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ORIGINAL ARTICLE

Maternal Mortality and COVID-19 Pandemic: Looking Beyond SARS CoV-2 Infection

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Abstract

Objective To study the impact of COVID-19 pandemic on maternal mortality ratio, aetiological and modifiable factors for maternal mortality and key interventions performed.

Method Retrospective exploratory study evaluating maternal mortality between April to November 2020 (study group) and 2019 (control group).

Results Demographic variations existed in the two groups. Increased maternal age and illiteracy were significantly more in the study group. Maternal mortality ratio (MMR) was significantly high in the study group (792 vs. 296 p value = 0.0). Hemorrhage accounted for 20% and COVID-19-related maternal deaths accounted for 15% deaths in the study group. Level 3 delay (delay in receiving care/inadequate care) was observed in 35% in the study group and 28% in control group (p value = 0.349). 17.5% of mothers in the study group as compared to 8% of control group were dead on arrival to hospital though not statistically significant (p value = 0.28). Significantly more women in study group died within 24 h of admission (45% vs. 20%, p value 0.04). Among the key interventions, the use of supplemental oxygen was significantly high in study group (p value = 0.02).

Conclusion Maternal mortality ratio was high in the pandemic year because of a significant decline in hospital delivery rate. The lesson learnt from this pandemic needs to be documented to guide better planning in the future to face similar situations.

Keywords Maternal Mortality · ICD-10MM (International Classification of Disease-10 Maternal Mortality) · Levels of delay · Key interventions · Maternal mortality ratio (MMR)

Introduction

Maternal mortality is defined by the World Health Organization (WHO) as "Death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes" [1].

Maternal mortality ratio (MMR) is a yardstick to measure the health status of a nation. Availability of integrated health facilities, skilled health personnel and optimal utilization of services are benchmark of good health care system. But despite having world class infrastructure and highly advanced health services many countries reeled under the impact of the unexpected COVID 19 pandemic. The COVID SARS -2 pandemic affected millions of people and overburdened the existing health care facilities in most countries. In India, many tertiary care centers were converted to COVID care centers and the routine medical services including obstetric care were disrupted.

Antenatal visits were reduced due to the fear of spread of infection. Further, lockdown imposed restrictions on movement leading to delays in access to health care. There was a change in admission policy, many hospitals admitted patients only after a COVID RTPCR negative report and other COVID-dedicated hospitals admitted patient only after a COVID positive report leading to a delay in receiving care awaiting the report. Women often had multiple referrals before admission because of refusal on grounds of non-availability of COVID report, lack of facilities and/or manpower.

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The COVID SARS-2 infection affected the maternal mortality in more ways than one. There was a decline in institutional delivery rate. Non-obstetric maternal deaths increased consequent to COVID-19.

This study was undertaken to the assess the impact of COVID-19 pandemic on maternal health by comparing the maternal deaths during COVID-19 pandemic with maternal deaths in pre-pandemic period.

Aim

The aim was to study the impact of COVID pandemic on maternal mortality.

Objectives

- The primary objective was to compare the maternal mortality ratio (MMR) and causes of maternal mortality during COVID pandemic (April to November 2020) with that in similar months in pre-pandemic time (April–November 2019)
- Secondary objectives were to compare the modifiable factors (Level I, II and III delays) and the key interventions undertaken in management during the above-mentioned periods.

Material and Methods

It was a retrospective exploratory study done after obtaining ethical clearance from the institutional ethical committee. All maternal deaths in the period between April and November 2020 comprised of the study group and the maternal deaths in the same time period in 2019 comprised of the control group. The maternal death was defined as per WHO definition [1]. Pregnant women who were dead on arrival were also included in the study. Maternal deaths beyond 42 days of termination of pregnancy were excluded from the study.

As per institutional protocol, all maternal deaths were recorded in a predesigned proforma and a detailed case summary with all relevant clinical findings, investigations and the management for each case was prepared. All maternal deaths were thoroughly discussed at the institutional facility based maternal mortality meeting conducted monthly, where consultants from different specialties involved in the management of the patient were present to discuss the maternal deaths and assign the final cause of death. Interventions performed were critically appraised, and any deficiency in management was flagged and guided future corrective action. Comments and suggestions of the members were recorded in the minutes of the meeting for further implementation.

In the present study, the data from the maternal mortality proforma, case summaries, case records and the minutes of mortality meeting were analyzed.

Modifiable causes of maternal mortality are related to three levels of delay. Delay in seeking care was assigned as level 1, delay in reaching the hospital was assigned as level 2, and delay in receiving care /inadequate care was as assigned level 3 delay [2].

Key interventions analyzed were the use of live saving procedures.

Causes of maternal mortality were classified according to etiological factors and according to ICD 10- MM coding system [3].

Outcomes compared between 2020 (study group) and 2019 (control group) were the MMR, proportion of maternal deaths caused by each etiological factor, proportion of modifiable factors in each group and proportion of key intervention performed in each group. Statistical analysis was done using chi-square test, and p value less than 0.05 was taken as significant.

Results

In the study period of eight months from April to November 2020, there were 40 maternal deaths (study group)) as compared to 25 deaths in the corresponding period in 2019 (control group) which is equivalent to 37.5% increase in the maternal deaths in the pandemic year 2020 (Table 1).

As depicted in table above, increased maternal age and illiteracy were more prevalent in study group. Due to the travel restrictions during the pandemic, significantly more maternal deaths in study group as compared to control group were reported from Delhi (Table 1).

Contrary to what was expected, delay in seeking care was observed less frequently in the pandemic year. This could be because people were aware that there could be difficulty in access to healthcare services, hence they were more inclined to seek medical care early. Similarly, delay in reaching hospital was less frequently observed in the pandemic year as the government had increased the ambulance services. Lack of facilities, manpower or expertise in the referral units was responsible for level 3 delays observed more in the pandemic year, but none of the delays were statistically significant.

The three levels of delay were further sub-categorized.

Causes for level 1 delay included lack of awareness of danger signs in 60% of study and 48% controls (p value = 0.343), illiteracy and ignorance in 45% study and 36% controls (p value = 0.473), delay in decision

making in 27.5% and 48% study and controls, respectively (p value = 0.092), no birth preparedness in 25% study and 12% in controls (p value = 0.202), delay due to lack of assured services in 2.5% study and 12% controls (p value = 0.121) and lack of awareness about services available in 15% study and 8% controls (p value = 0.403).

Causes of level 2 delay included delay in getting transport in 2.5% study and 4% of controls (p value = 0.733). Delay in mobilizing funds was noted in 2.5% study group and none in controls. Not reaching appropriate facility in time was observed in 32.5% in the study group and 36% in control group (Table 2).

Cause of level 3 delay included delay in initiating treatment in 12.5% of study and 4% of controls (p value = 0.556). In the pandemic year, 5% delays occurred at our facility and 7.5% delays occurred at the referring facility and in the pre-pandemic year 4% delays occurred at our facility and no delay was observed at the referring facility. Substandard treatment was observed in 22.5% study group and 24% controls (p value = 0.890). In the pandemic year, 7.5% of the treatment deficiencies occurred at our facility and 15% of deficiencies occurred before arrival to our facility compared to 4 and 20%, respectively, in the pre-pandemic year. Lack of blood transfusion was observed in 2.5 and 4% patients in the study and controls, respectively, all of which occurred prior to reaching our facility (p value = 0.733).(Table 2)

It was observed that 45% of women died within 24 h of admission in the study group. Delay in receiving care or substandard care during the pandemic could have contributed to the early deaths although sudden deaths due to embolism also showed a marked increase in the study group contributing to the early deaths. On the contrary, late deaths after 6–10 days of hospital stay were significantly more in the pre-pandemic year (36%) as compared to pandemic year (12.5%), suggesting that there were lesser delays in initiating management in the pre-pandemic year. (Table 3)

The pandemic did not alter the course of the labor and delivery as no significant difference was observed in the proportion of women who remained undelivered in both the groups. (Table 3)

Out of the 40 women in study group, seven were dead on arrival and out of the 25 women in control group two were dead on arrival to hospital and hence were excluded for comparison of the interventions.

Table 1 Demographic profile of maternal mortality in year 2020 and 2019

Variable	Study group Year 2020 $N=40$	%	Control group Year 2019 $N=25$	%	p value
Maternal age in years					
18–22	6	15%	4	16%	0.01
23–27	13	32.5%	12	48%	
28- 32	11	27.5%	8	32%	
≥33	10	25%	1	4%	
Mean Age	29.17 Years	25.31 Years			
Residence					
Delhi	29	72.5%	16	64%	0.001
Neighboring *Region*	9	22.5%	4	16%	
Other States	2	5%	5	20%	
Literacy					
Illiterate	23	57.5%	8	32%	0.007
Up to V	2	5%	10	40%	
VI-XII	1	2.5%	3	12%	
Graduate	0	–	1	4%	
Status not known	12	30%	4	16%	
Gravidity					
1	13	32.5%	5	20%	0.108
2	9	22.5%	13	52%	
3	8	20%	1	4%	
4	7	17.5%	3	12%	
5	2	5%	1	4%	
6	1	2.5%	2	8%	
Prior antenatal care received					
No	14	35%	7	28%	0.556
Yes	26	65%	18	72%	

Table 2 The details of modifiable causes (levels of delay)

Modifiable factors	Study group Year 2020 $N=40$	%	Control group Year 2019 $N=25$	%	P value
Delay in seeking care (Level 1)	26	65%	19	76%	0.349
Delay in reaching the hospital (Level 2)	13	32.5%	10	40%	0.538
Delay in receiving care/Inadequate Care (Level 3)	14	35%	7	28%	0.349
Referral status					
Not referred	11	27.5%	11	44%	0.17
Referred	29	70%	14	56%	0.25
No. of hospitals visited prior to arrival					
0	11	27.5%	11	44%	0.17
1	19	47.5%	10	40%	0.55
≥2	10	25%	4	16%	0.39

Table 3 Delivery details and duration of hospital stay

Variable	Study group (Maternal Mortality April–Nov 2020) $N=40$	Percentage	Control group (Maternal Mortality April–Oct 2020) $N=25$	Percentage	P value
Undelivered	10	25%	7	28%	0.788
Vaginal delivery	16	40%	7	28%	0.324
Cesarean Section	10	25%	10	40%	0.202
Laparotomy (rupture uterus)	2	5%	0	–	
Post-abortal	2	5%	1	4%	0.851
Duration of hospital Stay					
Brought dead	7	17.5%	2	8%	0.28
1–24 h	18	45%	5	20	0.04
2–5 days	5	12.5%	7	28%	0.117
6–10 days	5	12.5%	9	36%	0.024
11–15 Days	2	5%	1	4%	0.851
>15	3	7.5%	1	4%	0.567

Out of the 7 brought dead, 2 were COVID-19-related deaths and both were diagnosed based on positive RTPCR report. One brought dead patient who was also incidentally HIV-positive too was suspected to have COVID-19 based on symptoms, but her RTPCR sample was negative and she was not included as COVID-19-related death.

Out of the five patients in study group who were dead on arrival due to causes other than COVID-19, all five had level 1 delay, 3 had levels 1 and 2 delay and one had levels 1, 2 and 3 delay.

Of the two brought dead patients in control group, one had no delay, she collapsed suddenly after eating food and died, and the second patient had all three levels of delay. The level of delays was not statistically significant between both groups (Table 2).

A significantly higher number of women in the pandemic year required supplemental oxygen by nasal prongs or mask as compared to pre-pandemic year (p value 0.022). This increase can be attributed to the addition of cases of COVID-related severe acute respiratory infection (SARI) in the study group (Table 4).

The total number of deliveries was 5101 from April–November 2020 and 8386 from April to November 2019. This highlights the impact of COVID on the institutional delivery rate which had declined markedly in the pandemic year. Maternal mortality ratio was 792/100000 live births in the year 2020 compared to 296/100000 live births in the year 2019, and the p value was 0.000000 which is highly significant.(Table 5A)

Obstetric hemorrhage was the leading cause of maternal mortality in the pandemic year (20%) followed by COVID-19 (15%) and embolism (15%). In the pre-pandemic year, hypertensive disease of pregnancy, fulminant hepatic failure and lower respiratory tract infection were the three leading causes each contributing to 16% of maternal deaths. (Table 5A)

Except for fulminant hepatic failure which was significantly high in 2019, there was no significant difference

observed in causes of death other than COVID-19-related deaths that occurred in 15% of study group.(Table 5A)

Deaths due to fulminant hepatic failure (FHF) had shown a significant decline in 2020 (4%) as compared to 2019 (16%). In the year 2019, these deaths were mainly caused by hepatitis E infection which is prevalent in this part of the country. It is transmitted through contaminated water and food. Lockdown-imposed restriction in movement could be a reason for this decline, as women mostly stayed indoors and consumed home-made food and hence were less likely to be infected with Hepatitis E. In the pandemic period, the single death due to fulminant hepatic failure was because of acute fatty liver of pregnancy.

Maternal mortality was also compared based on the WHO application of ICD-10 to deaths during pregnancy, childbirth and the puerperium (ICD-10 MM), which is a standardized classification adopted worldwide [3]. All categories (category 1–7) of maternal deaths were comparable between the two groups. Other direct obstetric cause (class 5) in study group was predominantly due to embolic events. Amniotic fluid embolism caused 12.5% deaths in pandemic year as compared to 4% in pre-pandemic year. Since it is diagnosis of exclusion, there is a possibility of overdiagnosis. Non-obstetric indirect maternal deaths (category 7) were the leading cause of death in both the groups.(Table 5B)

Eight maternal deaths occurred out of a total of 357 women with COVID-19 infection who delivered at our hospital between April–November 2020. Amongst these eight deaths, six were attributed directly to maternal COVID-19-related complications (Table 6), whereas in the other two indirect deaths, one was due to atonic PPH and the other due to intestinal intussusception. Case fatality rate of pregnant women with COVID-19 infection in our series is 1.68%.

Discussion

Maternal deaths due to COVID-19 infection have been reported from many countries. In the present study, COVID-19 was a direct cause of maternal mortality in 15%. Since these data is from a single hospital which receives a high number of referrals of critically sick women, the MMR in the facility is much higher, that is 792/100000 live births than the national average of India, reported as 113/100,000 live births in 2016–18 [4]. In a study by Carvalho-Sauer et al. [5], a total of 144 maternal deaths occurred in 2020, out of which 13.19% was due to COVID-19. The MMR was 78.23/100,000.

In India the COVID-19 infection started to rise in April 2020 and thereafter showed a downward trend at the end of the year. The pregnant women were adversely affected due to the pandemic as is evident by the fact that during the pandemic the total number of hospital deliveries declined, whereas the maternal deaths increased.

In a review article by Pant et al. [6], it was projected that maternal mortality is expected to rise in COVID-19 pandemic due to delays in access to health care and delay in receiving treatment. However, no significant difference in level of delays is observed in our study.

Table 4 Key interventions performed

Interventions performed	Study group (year 2020) $N=33$		Control group (year 2019) $N=23$		p value
	Number	percentage	number	percentage	
Supplemental oxygen by mask/nasal prongs	23	69.69%	9	39.13%	0.022
Non-invasive ventilation	5	15.15%	1	4.34%	0.198
Invasive ventilation	25	75.75%	21	91.30%	0.135
Fluid resuscitation	18	54.54%	8	34.78%	0.144
Ionotropes/vasopressors	22	66.66%	17	73.91%	0.561
Blood and blood product transfusion	22	63.66%	14	60.86%	0.656
Therapeutic uterotonics	3	9.09%	4	17.39%	0.355
Balloon tamponade	1	3.03%	2	8.69%	0.354
External compression sutures for atonic PPH	0	–	0	–	
Obstetric hysterectomy	2	6.06%	2	8.69%	0.706
Internal iliac artery ligation	2	6.06%	1	4.34%	0.780
Uterine artery embolization	0	–	1	4.34%	
Repair of uterus (rupture)	2	6.06%	0	–	
Dialysis	0	–	0	–	
Higher antibiotics	14	42.42%	14	60.86%	0.174
Exploratory laparotomy (perforation/peritonitis)	1	3.03%	0	–	
Other surgical procedure (non-obstetric cause)	2	6.06%	0	–	

Table 5 A: Causes of maternal mortality

Variables	Cases (Year 2020) $N=40$	%	Controls (Year 2019) $N=25$	%	*P* Value
Hypertension (pre-eclampsia/eclampsia)	4	10%	4	16%	0.473
Hemorrhage (PPH, rupture uterus)	8 (6+2)	20%	3	12%	0.402
Obstetric Sepsis (Puerperal + Post-abortal)	4 (2+2)	10%	1	4%	0.377
Fulminant hepatic failure	1	2.5%	4	16%	0.046
Tuberculosis	1	2.5%	2	8%	0.303
COVID-19	6	15%	0	–	
LRTI/ARDS	3	7.5%	4	16%	0.282
Cardiac cause(myocarditis)	0	–	1	4%	
Pulmonary embolism	1	2.5%	1	4%	0.733
Amniotic fluid embolism	5	12.5%	1	4%	0.249
Epilepsy (status epilepticus)	1	2.5%	1	4%	0.733
Renal failure	1	2.5%	0	–	
Surgical emergencies: Bowel intussusception/obstruction	2	5%	0	–	
Anemia	2	5%	0	–	
Acute gastroenteritis	0	–	1	4%	
Unknown	0	–	1	4%	
Iatrogenic	1	2.5%	1	4%	0.733
Total deliveries (April–November)	5101		8386		
No. of live births (April–November)	5050		8421		
Maternal mortality ratio (MMR) (no. of maternal deaths/100000 live births)	792		296		0.000000
B: ICD-10 MM Maternal Mortality Coding					
Group/category	Study group $N=40$	%	Control group $N=25$	%	*P* Value
Maternal death: Direct 1. Pregnancies with abortive outcome	2	5%	1	4%	0.851
Maternal death: Direct 2. Hypertensive disorders in pregnancy	4	10%	4	16%	0.473
Maternal death: Direct 3. Obstetric hemorrhage	8	20%	3	12%	0.403
Maternal death: Direct 4. Pregnancy-related infection	2	5%	0	–	
Maternal death: Direct 5. Other obstetric complications	9	22.5%	2	8%	0.129
Maternal death: Direct 6. Unanticipated complications of management	1	2.5%	1	4%	0.733
Maternal death: Indirect 7. Non-obstetric complications	14	35%	13	52%	0.176
Maternal death: unspecified 8. Unknown/undetermined	0	–	1	4%	
Coincidental causes	0	–	0	–	

The key interventions for management of critically ill pregnant women during the two periods of time 2020 and 2019 were not much different except that more women required supplemental oxygen in the pandemic year, implying that more women in 2020 had hypoxia.

In the present study, out of six direct deaths due to COVID-19 two were dead on arrival. Among the rest four women oxygen saturation was low at the time of presentation. Hypertension was a significant comorbidity seen in all but one of the COVID-related maternal deaths. All women received mechanical ventilation (100%), three received enoxaparin (75%), three received antibiotics (75%), one received steroid (25%), and none received remdesivir (Table 6). Remdesivir was not available during the time of study, whereas corticosteroid was not given in the initial phase of the pandemic when the guidelines were evolving regarding the role of steroid. In a study by Blitz et al. [7], out of 465 women with COVID-19, 15% (70 women) had severe or critical disease and 13 women required ICU admission and 2 women died. Among women requiring ICU admission in their study, 62% received invasive ventilation, 100% received anticoagulant, 92% received antibiotic, and 23% received remdesivir.

In intubated critically ill pregnant woman with COVID-19, delivery is recommended after 32–34 weeks [8–10] as the fetus has a good chance of survival at this

Table 6 Details of direct maternal deaths due to COVID-19

PATIENT ⇨ FACTORS ⇩	A	B	C	D	E	F
Age (Years)	24	35	32	30	25	25
Delivery status	Undelivered	Day 11 post-LSCS	Undelivered	Undelivered	Undelivered	Undelivered
Gravida	3	2	1	4	3	1
Duration of hospital stay	11 h	12 days	0 h Brought dead	5 days	2 h	0 h Brought Dead
Chief complaints	Sudden breathlessness for 12 h	Referred in view of high BP records	Breathlessness for 3 wks more so for 3 days, generalized edema for 1 wk	Shortness of breath, sore throat, dry cough 3 days	Fever X 3 days Breathlessness & chest pain for 1 day	Cough and breathlessness for 2 days
BP (mmHg)	154/100 mmHg	190/104 mmHg	NR	108/70 mmHg	138/88 mmHg	NR
RR (min)	24	28	NR	30	Gasping	NR
SPO2	76% on room air 87% on O2	68% on O2	NR	68% on 02 97% on CPAP	NR	NR
Suppl O2	Yes	Yes	Not Given	Yes	Not given	–
NIV	No	No	–	Yes	No	–
INV VENT	Yes	Yes	–	Yes	Yes	–
CXR	Not available	B/L opacities in middle and lower zone	–	Not available	B/L opacities in middle & lower zone Cardiomegaly	–
D-dimer	2498	–	–	1140	949	–
Ionotropes	Yes	Yes	–	During resuscitation	During resuscitation	–
Antibiotics	Inj Piperacillin + tazobactum Inj Metronidazole	Inj Piperacillin + tazobactum Inj Metronidazole	–	Inj Ceftriaxone Inj Azithromycin	Not applicable	–
Other drugs received	Inj Enoxaparin	Inj Enoxaparin Inj Labetalol Inj MgS04 Tab Amlodipine	–	Inj Enoxaparin Inj Dexamethasone Regular insulin NPH insulin	Inj Lasix Inj Sodium Bicarbonate	–
Level of delay	I	I	I	I	2	I
Contributory factors	Pre-eclampsia	Severe pre-eclampsia, AKI	Chronic HTN Super imposed PE	Anemia GDM	Pre-eclampsia Pulmonary edema Septic shock	Gestational hypertension, GDM
COVID associated morbidity	Pulmonary embolism	ARDS Acute Kidney Injury	ARDS Pulmonary edema	ARDS	ARDS Septic shock	ARDS

NR Not recordable

gestation and decompression of uterus relieves the diaphragmatic compression and improves ventilation; however, surgery is a stress and may exacerbate the inflammatory response and risk vs benefit must be weighed on an individual basis. In our institution, delivery by cesarean is opted for women who require intubation and invasive ventilation for worsening hypoxemia. In our study, out of the six women who died of COVID-19, two were dead on arrival, one was postnatal, and the three antenatal women had a cardiac arrest soon after intubation and died before uterine decompression could be done.

Conclusion

Pandemic affected the maternal mortality in more ways than one. The highly significant MMR was not only consequent to the increased number of maternal deaths but also consequent to the steep decline in the institutional delivery rate. Thus, the lesson learnt from the pandemic is to enhance the preparedness of the health care system to provide uninterrupted maternal health services even during unforeseen circumstances. Strategies should be in place to optimize the care for pregnant women and prioritize

continuum of antenatal care and institutional delivery for all pregnant women under all circumstances.

Author Contributions RB performed planning and designing, conducting the work, collecting data, analysis of data, and writing the manuscript. MP contributed to concept, planning, designing, conducting work and co-writing manuscript. AS, RY and KA conducted the work and revised the manuscript. AS conducted the work, collected data and revised the manuscript. KC conducted work and collected and analyzed the data.

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Declarations

Conflict of interest There is no conflict of interest.

Ethical Approval The study was approved by the institute's ethical committee.

Informed Consent Waiver of consent was sought as it is retrospective study on maternal mortality and all data were deidentified.

References

1. Beyond the numbers : reviewing maternal deaths and complications to make pregnancy safer. WHO 2004.
2. Guidelines for Maternal Deaths Surveillance and Response, MOHFW, Govt of India, 2017: 90.
3. The WHO Application of ICD-10 to deaths during pregnancy, childbirth and the puerperium: ICD-MM, WHO 2012.
4. Special Bulletin on Maternal Mortality in India 2016–18, Sample Registration System Website link: https://censusindia.gov.in.
5. Carvalho-Sauer RCO, Costa MCN, Teixeira MG, et al. Impact of COVID-19 pandemic on time series of maternal mortality ratio in Bahia, Brazil: analysis of period 2011–2020. BMC Preg Childbirth. 2021;21:423. https://doi.org/10.1186/s12884-021-03899-y.
6. Pant S, Koirala S, Subedi M. Access to maternal health services during COVID. Eur J Med Sci. 2020; https://doi.org/10.46405/ejms.v2i2.110.
7. Blitz MJ, Rochelson B, Minkoff H, et al. Maternal mortality among women with coronavirus disease 2019 admitted to the intensive care unit. Am J Obstet Gynecol. 2020;223(4):595–9. https://doi.org/10.1016/j.ajog.2020.06.020.
8. Berghello V, Lockwood CJ, Barss VA. COVID-19: Pregnancy issues and antenatal care. Uptodate 2022.
9. Boelig RC, Manuck T, Oliver EA, Di Mascio D, Saccone G, Bellussi F, Berghella V. Labor and delivery guidance for COVID-19. Am J Obstet Gynecol MFM. 2020;2(2):100110. https://doi.org/10.1016/j.ajogmf.2020.100110.
10. Lópeza M, Gonce A, Melera E, et al. Coronavirus Disease 2019 in pregnancy: a clinical management protocol and considerations for practice. A Fetal Diagn Ther. 2020;47:519–28. https://doi.org/10.1159/000508487.

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