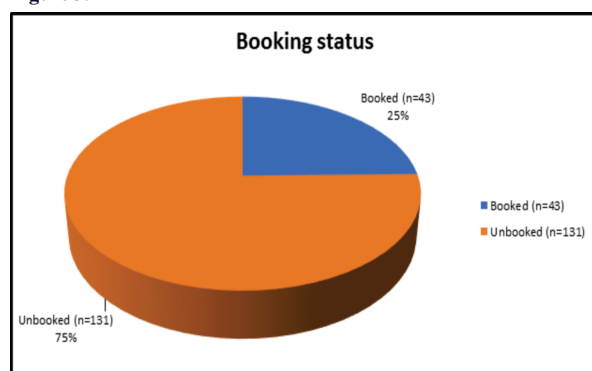


Figure 6:

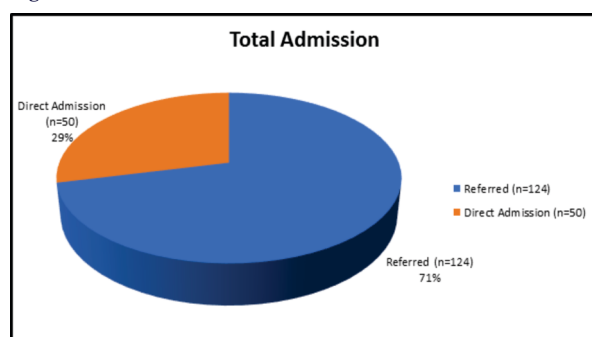


Figure 7:

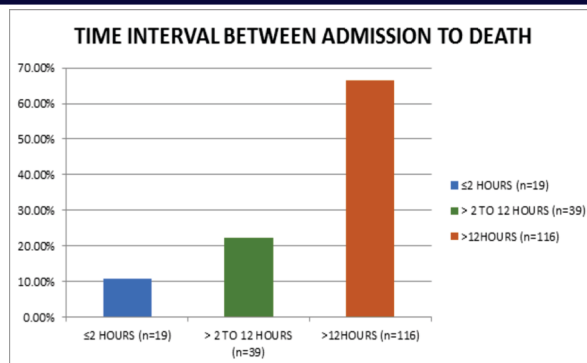


Figure 8:

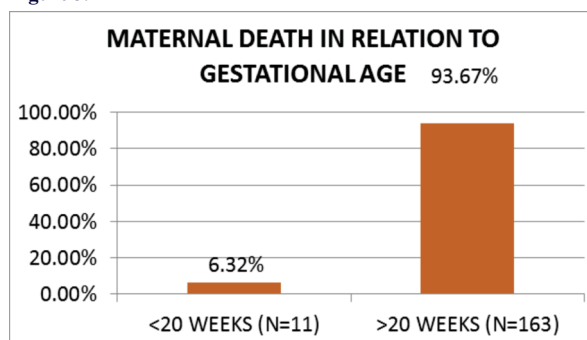


Figure 9:

Table 2:

PREGNANCY OUTCOME OF 174 MATERNAL DEATH

- Abortion= 7
- IUFD= 31
- Undelivered= 24 (live fetus)
- Still birth = 25
- Live birth = 91
- Ectopic = 1

Grand total = 179

- *There was one triplet resulting three live births.
- *There were three twins resulting 4 live births and two still birth.

DISCUSSION:

In our study direct causes were responsible for 71.84% and indirect causes were responsible for 28.16% of the maternal deaths of the total 174 maternal deaths out of 22,209 live births yielding MMR of 783. Hypertensive disorder of pregnancy 66 (37.93%), infection 29 (16.66%) [puerperal sepsis 22 (12.64%) + septic abortion 7 (4.02%)], hemorrhage 18 (10.30%) [postpartum hemorrhage 14 (8.04%), APH 3 (1.72%), ectopic pregnancy 1] were the leading direct causes and anemia (10.92%) and jaundice (5.17%) were the leading indirect causes of maternal death in our institution.

Reeta Bhuyan et al reported MMR of 1101.60/100000 live birth in Guwahati Medical College of Assam during 1st June 2011 to 1st May 2012 out of 9804 live birth. Out of the 108 maternal deaths, 76.85% belonged to rural areas, 76.86% unbooked cases, 60.18% were illiterate, and majority was from low socio-economic status. Out of the total maternal deaths 73 cases (67.6%) died within 24 hours of admission. Delays at different levels, often in type 2, contributed to the maternal deaths. Only 20 cases (18.52%) received intensive care unit (ICU) care showing a paucity of high dependency unit (HDU)/ICU facility.¹²

Hazarika L et al reported Institutional Maternal Mortality of 490 per 1,00,000 live births out of 9789 total deliveries during September 2015 to August 2016 at Assam Medical College, Dibrugarh. The maternal death was high among the Tea Garden community (66.7%) at the age group 15–20 years and was prevalent mainly in the illiterates (31.3%). Anaemia (29.1%) was the leading cause of death; followed by eclampsia (23.0%) and septicemia (17.0%).¹³

Out of 20,333 deliveries and 19,786 live birth Borah et al reported MMR of 446.38/100000 live birth at Jorhat Medical College during

Jan 2013 to Dec 2015. Hemorrhage and sepsis were responsible for 31.81% (n=28) and 6.87% (n=6) of total maternal deaths respectively and anaemia accounted for 12.50% (n=11) of total maternal deaths.¹⁴

Surat Zaman et al. reported maternal mortality of 709.35 out of 10,291 live births in their study during 2012 to 2013 and found that eclampsia was the cause of death in 28.76%, anemia in 23.24%, septicemia in 9.58% and septic abortion in 5.48%. Direct causes were responsible for 69.84% of maternal deaths and indirect causes were responsible for 30.16%.¹⁵

Nair et al. reported a total of 10,475 deliveries participating in IndOSS-Assam which included FAAMCH and GMCH of Assam in the 6 months of the pilot study during the period of March 2015 to August 2015; they found total of 402 cases with one of the following six conditions which includes eclampsia, PPH, anemic heart failure, puerperal sepsis, septic abortion & uterine rupture. Out of which 66 died as a result of one of the above conditions under surveillance. The incidence of eclampsia was 17 per 1000 deliveries (95% CI 14 to 19), PPH was 11 per 1000 deliveries (95% CI 10 to 13) and anaemic heart failure was 3 per 1000 deliveries (95% CI 2 to 5). For each of the other three conditions—puerperal sepsis, septic abortion and uterine rupture—the incidence rate was 2 per 1000 deliveries. Case fatality due to these conditions was high; 16% (95% CI 13% to 20%) of women who were diagnosed with these conditions died, the highest case fatality rate being for puerperal sepsis and anaemic heart failure.¹⁶

Paul B et al. cross-sectional study at S. C. B. Medical College and Hospital, Cuttack, Odisha, from 1 April 2006 to 31 March 2007 found that the total number of deliveries and live births in the hospital during the study period was 6,941 and 6,881, respectively. The maternal mortality ratio was 727 per 1,00,000 live births. Out of the total maternal deaths, 72% belonged to 20-30 yrs age group, 46.5% were illiterate, and majority (60.5%) were from low socio-economic status. Direct causes were responsible for 76.7% of maternal deaths. Hypertensive disorders of pregnancy were most common (32.6%) cause, while malaria (9.3%) and anemia (7%) were most common indirect causes.¹⁷

Rashmi Singh et al. during the study period of 2 years from August 2003 to July 2005 at tertiary care hospital Patna, Bihar reported 180 and 149 maternal deaths respectively. The MMR was 4159.93 and 3638.58 per 100,000 live births, respectively making the overall MMR 3906.44/100,000 live births. Among 329 total maternal deaths, the maximum were in the age group of 21 to 30 years (56.54%) followed by 31 to 40 years (22.49%). The death rate for mothers from rural areas was higher (67.17%). Maternal deaths were observed more among illiterate women (57.75%). The highest number of maternal death occurred among those who were second or third gravida (48.94%) followed by fourth gravida and above (26.14%). A total of 85.11% of maternal deaths happened among those who had not received adequate antenatal care services. Toxemia of pregnancy (24.01%) was observed as the major cause of maternal death followed by sepsis (17.93%). Anemia accounted for 15.81% of maternal deaths.¹⁸

A retrospective hospital based study was conducted in the Department of Obstetrics and Gynecology, Patna Medical College and Hospital, Patna, Bihar from Jan 2017 to March 2018. Sweetey et al. reported a total of 56 maternal deaths. The mortality rate in this study period was 333 per 1,00,000 live births. Maximum maternal deaths (60.7%) were reported in the age group 21-25 years. More deaths were reported in multiparous women (67.9%) as compared to primiparous women (32.1%). Most of them were unbooked cases (60%). Hemorrhage (30.4%), eclampsia (16.1%), sepsis (12.5%) and embolism (7.1%) were the major direct causes of maternal death. Anemia (16.1%) was the major indirect cause of death.¹⁹

Hansda J et al. in retrospective longitudinal study conducted in the department of obstetrics and gynecology Burdwan Medical college and hospital for a period of three years from 1st January 2018-31st December, 2020 reported 134 maternal deaths amongst 5,6815 live births with MMR 235.85. The majority of deaths were in 20-29 year of age group and most of the deaths seen in multigravida. The 91.79% death was observed within the 24 hours and after 72 hours. Eclampsia 26.86%, PIH 12.68% and hemorrhage 21.64%, sepsis 18% and anemia 7% were the leading causes of maternal deaths seen in their study.²⁰

In comparison to other studies in our institution MMR (783) was more

except studies of Reeta Bhuyan et al. (MMR 1101.60) and Rashmi Singh et al. (3906.44) although the period of studies were different.

MMR of our institution had increased during this study period due to increase in number of referral cases due to COVID-19 pandemic, more than 70% of our health staff got COVID-19 infection.

Hypertensive disorder of pregnancy was responsible for 37.93% of maternal death in our study and Paul B et al. reported 32.61%, Rashmi Singh et al. 24.01% (Toxemia of Pregnancy), Sweetey Rani et al. 16.1% (Eclampsia), Hansda J et al. (PIH-12.68%, Eclampsia 26.86%) and Surat Zaman et al. 28.76% (Eclampsia) in their studies.

Haemorrhage was responsible for 9.78% of maternal deaths in our study and Borah et al. reported 31.8%, Sweetey et al. 30.4% and Hansda J et al. 21.64% in their studies.

Sepsis was responsible for 16.66% (Puerperal Sepsis 12.64% and Septic abortion 4.02%) in our study for maternal deaths and Borah et al. reported 6.87%, Rashmi Singh et al. 17.93%, Sweetey et al. 12.50%, Hansda et al. 18% and Nair et al. 16% Puerperal sepsis, 16% for septic abortion.

Anemia was responsible for 10.92% of the total maternal deaths in our study and Sweetey Rani et al. (16.1%), Rashmi Singh et al. (15.81%), Borah et al. (12.50%), and Paul B et al. (7%) reported in their studies.

There are paucity of publications regarding MMR and causes of maternal death from different tertiary institutions of Assam and other parts of India during our study period for better comparison.

CONCLUSION:

Reduction of maternal death is a global challenge. It has a devastating and tragic impact in the family and society. Causes of maternal death are multi factorial. Though pregnancy and labour is a physiological condition, rapid deterioration occurs when complication arises. Targeted approach to the socioeconomically poorer section of the society is the need of the hour. It is distressing when planned facility births ended in a substantial proportion of deaths occurring at home or on the way to tertiary centre. Comprehensive efforts by individual, societal, government, peripheral health care centers and tertiary health care centers can improve the quality of antenatal, intranatal and postnatal care which can play the major roles in reduction of maternal death. Quality MDSR and maternal near miss conducted at different levels to find out the causes and implementation of remedies will definitely have impact to reduce MMR. There is definite impact of COVID-19 pandemic on maternal morbidities and mortalities in both rural and urban areas but the absolute effect need to be evaluated. Prevention of preventable causes of maternal deaths can reduce MMR to a great extent. Probably the father of the Safe Motherhood movement, Prof Mahmoud Fathalla rightly said "Women are not dying of diseases we cannot treat ... they are dying because societies have yet to decide that their lives are worth saving."

Acknowledgement:

We acknowledge HOD of Obstetrics and Gynaecology department and Superintendent for giving permission to do the study.

Financial support and sponsorship:

We have not taken any financial support.

Conflicts of interest:

There are no conflicts of interest.

Authorship criteria:

All authors have substantially contributed in the concept and design of the study, acquisition of the data and analysis, drafting the article / revising and final approval of the version to be published.

REFERENCES:

1. WHO U. UNFPA, World Bank Group and the United Nations Population Division. Trends in maternal mortality 2000 to 2017: estimates by WHO, UNICEF.
2. WHO U. Trends in maternal mortality: 1990 to 2008. Estimates developed by WHO, UNICEF, UNFPA and The World Bank. World Health Organization. 2010.
3. Finlay JE, Moucheraud C, Goshev S, Levira F, Mrema S, Canning D, Masanja H, Yamin AE. The effects of maternal mortality on infant and child survival in rural Tanzania: a cohort study. *Maternal and child health journal*. 2015 Nov;19(11):2393-402.
4. World Health Organization. Trends in maternal mortality: 1990-2015: estimates from WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. World Health Organization; 2015.
5. Ministry of Health and Family Welfare. Guidelines for antenatal care and skilled attendance at birth by ANMs/LHVs/SNs. 2010

6. Sample registration system (SRS).Maternal and child mortality and total fertility rates. Office of Register General of India 2013.
7. Special Bulletin on Maternal Mortality in India 2017-19, Office of Registrar General of India. Govt. of India (2020)
8. Special Bulletin on Maternal Mortality in India 2017-19, Office of Registrar General of India. Govt. of India (2022)
9. Maternal health, <https://www.unicef.org/india/what-we-do/maternal-health>
10. Maternal Mortality in India: 1997-2003, Trends, Causes and Risk factors, Registrar General, India, New Delhi in collaboration with Centre for Global Health Research University of Toronto Canada. Govt. of India (Sample Registration System), (2022).
11. Special Bulletin on Maternal Mortality in India 2014-16, SRS, July 2020, Office of Registrar General of India, Govt. of India (2022).
12. Bhuyan R, Deka G, Das GC, Baruah RR, Majumdar M. The impact of health care system on maternal mortality – a tertiary hospital based study. The New Indian Journal of OBGYN. 2016; 2(2): 110-4
13. Hazarika L, Phukan P, Sharma A, Das NK. Maternal mortality at a tertiary care teaching hospital in Dibrugarh district, Assam: a retrospective study. Int J Community Med Public Health. 2017 Sep;4(9):3342-46.
14. Borah BK, Rajkhowa NR. Maternal mortality at a tertiary care teaching hospital of rural Assam: A retrospective study with special emphasis on time interval from admission to death along with impact of late referral. The New Indian Journal of OBGYN. 2017; 3(2): 79-85.
15. Zaman S, Begum AA. Maternal mortality at rural medical college of Assam: a retrospective study. J Obstet Gynaecol Barpeta 2014; 1(1):46-51.
16. Nair M, Choudhury MK, Choudhury SS, Kakoty SD, Sarma UC, Webster P, Knight M. IndOSS-Assam: investigating the feasibility of introducing a simple maternal morbidity surveillance and research system in Assam, India. BMJ global health. 2016 Apr 1;1(1):e000024.
17. Paul B, Mohapatra B, Kar K. Maternal deaths in a tertiary health care centre of Odisha: an in-depth study supplemented by verbal autopsy. Indian journal of community medicine: official publication of Indian Association of Preventive & Social Medicine. 2011 Jul;36(3):213.
18. Singh R, Sinha N, Bhattacharyya K, Ram R. Pattern of maternal mortality in a tertiary care hospital of Patna, Bihar. Indian Journal of Community Medicine. 2009;34(1):73.
19. Rani S, Singha AR., Evaluate the existing mmr and the etiology of maternal mortality in a tertiary care hospital in bihar: a retrospective analysis. International Journal of Medical and Biomedical Studies, 2020 April;4(4)
20. Hansda J, Roy D, Das K, Sarkar M, Das R, Pramanik A. Maternal mortality-a three-year retrospective study in a rural medical college of India. International Journal of Reproduction, Contraception, Obstetrics and Gynecology. 2021 Aug 1;10(8):3019-23.