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AN IN-DEPTH ASSESSMENT OF MATERNAL MORTALITY AND NEAR-MISSES DUE TO SEPSIS IN LOW-INCOME COUNTRY: PROSPECTIVE CROSS-SECTIONAL STUDY

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Abstract:

Background: Post natal infection is a global health care issue and continues to be the leading cause of death in developing countries like Pakistan. The objective of this study was to determine the burden and factors associated with maternal near miss and mortality due to postnatal infections at tertiary care hospital.

Methodology: A prospective cross sectional study was conducted for one year in the department of OBGYN at Liaquat University of Medical and Health sciences Jamshoro from May 2021- April 2022. All women with post natal and post aborted infections identified as Near Miss or died were included in the study.

Result: Out of 143 women included in study, 95.1% women identified as Near Miss and 4.9% were expired. Majority of women (53.1%) were 25-36 years of age, belong to rural areas (62.9%) mostly uneducated, referred cases from primary and secondary care hospitals. There was no significant association of baseline maternal characteristics with maternal outcomes ($P>0.05$). (58.1%) near miss and (71.4%) maternal deaths cases have initial procedure of cesarean section there was a significant association of cesarean section with maternal near miss and mortality cases ($p<0.01$). The major causes of postnatal infections were peritonitis (39.2%), wound infection (30.1%) and septic abortion (20.3%). (76.2%) women received antibiotics before transfer to tertiary care hospital. Data was analyzed using SPSS version 23.0, Association of parameters with Maternal outcomes were tested using Chi Square test and Fisher's Exact test (when $n<5$). P-values less than 0.05 were considered statistically significant.

Conclusion: Cesarean section and septic abortion were mainly associated with post natal infection. Local strategies and policies should be established and implemented to improve the quality, safety and infection control for postnatal period of women.

Key Words: Maternal near miss, Morbidity, Mortality, Cesarean section, Post natal infection, septic abortion.

INTRODUCTION

In spite of universal efforts through the safe mother hood initiative, maternal mortality remains a major challenge to health system [1].It is inappreciably reduced in developing countries like Pakistan. According to Pakistani demographic and health survey, each year 30,000 women die from pregnancy related causes [2].As claimed by Sustainable development plan (SDP) that every country should reduce maternal mortality ratio to <70/100,000 by the year 2030 [3].

A number of discussions have been generated in low-income countries on catastrophe of maternal death [4]. Maternal deaths around the globe are high. Every year>500,000 women die worldwide due to obstacles of pregnancy and child birth [5] and 15% are related with puerperal sepsis [3].In developing nations, it ranks as the second most common cause of maternal mortality.[6] Within 42 days following delivery, puerperal sepsis is an infection of the genital system which results from the rupture of amniotic sacs.[7]Septic women are at threat of secondary injuries, [8] its management basically focuses on infection control, antibiotics, and organ function support.[9]

Obesity, impaired glucose tolerance, impaired immunity, immunosuppressant medication, anemia, pelvic infection, group B and A streptococcal infections, prolong rupture of membranes and black or other minority ethnic group origin are the risk factors of post natal infections[10].Maternal near miss is typically defined as a woman who was on the verge of passing away but survived a condition that happened during pregnancy, childbirth, or within 42 days of terminating the pregnancy. A maternal death is defined as the passing away of a woman while she is pregnant or within 42 days of her pregnancy ending, regardless of the length or site of the pregnancy, from any factor affecting the pregnancy or the care provided for it, whether directly or indirectly, but not from unintentional or incidental causes[11]

It is calculated that for every women who dies suffers from serious injuries, infections or disabilities.[12] Clinicians and health facilities utilizes near miss approach to assess and improve the quality of maternal health care [13] by determining the prevalence of severe outcomes.[14]Sepsis remains one of the major element of curable maternal death globally even decades after the emergence of economical innovative antimicrobials[15] Health care professionals must not underrate the severity of maternal sepsis and cling to treatment guidelines.[16]The present study was proposed to analyze the patients presenting with puerperal sepsis post aborted and post delivery in a tertiary care hospital, to determine the magnitude of problem, maternal near miss and mortality due to postnatal sepsis . This will aid to map out institutional protocols; consecutively it will be influential in planning preventive strategies at higher levels. This would go a long way in fostering maternal health.

Methodology: A cross sectional study conducted in the department of obstetrics and gynecology at Liaquat University of Medical and Health Sciences Jamshoro from 7-5-2021 to 6-4-2022, after ethical approval. All the admitted women identified as Near miss or died and were diagnosed with post natal infection after vaginal delivery, cesarean section or septic abortion during the study period were included. Patients who met the WHO criteria for "near misses" based on organ system failure [17] were included in the study. The organ dysfunction-based strategy is "the most promising frame for defining a common set of criteria," according to the WHO Working Group [18]. Patient's history, clinical examination, base line investigations blood culture, pus C/S, C reactive protein and serum lactate

levels were done for the diagnosis. Demographic and obstetric data was collected on pre designed Performa after taking informed and written consent either from women or her close relative.

Definition and operationalization of variables:
When the hospitalized mother met at least one of the WHO requirements yet lived, the case was classified as an MNM: 1)Intensive care (including any blood transfusions, laparotomies, or hospitalization); 2) Organ failure, including heart disease, severe postpartum hemorrhage, severe preeclampsia, eclampsia, sepsis, or a serious systemic infection, or ruptured uterus and 3) Significant pregnancy-related maternal complications malfunction, including respiratory, renal, hepatic, and neurological issues coagulation/hematological dysfunction, uterine dysfunction [19]. These are all evaluations were conducted by gynecologists or general practitioners, and the data were collected from mothers' medical records by data gatherers

Identification of cases:
Women who met at least one of the requirements outlined in the WHO criteria [17] and were admitted during the study period for the treatment of pregnancy-related complications (including early pregnancy complications), after giving birth, or within 42 days of terminating a pregnancy were included. Maternal near-miss instances were further divided into two categories based on when they happened. Prior to admission, women who were found to be in serious condition at the hospital were categorized as near-misses. On the other hand, if the near-miss happened while the patient was hospitalized, it was considered a near-miss after arrival.

Data collection:
Using the WHO data abstraction tool [17] information about the most crucial variables was extracted from the participants' medical records. The labor Ward, Antenatal Ward, ICU, and Emergency Department were where the data were gathered. According to the WHO International Statistical Classification of Diseases and Related Health Problems, only one underlying cause was found for each incidence of maternal near-miss (ICD). The disease that started the chain of events leading up to mortality, as defined by the ICD, is the root cause. The classifications utilized for maternal near-miss were the same as those specified in the ICD for maternal mortality. All potential contributing factors, though, were taken into account. In order to pinpoint the location of the near-miss, data indicating whether it existed prior to hospitalization or emerged during that time was also gathered. Data were taken from the Health Management Information System on the total number of live births that took place in hospitals over the course of a year (HIMS)

Data management:
The consultants were in charge of verifying the accuracy of the data. Each questionnaire was filled out by the enumerators, who also signed, checked, and added a date. Each supervisor stored the hardcopy data they had gathered in a locked cabinet until the primary investigator collected them while supervising. The data were then entered into SPSS version 23 for the last analysis

Data quality assurance:
A trained staff collected the data to maintain the data's quality. Each participating staff member received special training on the subject so they would alert the enumerators if they detected an instance of a near-miss. Additionally, hospital printed and posted inclusion standards for maternal near-misses on the walls of each ward. To look for possible cases, the data collectors routinely visited the labor ward, antenatal and postnatal ward, intensive care unit, and emergency outpatient department. To standardize procedures and guarantee consistency in data gathering, training was provided to the data collectors. Additionally, the questionnaires underwent preliminary testing in our hospital to ensure that the instrument was suitable. As a result, the aforementioned processes were very helpful in obtaining high-quality data.

Statistical Analysis:
Data was analyzed using IBM-SPSS version 23.0, Counts with percentages were reported for Maternal Demographics, Mode of Admission, delivery, indications for Cesarean Section, initial procedures, surgeries prior to transfer, diagnosis and initial management at Tertiary care hospital. Association of these parameters with maternal outcomes (Near miss or mortality) was tested using Pearson Chi Square test and Fisher's exact test. P-values less than 0.05 were considered statistically significant.

Results:
Incidence of maternal near-miss and mortality
143 women were the study participants, Pie diagram-1 showing 95.1% women identified were as NM and 4.9% as MD.

Demographics Characteristics
Table-1 reports the maternal baseline characteristics with maternal outcomes, among NM majority (52.2%) women were between 26 – 35 years of age, 64.7% from urban areas,35.3% were from rural areas, 66.2% were housewife, 44.6% with primary or more education and 76.5% were Multiparous, whereas among MD (71.4%) women were 26 – 35 years of age, 71.4% from urban areas, 42.9% were housewife, 71.5% with primary or more education and 57.1% were Multiparous, there was no significant association of baseline maternal characteristics with maternal outcomes ($P>0.05$).

Characteristics of woman experiencing near-misses or mortalities
Table -2 reports among NM women 55.1% were referral cases, 69.9% were un-booked, 63.2% had cesarean section and 31.6% had previous cesarean section. Among mortality cases 71.4% were referred, 57.1% were un-booked, 57.1% with cesarean section and 14.3% had previous cesarean section. A significant association of cesarean section as mode of delivery was found with maternal outcomes ($p=0.012$).

Table-3 reports the outcomes on initial procedures and surgeries prior to admission in our tertiary care hospital, among near miss samples 58.1% cases had cesarean section, 83.1% had 1-0 surgeries prior to admission, 76.5% received prophylactic antibiotics prior to surgery, 40.4% had less than seven post operative days of transfer, among maternal death cases 71.4% had cesarean section, there were 85.7% had 1-0 surgeries prior to transfer, 71.4% received prophylactic antibiotics prior to surgery, 57.1% had less than seven days post operative days of transfer, a significant association of initial procedures was observed with maternal outcomes ($p<0.01$).

Underlying and contributory causes:
Table-4 shows among near miss samples 39.7% women diagnosed with peritonitis, 30.1% with wound infections, 64.7% women were initially managed by exploratory laparotomy followed by peritoneal toilet, among MD cases 57.2% women diagnosed with peritonitis and wound infections, 57.1% women were initially managed by exploratory laparotomy with peritoneal toilet. 15.4% women had total abdominal hysterectomy. There was no significant association observed of diagnosis and initial management at tertiary care hospital with maternal outcomes ($p>0.05$).

Pie Chart 1:

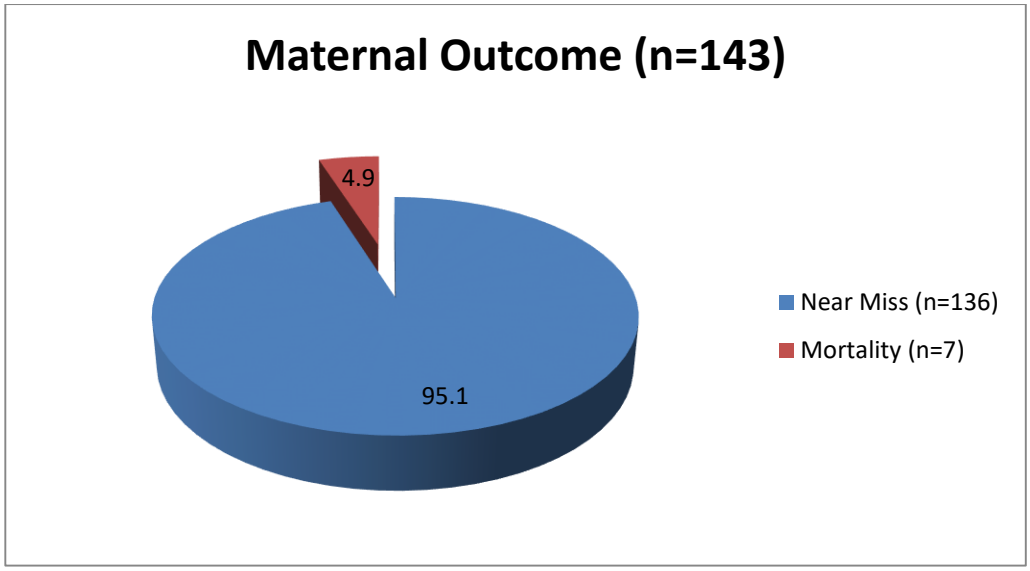


Table1: Maternal Baseline Characteristics with Maternal Outcome

Characteristics		Maternal outcome						p-value
		Near Miss (n=136)		Mortality (n=7)		Total (n=143)		
		n	%	n	%	N	%	
Age (years)	15-25	47	34.6	1	14.3	48	33.6	0.52
	26-35	71	52.2	5	71.4	76	53.1	
	Above 36	18	13.2	1	14.3	19	13.3	
Address	Rural	48	35.3	5	71.4	53	37.1	0.06
	Urban	88	64.7	2	28.6	90	62.9	
occupation	House wife	90	66.2	3	42.9	93	65.0	0.42
	Working lady	46	33.8	4	57.1	50	35.0	
Education	Uneducated	73	53.7	2	28.6	75	52.4	0.10
	Primary	44	32.4	2	28.6	46	32.2	
	Secondary	19	14.0	3	42.9	22	15.4	
Parity	Nulliparous	7	5.1	1	14.3	8	5.6	0.43
	Primiparous	25	18.4	2	28.6	27	18.9	
	Multi Parous	104	76.5	4	57.1	108	75.5	
*p<0.05 was considered statistically significant								

Table 2: Mode of Admission, Delivery and indications for Cesarean Section

Variables		Maternal outcome						p-value
		Near Miss (n=136)		Mortality (n=7)		Total (n=143)		
		n	%	n	%	N	%	
Mode of Admission	OPD	28	20.6	1	14.3	29	20.3	0.69
	Emergency	33	24.3	1	14.3	34	23.8	
	Referral	75	55.1	5	71.4	80	55.9	
Booking Status	Booked	41	30.1	3	42.9	44	30.8	0.36
	Un-booked	95	69.9	4	57.1	99	69.2	
Mode of delivery	Cesarean Section	86	63.2	4	57.1	90	62.9	0.94
	Vaginal Delivery	17	12.5	1	14.3	18	12.6	
	Septic abortion	33	24.3	2	28.6	35	24.5	
Indication for cesarean section	Labor dystocia	41	30.1	0	0.0	41	28.7	0.012*
	Non re-assuring fetal status	18	13.2	2	28.6	20	14.0	

	Previous cesarean section	43	31.6	1	14.3	44	30.8	
	Antepartum hemorrhage	8	5.9	3	42.9	11	7.7	
	Malpresentation	5	3.7	0	0.0	5	3.5	
	Multiple Pregnancy	6	4.4	1	14.3	7	4.9	
	Intrauterine fetal demise	8	5.9	0	0.0	8	5.6	
	Unknown Indication	7	5.1	0	0.0	7	4.9	
*p<0.05 was considered statistically significant								

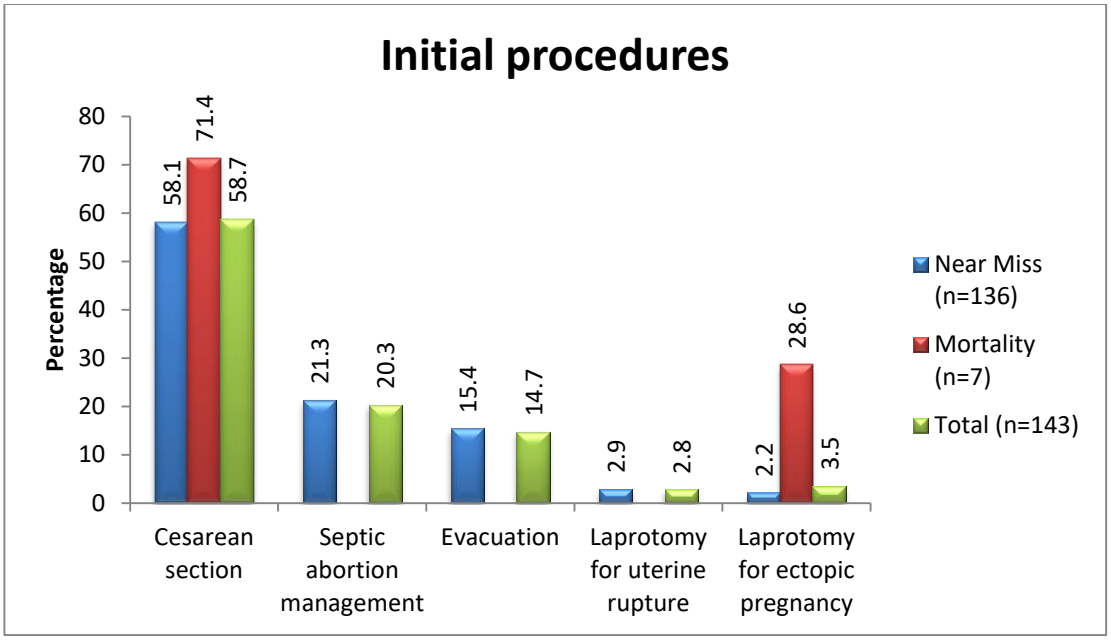
Table 3: Outcomes on Initial Procedures and Surgeries prior to Transfer

Variables		**Maternal outcome**						**p-value**
		Near Miss (n=136)		**Mortality (n=7)**		**Total (n=143)**		
		n	**%**	**n**	**%**	**n**	**%**	
Initial procedure	**Cesarean section**	79	58.1	5	71.4	84	58.7	<0.01*
	Septic abortion management	29	21.3	0	0.0	29	20.3	
	Evacuation	21	15.4	0	0.0	21	14.7	
	Laprotomy for uterine rupture	4	2.9	0	0.0	4	2.8	
	Laprotomy for ectopic pregnancy	3	2.2	2	28.6	5	3.5	
Surgeries prior to transfer	**1-0**	113	83.1	6	85.7	119	83.2	0.78
	2-1	15	11.0	1	14.3	16	11.2	
	3-2	8	5.9	0	0.0	8	5.6	
Received antibiotics prior to surgery	**Yes**	104	76.5	5	71.4	109	76.2	0.35
	No	17	12.5	2	28.6	19	13.3	
	Unknown	15	11.0	0	0.0	15	10.5	
Post operative day of transfer	**< 7 days**	55	40.4	4	57.1	59	41.3	0.74
	7-14 days	42	30.9	2	28.6	44	30.8	
	>14 days	25	18.4	1	14.3	26	18.2	
	unknown	14	10.3	0	0.0	14	9.8	
*p<0.05 was considered statistically significant								

Table 4: Diagnosis and Initial Management at Tertiary Care Hospital

Variables		**Maternal Outcome**						**p-value**
		Near Miss (n=136)		**Mortality (n=7)**		**Total (n=143)**		
		N	**%**	**n**	**%**	**n**	**%**	
Diagnosis at tertiary care hospital	**Peritonitis**	54	39.7	2	28.6	56	39.2	0.94
	Wound infection	41	30.1	2	28.6	43	30.1	
	Endometritis	6	4.4	1	14.3	7	4.9	
	Parietal infection	3	2.2	0	0.0	3	2.1	
	Hemoperitoneum	4	2.9	0	0.0	4	2.8	
	Uterine dehiscence	8	5.9	1	14.3	9	6.3	
	Foreign body	3	2.2	0	0.0	3	2.1	
	Retained placenta	11	8.1	1	14.3	12	8.4	
	Tubo-ovarian abscess	2	1.5	0	0.0	2	1.4	
	Necrotizing fasciitis	4	2.9	0	0.0	4	2.8	
Initial management at tertiary care hospital	**Exploratory laparotomy with peritoneal toilet**	88	64.7	4	57.1	92	64.3	0.80
	Exploratory laparotomy with total abdominal hysterectomy	20	14.7	2	28.6	22	15.4	
	debridement only	11	8.1	0	0.0	11	7.7	
	Non surgical management	15	11.0	1	14.3	16	11.2	
	other surgical management	2	1.5	0	0.0	2	1.4	
*p<0.05 was considered statistically significant								

Bar Chart 2:



Bar Chart 2 showing commonest initial procedure among near miss or mortality samples was Cesarean Section.

DISCUSSION:

Puerperal sepsis is the third prevalent cause of maternal mortality worldwide, and report for 15% of total mothers die [17]. The sequence from good health to death in a pregnant woman is a clinical insult. customarily the indicator of maternal health was maternal mortality, more recently review of the cases with near miss obstetric events has been found to be fruitful addition to investigate not only maternal mortality but it is also used to evaluates the quality of obstetrical care in an institutes. Maternal morbidity is the foundation, while maternal deaths (MD) are like the "tip of an iceberg," with more women surviving pregnancy problems than those who pass away [18]

In present study total numbers of obstetric admissions in a year were 5686, out of those 143 women, presented with Near Miss post-natal infections. The incidence of puerperal sepsis was 1.7%. The majority 95.1% of women were found with near miss and 4.9% with mortality. On other hand study conducted by J Vanukuruetal, in India. Total 7887 deliveries conducted in their hospital out of that 45 (0.2%) had puerperal sepsis. There were two (4.4%) deaths and 13/45 (28.8%) had near-miss morbidity[12].In resource poor settings, incidence ranges from 1% to more than 15%.[19] According to a study by C Benimanaetal, the age range of 25 to 34 years represented 52.1% of mothers who either died or had near-death experiences. The majority of referrals were from hospitals in the city of Kigali (30.6%) and the eastern province (39.7%). The majority of them (76%), who made up half of the sample (53.7%), identified as either laborers or housewives [20]. Our study reports, among near miss samples, majority 52.2% samples were with age group 26-35 years, major part of young participants reflects an early age at marriage and conception. 64.7% from urban areas, 66.2 % were house wives, 44.6% with primary or more education and 76.5% were multiparous. There was no statistically significant link between parity and severe morbidity or mortality, with about 50% of patients being primiparous. Most of the patients were un-booked and referred cases. This shows lack of basic infrastructural facilities, or unable to approach the facilities in the peripheral hospitals /or to the referral chain.[21]

The World Health Organization (WHO) suggests a cesarean section rate from 5% to 15%, but the global percentage is higher. Our study shows, among near miss cases 58.7 % cases had initial procedure of cesarean section, there were 83.1% sample found with previous one surgery prior to

transfer to tertiary care hospital, A significant association of initial procedure was observed with maternal outcomes ($p<0.01$), while septic abortion (20.3%) remained on second number .In addition to being frequent complications and important causes of patient mortality and morbidity, post-operative infections also place a considerable financial burden on patients and healthcare systems.[6]
Despite of advancements in pre- and post-operative care, sepsis in the field of surgery persists remarkable. However, compliant antibiotics can profitably reduce the puerperal sepsis. In our study *76.5*% received antibiotics prior to surgery. there were 85.7% sample found with surgeries prior to transfer, calling attention on the overuse of antibiotics/multidrug resistance and greater number of obstetric surgeries, in developing countries are still being done by unskilled personnel's for irrelevant reasons, who fail to follow the certified standards of disinfection during surgeries, unknowing of safe surgical practices. [6] All healthcare professionals should be aware of the symptoms, signs of maternal sepsis and potentially lethal course of septic shock. All suspicious septic patients must be referral to tertiary care hospitals [10].
Among mortality cases more than half the patients were diagnosed with peritonitis and wound infection, 57.1% samples were initially managed by examination under anesthesia followed by exploratory laparotomies and peritoneal toilet. There was no significant association observed of diagnosis and initial management at tertiary care hospital with maternal outcomes ($p>0.05$). Maternal Mortality in poor resource country like Pakistan is still a challenge for the achievement of the Millennium development Goal (MDG). [22]Early recognition of post natal infection and instant treatment can bring down near miss and maternal deaths.[11]Strong primary and secondary level care can decrease the load of maternal morbidity [23]

CONCLUSION:

Cesarean section and septic abortion were mainly associated with post natal infection. Local strategies and policies should be established and implemented to improve the quality, safety and infection control for postnatal period of women

REFRENCES

1. MC Hogan, KJ Foreman, MNaghavi, Ahn SY, MR Wang, SMMakela, Et al. Maternal mortality for 181 countries, 1980–2008: a systematic analysis of progress towards Millennium Development Goal 5.Lancet (British edition). 2010;375(9726):1609–23
2. Yasir P. Khan, Shereen Z. Bhutta, Shama Munim, Zulfiqar A. Bhutta,Maternal Health and Survival in Pakistan: Issues and Options, Journal of Obstetrics and Gynaecology Canada,Volume 31, Issue 10, 2009, Pages 920-929, ISSN 1701-2163, https://doi.org/10.1016/S1701-2163(16)343 21-3.
3. GADemisse et al. Determinants of puerperal sepsis among post partum women at public hospitals in West SHOA zone Oromia regional STAT, Ethopia (institution BAEDCASE control study) BMC Pregnancy and Childbirth (2019) 19:95.
4. Akpan UB, et al. Severe Life –Threatening complications, Near Miss and Mortality in a Tertiary hospital in southern Nigeria.ObstetGynecol Int. 01 july2020: 9732648.
5. Ellen JT Nelissen et al. Maternal near miss and mortality in a rural referral hospital in northern Tanzania. BMC Pregnacy and Childbirth 2013; 13:141.
6. Marwah S et al. Severe Puerperal Sepsis- A Simmering Menace. J ClinDiagn Res.2017 May; 11(5).
7. Oppong SA et al. Incidence, causes and correlates of maternal near-miss morbidity: a multi-center cross-sectional study. An International Journal of Obstetrics and Gynecology 12 December 2018.
8. Nunnally M E. Sepsis for anaesthetist. Br J Anaesth. 2016 Dec:117(suppl 3):
9. Rello J et al. Sepsis: A Review of Advances in Management.Adv Ther. (2017)34:2393-2411
10. Centre for Maternal and Child Enquiries (CMACE). Saving Mothers' Lives: reviewing maternal deaths to make motherhood safer: 2006–08.The Eighth Report on Confidential Enquiries into Maternal Deaths in the United Kingdom. BJOG 2011;118 Suppl 1:1–203.

11. Vogel JP et al. The burden of severe maternal out comes and indicators of quality of maternal care in Nigerian Hospitals: A secondary analysis comparing two large facility based surveys. British Journal Of Obstetrics and Gynecology. Volume 126, issue S3 / p. 49-57.
12. World Health Organization. Trends in maternal mortality: 1990 to 2015: estimates from WHO, UNICEF, UNFPA, world bank group and the United Nations population division: executive summary.who.int/iris/handle/10665/193994
13. Shresta N S et al. Near miss maternal morbidity and maternal mortality at Khathmandu medical college teaching hospital. KhathmanduUniv Med J (KUMJ). April-Jun 2010.
14. Olufemi T Oladapo et al. Near miss obstetric events and maternal deaths in Sagamu Nigeria: A retrospective study. Reproductive Health vol 2, Article Number: 9, 01 November 2005
15. Adams A et al. Proportion of bacterial isolates, their antimicrobial susceptibility profile and factors associated with puerperal sepsis among post partum/ aborted women at a refral hospital in Bahir Dar, Northwest Ethopia. Antimicrob Resist Infect Control. Volume 9, Article number: 14 (2020)
16. Pattison R et al. Too little, too late: the recurrent theme in maternal deaths due to sepsis. Obstetrics and Gynecology Forum.Volume.28, No. 3, Nov 2018
17. WHO. Evaluating the quality of care for severe pregnancy complications. The WHO near miss approach for maternal health. World Health Organization. 2011.
18. Chikadaya H et al. Incidence of maternal near miss in the public health sector of Harare, Zimbabwe: a prospective descriptive study.BMC Pregnancy and childbirth.2018; 18: 458.
19. Goldenberg R L, Saleem S, maternal near miss in low resource areas. Int J GynaecolObstet. 2017 Sep; 138 (3): 347-355
20. Benimana C et al. Preventability of maternal near miss and mortality in Rwanda: A case series from the University Teaching Hospital Kigali (CHUK). PLOS ONE, June 26, 2018
21. Rawabzi D et al. Maternal near missand mortality due to postpartum infections: A cross sectional analysis from Rwanda. BMC Pregnancy and childbirth.16 Article No 177: (2016)
22. Nisar N et al. Maternal Mortality in rural community: a challenge for achieving millennium development goal. J Pak Med Assoc Jan 2010: 60 (1): 20-4
23. Wasim T et al. Maternal near mortality, and their correlates at tertiary care hospital. Journal of Pakistan Medical Association.13.4 2021