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CLINICAL ARTICLE

Obstetrics

Maternal mortality is preventable in Lebanon: A case series of maternal deaths to identify lessons learned using the “Three Delays” model

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Abstract

Objective: To identify the lessons learned from women who died during pregnancy or childbirth in Lebanon between 2018 and 2020.

Method: This is a case series and synthesis of maternal deaths between 2018 and 2020 that were reported by healthcare facilities to the Ministry of Public Health in Lebanon. The notes recorded from the maternal mortality review reports were analyzed using the “Three Delays” model to identify preventable causes and lessons learned.

Results: A total of 49 women died before, during, or after childbirth, with hemorrhage being the most frequent cause ($n=16$). The possible factors that would have prevented maternal deaths included a prompt recognition of clinical severity, availability of blood for transfusion and magnesium sulfate for eclampsia, adequate transfer to tertiary care hospitals comprising specialist care, and involvement of skilled medical staff in obstetric emergencies.

Conclusion: Many maternal deaths in Lebanon are preventable. Better risk assessment, use of an obstetric warning system, access to adequately skilled human resources and medications, and improved communication and transfer mechanisms between private and tertiary care hospitals may avoid future maternal deaths.

KEYWORDS

amniotic fluid embolism, avoidable, COVID-19, hypertensive disorders, maternal mortality, postpartum hemorrhage, preventable, sepsis

1 | INTRODUCTION

Reducing maternal mortality remains a global priority, as the majority of maternal deaths are avoidable.¹ Maternal deaths occur when the care provided is “too little, too late” or “too much, too soon”² (p. 2176) and can be attributed to multiple factors, including poorly performing

health systems, lack of referral systems for high-risk pregnancies, shortage of medications and resources, and limited clinical skills or experience to provide the appropriate level of care.^{2,3} In addition, lack of evidence-based guidelines, non-adherence to guidelines and inadequate contextualization of guidelines can prevent high-quality care from being delivered to women during pregnancy.^{2,4}

Faysal El-Kak is the senior author of this publication.

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Globally, maternal mortality was reduced by 38% from 2000 to 2017.⁴ The United Nations (UNs) Sustainable Development Goal (SDG 3.1) aims to decrease maternal mortality to less than 70 maternal deaths per 100 000 live births.⁵ The burden of maternal mortality is highly distributed among vulnerable populations in conflict settings and among those who face health inequalities based on gender, ethnicity, and socioeconomic status.^{5,6} However, maternal death remains preventable in most settings. Maternal mortality reviews are a fundamental tool to improve the quality of care, identify key lessons learned, and provide opportunities to improve clinical practice and service delivery.⁷⁻⁹

Lebanon hosts Syrian and Palestinian refugees and migrant domestic workers of several nationalities, including an estimated 1 million Syrian refugees, 200,000 Palestinian refugees, and more than 250 000 migrant workers.^{10,11} These vulnerable populations have access to maternity care in public hospitals and primary healthcare services funded by UN agencies and non-governmental organizations, yet they face many restrictions and barriers.

In addition, Lebanon does not have a unified system for electronic health records, which is problematic in a healthcare system where women receive maternity care from multiple providers during pregnancy. Furthermore, in the context of a high cesarean delivery rate of 49.5% in Lebanon, women may be transferred between healthcare facilities during childbirth, which emphasizes the requirement for clinical data to be available between healthcare facilities.¹²

Despite the high number of births in the large population of Syrian refugees, Lebanon had a low maternal mortality ratio of 14.9 between 2010 and 2018.¹³ In Lebanon, where the majority of births are in hospitals, it is mandatory to report maternal deaths. However, the maternal mortality ratio may be underestimated as there is no internal function to enforce reporting, and there is no centralized national electronic health record system. The large number of refugees, political and economic crises, coronavirus disease 2019 (COVID-19) pandemic, and discrimination faced by many communities may have affected the factors leading to maternal deaths. These contextual issues may have also affected reporting of maternal deaths as some women, due to the increased cost of deliveries, are not fully compensated by the UN High Commissioner for Refugees and may not be able to access care. This study aimed to identify the lessons learned from maternal deaths in Lebanon, including delays in accessing care and the quality of care received and to detail recommendations based on the findings.

2 | MATERIALS AND METHODS

2.1 | Study design, study population, and sampling

This was a case series and synthesis of maternal deaths in Lebanon between 2018 and 2020. Maternal deaths were defined using the following WHO definition: "the 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 unintentional or incidental causes" (p. 8).⁴ This case series included all available and reported maternal deaths in Lebanon between 2018 and 2020.

2.2 | Data source for maternal mortality in Lebanon

Maternal deaths are reported through the Maternal Death Surveillance System established by the Ministry of Public Health (MOPH) in Lebanon.¹³ Public and private hospitals staff are legally required to inform the Primary Care Department of the MOPH about all maternal deaths through an online-based charting system every month. Maternity care in Lebanon is provided by obstetricians and/or midwives, depending on the type of health facility, and antenatal care is provided by obstetricians in private clinics or outpatient departments. Every case is reported to the MOPH via a focal point in the specific hospital or region, and then it is investigated by an obstetrician, who is a member of the expert group. The investigating physician completes a data collection form using the medical records and interviews with those who provided medical care to the woman, including the medical team and hospital management staff. The data collection form includes the agreed cause of death, secondary factors, and a narrative description of the events that led to death. The reported cases are then discussed within the national committee on safe motherhood for feedback and recommendation. These reports are presented every year to the maternal mortality committee and stored at the MOPH's Statistics Department.¹³ The maternal mortality review committee classifies the cause of every reported maternal death.

2.3 | Data synthesis

We examined all maternal mortality review notes for preventable factors, including delays and barriers in obtaining care, and the quality of care given using the "Three Delays" model and our developed conceptual framework presented in Figure 1.^{14,15} Figure 1 was adapted from a clinical pathway of major obstetric hemorrhage and represented our consensus of the clinical pathway for maternal death.¹⁶ For each maternal death, we built a timeline and identified risk factors and preventable factors based on the three types of delays through review of the report from the maternal mortality committee. Extracted factors were grouped into three types including phase 1 (delay to seek medical care), phase 2 (delay to reach the hospital), and phase 3 (delay to receive appropriate care at the hospital).¹⁵ The conceptual framework and "Three Delays" model provided a lens in which to conduct a narrative synthesis among all maternal mortality case notes to identify lessons learned. Aligned with the findings,

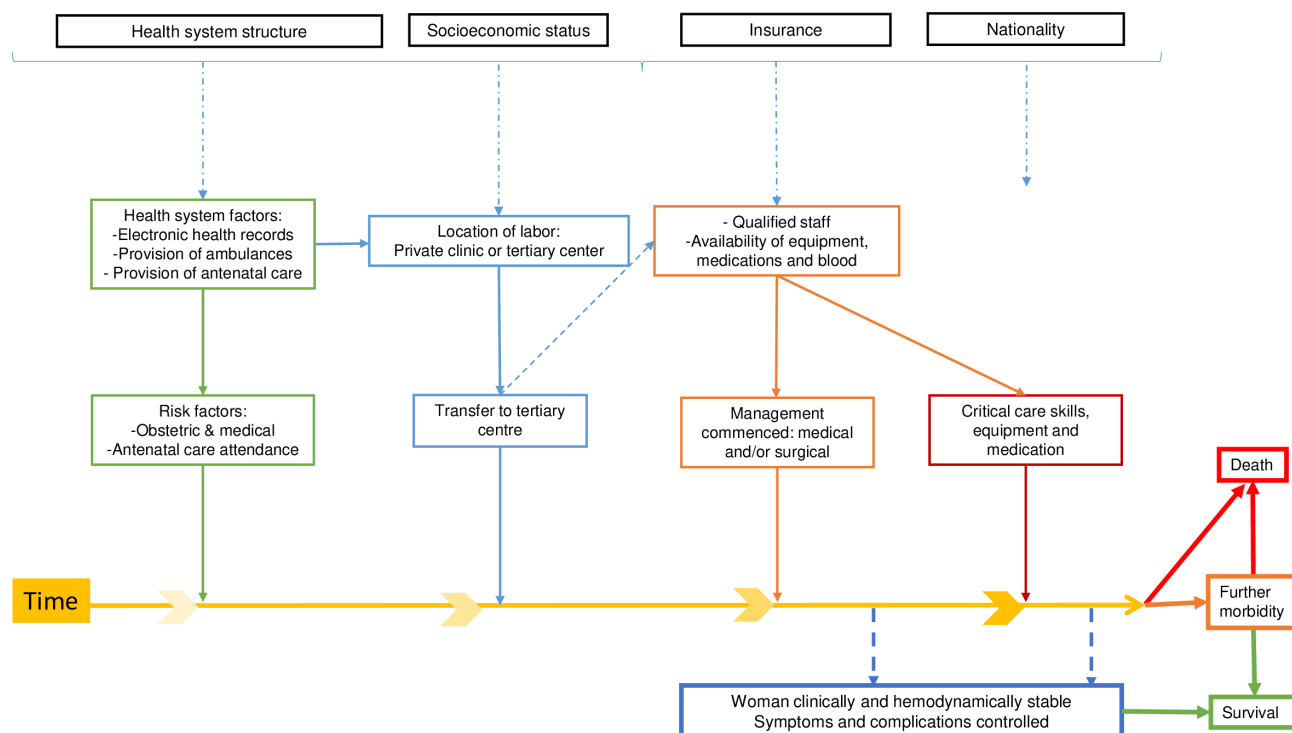


FIGURE 1 Conceptual framework for the analysis of maternal mortality.

TABLE 1 Specific causes of delays using the “Three Delays” model for maternal deaths in Lebanon between 2018 and 2020.

Phase 1 delay: to seek medical help	Phase 2 delay: to reach a healthcare facility	Phase 3 delay: to receive adequate care in the healthcare facility
- Limited awareness and knowledge among women about symptoms: hypertensive disorders of pregnancy, anemia, epileptic status, status asthmaticus - Unawareness among women, partners, and families of the high-risk pregnancy due to no or limited antenatal care attendance - Lack of health insurance and finances to access antenatal care - Fear of stigmatization and deportation among undocumented Syrian refugees - Delay in women seeking help despite worsening symptoms	- Lack of awareness of clinical deterioration requiring a higher level of care - No formal referral mechanism between healthcare facilities - Delay in transferring women to a higher care facility after progression of symptoms - No transfer of hemorrhaging women in an ambulance equipped for trauma care - Lack of health insurance resulting in not being admitted to a healthcare facility	- Delay in recognizing the severity of the clinical situation - Lack of situational awareness of the clinical deterioration - Incomplete medical history taking - Incorrect diagnosis of the cause of hemorrhage or obstetric emergency - Lack of equipment and medications for obstetric emergencies, e.g. magnesium sulfate or antihypertensives - No obstetric warning system - No blood transfusion due to unavailability of blood products - No available anesthetists - No available intensive care unit-trained staff
Other relevant factors that contributed to maternal deaths in Lebanon <i>Health system:</i> No centralization and unified access to antenatal care medical notes <i>Lack of continuity of care:</i> Lack of communication and direct follow-up between primary healthcare/private clinic and referral center <i>Antenatal care uptake:</i> Incomplete or lack of antenatal care uptake and delayed booking of antenatal care visits		

important messages to improve maternal healthcare outcomes in Lebanon were identified and extracted from our review, while referring to international recommendations and previous maternal mortality reviews.^{7,14,17–26}

We received an exemption from requiring institutional review board approval from the American University of Beirut. The medical records were anonymized before the data were analyzed.

3 | RESULTS

Between 2018 and 2020, a total of 49 maternal deaths were reported to the MOPH during a period of 349 932 live births.²⁷ The causes of delays that led to maternal death were organized by type of delays in Table 1. The leading causes of maternal death were postpartum hemorrhage (PPH) ($n = 16$, 33%) followed by infections ($n = 10$, 20%),

hypertensive disorders of pregnancy ($n=4$, 8%), pulmonary embolism ($n=4$, 8%), amniotic fluid embolism ($n=4$, 8%), epilepsy ($n=2$, 4%), and other causes ($n=5$, 10%). Four (8%) maternal deaths had an unknown cause of death.

Women who died between 2018 and 2020 were Syrian ($n=26$, 53%), Lebanese ($n=20$, 41%), and other nationalities (Ethiopian [$n=1$, 2%], Bangladesh [$n=1$, 2%], or Palestinian [$n=1$, 2%]).

All 49 women who died were between the ages of 17 and 47 years, with a mean age of 31.6 years. Most women who died had a median gravida of three and a median parity of two. Of all 49 women who died, 14 gave birth by cesarean delivery (29%), 10 had a normal vaginal delivery (20%), one had an instrumental vaginal delivery (2%), and one had a septic abortion (2%). Twenty-three women had an undocumented mode of delivery (47%). Figure 2 presented 49 maternal deaths that were reported by healthcare facilities to the MOPH between 2018 and 2020. Of the 49 maternal mortality notifications to the MOPH, there were 22 detailed case notes available for analysis of preventive factors. We selected some of these detailed case notes and summarized them in Table 2.

3.1 | Postpartum hemorrhage

Among the 16 women who died from PPH, the initial underlying cause of PPH was reported as follows: uterine atony ($n=4$, 25%), placental abruption ($n=3$, 19%), uterine rupture ($n=2$, 13%), placenta percreta ($n=1$, 6%), placenta previa ($n=1$, 6%), cervical laceration ($n=1$, 6%), and other ($n=4$, 25%). A higher proportion of women who died from PPH had a Syrian nationality ($n=13$, 81%) versus Lebanese ($n=3$, 19%), and had a normal vaginal delivery ($n=8$, 50%) versus cesarean delivery ($n=5$, 31%) (undocumented mode of delivery [$n=3$, 19%]).

Deaths from PPH were mostly due to either a delay in getting to the healthcare facility (phase 2 delay) or a delay in receiving adequate

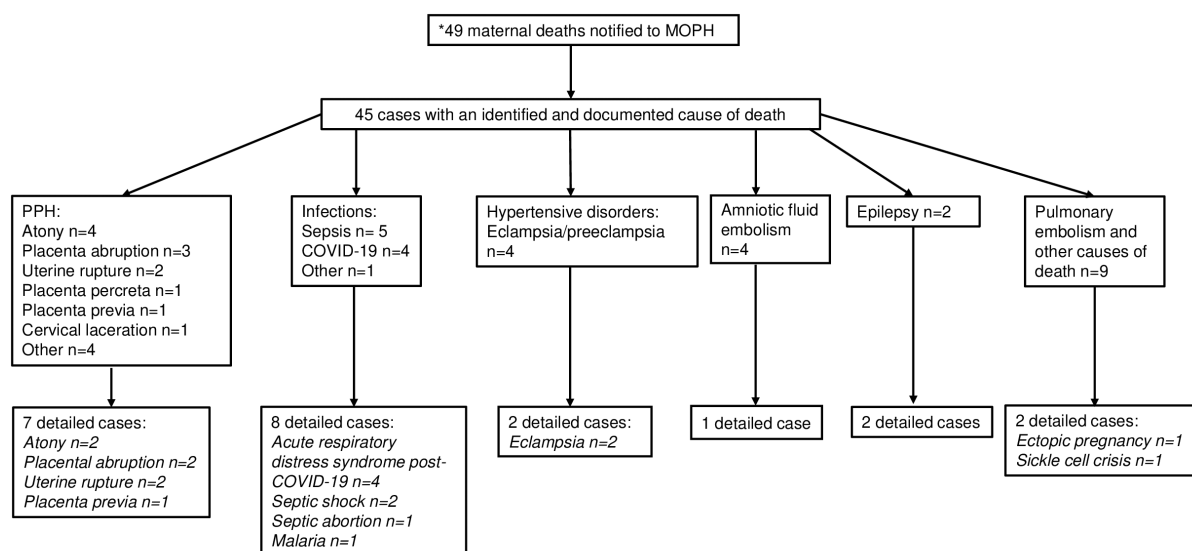
care in the healthcare facility (phase 3 delay). Two women arrived late to the hospital, including one who had a uterine rupture. One woman was transferred after a delay to a higher level healthcare facility without recognition and proper documentation of the severity of bleeding at the referring facility and no communication between these hospitals. One woman did not receive a blood transfusion due to unavailable blood products, and another woman was inadequately resuscitated due to the absence of appropriate equipment, medications, and trained medical staff in obstetric emergencies.

Recurring themes were the lack of awareness of the amount of blood loss and incomplete documentation of timing and amount of bleeding. The cause of PPH was often not discovered in a timely manner, and there was limited communication between health professionals, which prevented appropriate management of the PPH. Furthermore, the lack of availability of blood products, intensive care unit equipment, medications, skilled clinical staff, and ambulances for transfer to higher care facilities contributed to the death of three women.

3.2 | Sepsis and other infectious causes

Among women who died from infectious causes, five died of sepsis ($n=5$, 50%), four of acute respiratory distress syndrome post-COVID-19 ($n=4$, 40%), and one of malaria during pregnancy (10%) which was acquired outside of Lebanon. Of all 10 women who died from infections, 5 (50%) had avoidable risk factors, 3 (30%) had none (30%), and 2 (20%) had unknown risk factors.

The key themes among women who had infectious causes were inadequate initial assessment, delay in transferring women to a higher care facility after the progression of symptoms, and an inadequate final diagnosis made in the higher care hospital. A case of type 1 delay was one woman with COVID-19 who delayed seeking medical



*This number may be higher as this is based on a hospital reporting system.

FIGURE 2 Flow diagram of maternal mortality cases by cause of death notified to the MOPH between 2018 and 2020. COVID-19, coronavirus disease 2019; PPH, postpartum hemorrhage.

TABLE 2 Selected summaries of women who died in Lebanon between 2018 and 2020.

(1) Postpartum hemorrhage	A multigravida woman in the third trimester with placenta previa was referred late from a private clinic to a tertiary care hospital where she arrived with severe hemorrhage. It was unclear whether the antenatal care notes were communicated to tertiary care. She underwent cesarean delivery in the higher care facility where no blood products were available. After cesarean delivery, she was transferred to the intensive care unit where her condition deteriorated. She developed hypovolemic shock and had a cardiac arrest.
(2) Postpartum hemorrhage	A multigravida woman had placental abruption followed by severe postpartum hemorrhage and hypovolemic shock, after which she had a cardiac arrest. Barriers faced were no escalation of care to the level of a consultant, unavailability of physicians specialized in high-risk pregnancies and intensive care medicine, and lack of lifesaving equipment and medications.
(3) Postpartum hemorrhage	A multigravida woman was initially delivered in a private clinic where she developed severe postpartum hemorrhage. After staying in the clinic for several hours without any investigation for the cause of postpartum hemorrhage, her clinical condition worsened. She was taken by her family to a public hospital without an ambulance. During her transfer, she had no access to lifesaving medication, fluids, or trained healthcare workers. Upon arrival at the emergency department, she had disseminated intravascular coagulation. Despite receiving packed red blood cells and fresh frozen plasma on arrival, her condition deteriorated rapidly.
Infection	One woman died of sepsis 2 weeks after cesarean delivery, which was indicated for failure to progress. She initially developed a fever a few days after cesarean delivery. Wound inspection and blood and urine tests did not indicate infection. She was started on a broad-spectrum cephalosporin antibiotic and was readmitted 2 weeks postpartum with non-resolving fever. She was later transferred to the intensive care unit with hypotension and metabolic acidosis. Findings from chest x-ray and computed tomography scans of her abdomen and pelvis were negative for a source of infection. Several hours later, she died from cardiopulmonary arrest.
(1) Hypertensive disorders	A primigravida woman was admitted to the hospital in the third trimester for severe dyspnea and high blood pressure. Her pregnancy was complicated by hypertension and proteinuria. She underwent a cesarean delivery after which she developed severe cardiac insufficiency and eclampsia. She was urgently transferred to the intensive care unit where she died after a cardiac arrest. She did not receive any antihypertensive medication or magnesium sulfate.
(2) Hypertensive disorders	A primigravida woman was admitted to the hospital in the third trimester for visual problems and high blood pressure. She received no antenatal care and delayed seeking medical help when her symptoms started. She was diagnosed with pre-eclampsia and underwent urgent cesarean delivery. She developed eclampsia due to severe uncontrolled hypertension and had a cardiac arrest. She did not receive any antihypertensive medication or magnesium sulfate.
Epilepsy	One woman with unknown parity had sudden unexpected death in epilepsy. She presented to the emergency department in the third trimester due to discomfort. Fetal echography revealed an intrauterine fetal demise without placental or fluid changes. She suddenly lost consciousness and had bradycardia with generalized muscle contractions. Despite immediate resuscitation, she died of cardiopulmonary arrest.

help when severe symptoms started. A case of type 2 delay was one woman with COVID-19 who was transferred late to the intensive care unit after symptoms progressed. One woman initially had a cerclage due to her previous history of recurrent pregnancy losses, and she developed sepsis, after which the cerclage was removed. However, after removal of the cerclage, she did not receive hospital care for the treatment of sepsis (this could have been the result of lacking insurance or money for the costs of the hospitalization). One woman had a severe malarial infection with multiple organ damage following a delay in seeking medical help as she was living abroad and traveled to Lebanon for further medical management. The type of malaria she acquired was unknown and undocumented.

One woman died of septic shock, as the initial diagnosis of sepsis was not considered. Two women died of acute respiratory distress syndrome as a complication of COVID-19. One woman died of sepsis 2 weeks following a cesarean delivery performed for failure to progress. It was unclear whether she received prophylactic antibiotics before the cesarean delivery.

3.3 | Hypertensive disorders

All four women who died from hypertensive disorders of pregnancy were diagnosed with eclampsia ($n=3$, 75%) and pre-eclampsia ($n=1$, 25%). Half of the women who died from hypertensive disorders were primiparas ($n=2$, 50%) and delivered by cesarean delivery ($n=2$, 50%).

The key themes identified were limited antenatal care attendance, no follow-up on blood pressure (BP) and urine measurements, lack of medications, unawareness of symptoms, and incomplete implementation of a pre-eclampsia protocol to prevent eclamptic complications. It was unclear from the review notes whether these women had attended all antenatal visits, had prenatal or admission BP measurements or urine checks, or received antihypertensive medications or magnesium sulfate. Incomplete medical history taking may have also contributed to the limited information on attendance of antenatal care and adequate prenatal assessment.

3.4 | Other causes of maternal deaths

One woman died of what was presumed to be amniotic fluid embolism, and the contributing factors to maternal death were inadequate resuscitative measures and a delay in responding to the obstetric emergency. The diagnosis was established by the treating physicians with no histologic confirmation. One woman died from a sudden unexpected death in epilepsy. She had limited attendance to antenatal care visits, and it was unclear whether she was managed by a neurologist or was compliant with antiepileptic medications.

From this review, there are several key messages and lessons identified (Table 3). Of the 49 women who died in Lebanon between 2018 and 2020, 27 (55%) had absent data on potential risk factors resulting in their deaths. Among women with detailed available data, maternal death could have been prevented in 64% of women (14 of 22).

4 | RECOMMENDATIONS

These findings are similar to previous confidential enquires where many of the maternal deaths were preventable by early recognition of clinical severity and correct diagnosis of cause, and by accessing appropriate and quality care.^{7,20} Similar to our findings, obstetric hemorrhage was the primary cause of maternal mortality.²² Similar

to other confidential enquiries, deaths from hemorrhage and sepsis were mostly preventable. They occurred due to delays in identifying the underlying cause, transfer of hemodynamically unstable women, limited communication between healthcare providers, and no escalation to more experienced colleagues who manage obstetric emergencies.^{7,14,20}

4.1 | Recommendations at the health system level

By financing antenatal care for the population and making it more freely accessible, the health system can overcome the phase 1 delay and encourage women to seek timely medical attention. A national electronic health database across Lebanon would allow information and knowledge to be transferred between private clinics and primary and tertiary care centers with ease, thus facilitating communication and referral actions between these centers.

Delay in reaching the hospital can be avoided by establishing mechanisms that can secure transfers between low-risk and high-risk maternity centers. Providing fast and efficient transfers to higher care facilities that have operating rooms for lifesaving cesarean deliveries, anesthetic material, and blood products would ensure that appropriate care is provided in a timely manner. We would recommend creating national guidelines to apply a unified obstetric warning system across the country for all medical

TABLE 3 Key themes of factors by cause of death that led to maternal mortality in Lebanon between 2018 and 2020.

Postpartum hemorrhage	1. Lack of health insurance 2. No antenatal care attendance or limited uptake of antenatal care 3. Limited knowledge of symptoms: unawareness of worsening symptoms and delay in seeking medical help 4. Delay in reaching medical care 5. Delayed recognition of severe hemorrhage 6. Delay and late referral to a higher care facility 7. No formal referral mechanism between health facilities and a lack of knowledge transfer between facilities 8. Inadequate equipment and skilled medical personnel for transfer between health care facilities, i.e. ambulance lacking skilled staff, equipment, and medication for major obstetric emergencies and trauma 9. The initial cause of postpartum hemorrhage was not identified 10. High-risk pregnancies, e.g. placenta previa and multiparous, were delivered in low-risk centers without a skilled multidisciplinary team, medication, or blood transfusion 11. Lack of equipment including blood components and other resuscitative resources in hospitals 12. Lack of skilled medical staff with appropriate expertise in the level of complexity of care in a maternal collapse 13. Delayed and limited communication between medical personnel, and unavailable consultants for obstetric emergencies
Sepsis	1. Delay in transferring to a higher care facility after progression of symptoms 2. Inadequate initial assessment 3. Inability to find the source of infection and causes after cesarean delivery
Hypertensive disorders	1. Lack of health insurance 2. Little to no antenatal care attendance 3. Lack of blood pressure and urine measurements on admission, leading to unawareness of hypertension and pre-eclampsia 4. The healthcare facility did not enact a pre-eclampsia protocol 5. Lack of medication in hospitals, including magnesium sulfate and antihypertensives
Amniotic fluid embolism	1. Inadequate resuscitative measures 2. Lack of skilled and experienced medical and intensive care staff in prompt and effective responses to sudden maternal collapse
Epilepsy	1. Limited knowledge about the severity of their epileptic status 2. Infrequent/inadequate antenatal care visits 3. No clear communication between the neurology and obstetric teams

centers. This would suggest that all healthcare facilities use a unified scoring tool that would be recorded in electronic medical charts. This warning system would score the risk of clinical deterioration and would prompt faster and adequate management and referrals.²⁵ In addition, refusing the provision of medical care for obstetric emergencies must be made illegal and upheld by the judicial system in Lebanon.

4.2 | Recommendations at the patient level

Women must recognize the importance of consistent antenatal care follow-up visits, how to identify symptoms that require medical investigation, and be aware of their pregnancy risk assessment. In the context of Lebanon, it may also be recommended that women carry their medical records on a portable device so information can be shared through each facility they visit. Women living in rural areas may have limited mobility and transportation, which would reduce their ability to access hospitals. This phase 2 delay could be addressed by implementing an internal system for easy and accessible transfers between hospitals. These transfers would follow detailed protocols on the management of life-threatening obstetric emergencies before reaching the health facility.

4.3 | Cause-specific recommendations

4.3.1 | Recommendations for the management of postpartum hemorrhage

If a woman has severe PPH outside the hospital or in a setting other than the delivery unit, immediate transfer to a higher care facility must be done to provide adequate resuscitation, medications, and blood products. Prompt recognition of the cause of hemorrhage is essential for faster transfer and appropriate delivery of care, whether medical or surgical. We would strongly suggest developing national guidelines that require every hospital in the country to follow detailed major obstetric hemorrhage protocols, thus being a step closer to resolving phase 3 delay. In the frame of highly prevalent cesarean deliveries in Lebanon, any woman with a previous cesarean delivery and low-lying placenta should be considered at risk of placenta accreta spectrum.¹⁸ Women with a previously established risk factor for PPH such as placenta accreta should be planned for cesarean delivery and hysterectomy in referral centers designated by the MOPH.¹⁸

4.3.2 | Recommendations for the management of sepsis and other infectious causes

To manage septic women, it is advised to quickly identify the signs and symptoms of sepsis, immediately transfer to higher care facilities, start antibiotics early, and consult a high-risk specialized

obstetrician and an infectious disease specialist.⁷ With the ongoing COVID-19 pandemic, it is highly recommended that all physicians encourage pregnant women to have their coronavirus and influenza vaccinations to prevent COVID-19- and influenza-related deaths.²¹

4.3.3 | Recommendations for the management of hypertensive disorders

Consistent antenatal care uptake should be emphasized to all women for prompt recognition of hypertensive disorders and preventing the escalation to eclampsia.²⁶ Antepartum monitoring includes baseline BP measurements and urine assessment for proteinuria, followed by regular BP observations, frequent fetal ultrasounds, and blood and urine tests.²³ Access to antenatal care would prevent the phase 1 delay by enabling women to have a good knowledge of their condition, be aware of the risks of having uncontrolled BP, and recognize alarming symptoms including, severe headache, abdominal pain, or blurry vision. In Lebanon, every maternity center must have access to a supply of antihypertensive medications and magnesium sulfate to prevent deaths related to pre-eclampsia and eclampsia.

4.3.4 | Recommendations for the management of epilepsy

Women with epilepsy should have constant follow-up with neurologists and high-risk pregnancy specialists throughout the pregnancy.¹⁹ In addition, they should have access to antenatal care, assessment for compliance to antiepileptic medications, and assessment for predictors of seizures such as stress and insomnia.^{7,19,28} Information about the risks of non-compliance with antiepileptic medications should be communicated to all women with epilepsy.¹⁹ If a woman with epilepsy is assessed to be at high risk for developing a seizure at the time of delivery, she should be planned for delivery in a higher care facility under the care of a multidisciplinary team, including neonatologists.¹⁹

4.3.5 | Recommendations for the management of cardiac arrest

Some aspects of cardiovascular life support are altered in obstetric cardiac arrest and should be considered by the clinical team.¹⁷ After 20 weeks of gestation, the inferior vena cava and abdominal aorta may be compressed by the gravid uterus.¹⁷ To increase the chance of successful resuscitation, the gravid uterus can be moved to the left side to relieve the compression on the aorta and vena cava.^{17,24} If this maneuver fails and the woman is not responding, a perimortem cesarean delivery is advised to increase the chances of a successful cardiac resuscitation.¹⁷

5 | DISCUSSION

5.1 | Summary

In Lebanon between 2018 and 2020, PPH, infections, and hypertensive disorders were the most common causes of maternal death. This review identified numerous lessons learned for clinical care and health system structuring. Maternal death in Lebanon could be prevented by following specific measures that include adequate receipt of antenatal care, communication between healthcare providers, understanding the underlying cause of clinical deterioration, managing high-risk pregnancies by multidisciplinary teams in equipped centers, and removing barriers to receiving timely lifesaving care, blood products, and medications (e.g. magnesium sulfate). Death could have been prevented in almost two-thirds of women in Lebanon during this period.

5.2 | Limitations

Our study was limited in that some of the case notes were missing data regarding the medical history, antenatal care, and details about the management in some cases. Furthermore, it is possible that important details about the events that led to the maternal death were not identified because of missing data. Due to the nature of hospital surveillance, it is possible there is underreporting so the actual number of maternal deaths in Lebanon may be higher. We recommend that the MOPH implements an electronic data collection system to capture standardized details on maternal deaths. In addition, Lebanon does not currently conduct its maternal mortality review as a confidential enquiry, which might impact the recall of events.

6 | CONCLUSION

Learning from the factors that led to maternal deaths in Lebanon is fundamental to prevent future deaths. Access to timely and quality maternity care for all women living in Lebanon is required to prevent maternal mortality and morbidity. Strengthening high-quality obstetric care, improving referrals between private and tertiary care facilities, and following evidence-based protocols through proactive and responsive management of obstetric emergencies are lifesaving measures for pregnant women. Addressing the individual, clinical, and structural factors related to maternal death identified in this review will save women's lives in Lebanon.

AUTHOR CONTRIBUTIONS

Conceptualization and funding acquisition by Stephen J. McCall; acquisition, analysis, and interpretation of data by Marie-Claire Rebeiz and Stephen J. McCall. Marie-Claire Rebeiz wrote the first draft of the manuscript. Stephen J. McCall and Thomas van den Akker made substantial edits and comments to the manuscript and interpreted the data. Randa Hamadeh and Faysal El-Kak obtained the

data, interpreted the data, and reviewed and edited the manuscript. Faysal El-Kak is the coordinator of the National Committee on Safe Motherhood who acquired funding for data collection. All authors have read and agreed to the submitted version of the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest.

DATA AVAILABILITY STATEMENT

Research data are not shared.

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