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Jordan's National Maternal Mortality Report 2022

The National Maternal Mortality Surveillance & Response System
النظام الوطني للرصد والاستجابة لوفيات الأمهات

This national report was developed by the Ministry of Health and the Maternal Mortality National Advisory Group with support from USAID Health Services Quality Accelerator Activity. The data and findings presented in this report are drawn from Jordan's Maternal Mortality Surveillance and Response (JMMSR) system implemented by the Ministry of Health and launched with USAID support.

USAID Health Services Quality Accelerator Activity is implemented in Jordan by University of Research Co. LLC (URC) and is made possible by the generous support of the American people through the United States Agency for International Development (USAID).

FOREWORD

Since its inception in 2018, Jordan's Maternal Mortality Surveillance and Response (JMMSR) system has matured into a robust, five-year active surveillance framework collaboratively advanced by the Ministry of Health (MOH) and key stakeholders from both the public and private health sectors. Adhering to the mandates of JMMSR Bylaw no. 10, this system has been instrumental in collecting and analyzing data on maternal mortality across Jordan to foster informed decision-making and implement strategies aimed at preventing maternal deaths, thereby contributing to the achievement of Sustainable Development Goal 3 (ensure healthy lives and promote well-being for all at all ages).

As we mark the fifth year of the JMMSR system's operation, this annual report leverages half a decade of accumulated data to examine trends in maternal mortality rates and the factors contributing to these outcomes. This analysis is crucial as we develop action plans aimed at averting preventable deaths and enhancing maternal health.

The MOH remains committed to leading these efforts, driving change throughout Jordan's health sector with robust, practical, and evidence-based recommendations developed in collaboration with all relevant stakeholders. We express profound gratitude to all individuals and groups involved in the JMMSR system's implementation, including the National Advisory Group representing the MOH, Royal Medical Services, university hospitals, and the private health sector, as well as the Directorate Advisory Groups, the MOH Non-Communicable Diseases Directorate, and the MOH Electronic Transformation and Information Technology Directorate teams. Their dedication has been pivotal in every phase of system implementation.

We also extend our sincere appreciation to the United States Agency for International Development for their sustained support to the Government of Jordan, particularly in developing and launching this surveillance system. We are also grateful to the authors and contributors of "Jordan's National Maternal Mortality Report 2022" for their expertise and dedication to producing this crucial national document.

With its vital recommendations, this report aims to prevent maternal deaths and improve the lives of families across Jordan. We deeply appreciate the families of the deceased women, who, in their time of grief, provided invaluable insights during household surveys about the circumstances surrounding these tragic losses. Our hearts go out to the women who lost their lives during pregnancy, childbirth, or the postpartum period, as well as to their loved ones and the healthcare providers who cared for them.

H.E. The Minister of Health

Prof. Feras Hawari

Chairman of the JMMSR National Advisory Group and Chief of Ob/Gyn Specialty at MOH

Dr. Abdelmanem Al Suleimat

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

4R	Readiness, Recognition, Response, and Reporting
ALSO	Advanced Life Support in Obstetrics
ALT	Alanine Transaminase
AMTSL	Active Management of the Third Stage of Labor
ANC	Antenatal Care
AST	Aspartate Transaminase
CRE	Creatinine
CSPD	Civil Status and Passport Department
DAG	Directorate Advisory Group
HAD	Health Affairs Directorate
ICD	International Classification of Diseases
INR	International Normalized Ratio
IT	Information Technology
IVF	In Vitro Fertilization
JMMSR	Jordan's Maternal Mortality Surveillance and Response
JMMSR IS	Jordan's Maternal Mortality Surveillance and Response Information System
MDR	Maternal Death Review
$MgSO_4$	Magnesium Sulfate
MMR	Maternal Mortality Ratio
MOH	Ministry of Health
NAG	National Advisory Group
NCDD	Non-Communicable Diseases Directorate
Ob/Gyn	Obstetrics and Gynecology
PCR	Polymerase Chain Reaction
RMS	Royal Medical Services
SLE	Systemic Lupus Erythematosus
TTP	Thrombotic Thrombocytopenic Purpura
USAID	United States Agency for International Development
WHO	World Health Organization

TERMS AND DEFINITIONS

Avoidable Death: A maternal death can be classified as avoidable if it might have been avoided by a change in patient behavior, provider/institutional practices, or healthcare system policies. The determination of avoidability does not follow rigid criteria, and it is often open to interpretation.

Direct Obstetric Deaths: Maternal deaths resulting from obstetric complications of the pregnancy state (pregnancy, labor, or puerperium), from interventions, omissions, or incorrect treatment, or from a chain of events resulting from any of the above.

Directorate Advisory Group (DAG): A multidisciplinary committee of technical experts from all health sectors in each Health Affairs Directorate (HAD) formed by the Director of the HAD. There is one DAG committee for each HAD, making up the 14 DAGs for Jordan's Maternal Mortality Surveillance and Response (JMMSR) system implementation. Based on Article no. 5 (Public Health Bylaw no. 10 of the year 2016), DAG members include the following:

- Head of the DAG: An obstetrician/gynecologist from the Ministry of Health (MOH) or any other public sector with 10 years of experience.
- DAG rapporteur: a public health physician.
- An obstetrician/gynecologist representing another health sector (Royal Medical Services [RMS], university, and private health sector if present).
- Head of the Maternal and Child Health Department in the HAD.
- Forensic physician.
- Experienced midwife.

Grand Multipara: A woman who has given birth to five to six infants beyond 24 weeks of gestation.

Great Grand Multipara: A woman who has given birth to seven or more infants beyond 24 weeks of gestation.

Health Facility: Any hospital or forensic medicine department in all health sectors (public and private). According to the JMMSR Bylaw no. 10 (described below), Article no. 4, all health facilities in Jordan are mandated to notify the relevant DAG of all deaths among women of reproductive age.

Health Facility Focal Point: A trained individual from the medical records department at any hospital or forensic medicine department in the public or private sectors responsible for the notification of all deaths among women of reproductive age to the relevant DAG in each Health Directorate.

Indirect Obstetric Deaths: Maternal death resulting from a previously existing disease or disease that developed during pregnancy. These deaths are not due to direct obstetric causes but are aggravated by the physiological effects of pregnancy.

JMMSR Bylaw: His Majesty King Abdullah II decreed that Bylaw no. 10 of 2016 be established as part of the Public Health Law (no. 47 of 2008). It mandates the notification of all deaths among women of reproductive age (15 – 49 years of age). The bylaw calls on the MOH to

establish, implement, and monitor a national maternal mortality surveillance and response system across all health sectors.

The JMMSR Guidelines for Implementation: A comprehensive reference providing a detailed description of the JMMSR system implementation steps and tools to guide implementers and managers throughout all stages and functions of the JMMSR system to achieve its overall objectives.

The JMMSR Policies and Procedures: A set of brief statements approved by the MOH describing the roles and responsibilities of stakeholders in standardizing the JMMSR system implementation.

Maternal Death: The death of a woman while pregnant, during labor, or within 42 days of the end of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, including self-harm, but not from accidental or incidental causes (accidents, homicide).

Maternal Death Surveillance and Response Technical Guidance: Published by the World Health Organization in 2013 as a global framework for action to prevent maternal death. This publication introduces the critical concepts of MDSR, including goals, objectives, and specific instructions for implementing each surveillance component.

Maternal Mortality Ratio (MMR): The total number of maternal deaths per 100,000 live births in the same period.

- Numerator: Maternal deaths
- Denominator: Live births
- Multiplier: 100,000

Multipara: A woman who has given birth to more than one infant and no more than four infants beyond 24 weeks of gestation; see also "grand multipara" and "great grand multipara.

National Advisory Group (NAG): A national-level technical advisory group representing all health sectors, formed according to a ministerial decree issued by the Minister of Health at the time of establishing the JMMSR system. It consists of senior obstetrics/gynecology specialists from all health sectors in Jordan. This group includes the following members:

Chairman of the NAG: Head of the Obstetrics and Gynecology Specialty at the MOH.

- NAG Deputy Chairman and Rapporteur: Head of the National Registry of Maternal Mortality at the MOH Non-Communicable Diseases Directorate (NCDD).
- Head of the National Registry of Deaths at the MOH/NCDD.
- An obstetrics/gynecology specialist from the RMS.
- Two obstetrics/gynecology specialists from the private sector.
- One obstetrics/gynecology specialist each from Jordan University Hospital and King Abdullah University Hospital.
- Director of the National Center for Forensic Medicine.
- Director of the Woman and Child Health Directorate at the MOH.

Nullipara: A woman who has not given birth previously.

Para 1: A woman who has given birth once.

Parity: The number of previous pregnancies carried to a viable gestational age (24 weeks and above) and resulting in live births or stillbirths, including the pregnancy that led to the woman's death.

Postmortem Autopsy: The examination of a body after death to determine the cause of death.

Probable Maternal Death: Any death among women of reproductive age during pregnancy, labor, or within 42 days of the end of pregnancy.

Public Sector: The sector that serves as one of the main service providers in Jordan; entities in this sector are owned and operated by the government. This includes the MOH, the RMS, and university hospitals (including University of Jordan Hospital and King Abdullah University Hospital).

Suspected Maternal Death: Any death among women of reproductive age.

Three Delays Model: A framework developed by Thaddeus and Maine in 1994 that helps identify the points at which delays can occur in the management of obstetric complications. The model proposes that pregnancy-related mortality is often due to the following delays:

- *Delay I*: Delay in seeking care.
- *Delay II*: Delay in reaching care.
- *Delay III*: Delay in receiving care.

Women of Reproductive Age (WRA): Women aged between 15-49 years old.

EXECUTIVE SUMMARY

"Jordan's National Maternal Mortality Report 2022" is the fifth such report in a row. It provides comprehensive information about each maternal death that took place during the reporting period (January-December 2022) and is based on the Jordan Maternal Mortality Surveillance and Response Information System (JMMSR IS). This report is intended to provide an opportunity to strengthen the Jordanian health system, with the aim of eliminating preventable maternal deaths and improving maternal health outcomes.

During the reporting period, **1,425** deaths among women of reproductive age occurred, of which a total of **60** maternal deaths were identified, with nine deaths due to COVID-19 infection.

The total number of live births for the same period was 181,991, resulting in a national maternal mortality ratio (MMR) of 33 per 100,000 live births, about 2.6 times less than the 2021 value. The non-COVID MMR was **28 per 100,000 live births**, which was the lowest annual figure since the inception of JMMSR in 2018 yet still close to the figures from the last four years**.**

The MMR breakdown by background variable was limited to age, nationality, and place of residence, where the denominator in terms of live births was available. MMR for Jordanian women showed an increasing trend with age, going up from 24.5 for the age group 20-24 years and reaching 65.5 in the age group 40 years and above. The adolescent age group 15-19 years showed a value of 41.4. The MMR for Jordanian women was 35.4 compared to 18.9 for non-Jordanians; however, the non-COVID MMR for Jordanian women was 29.6 compared to 18.9 for non-Jordanians, as all COVID-19 deaths took place among Jordanian women. The MMR varied widely by place of residence, with the lowest MMR for Amman at 19.5 and the highest for women residing in Jerash governorate at 95.1. In addition to Amman, only Mafraq and Zarqa governorates showed values lower than the national value of 33.

Directorate Advisory Groups at the Health Affairs Directorate level and the National Advisory Group (NAG) at the national level conducted reviews for all maternal death cases. Of the 60 maternal death cases, the NAG assigned the main cause of death to 57 cases, while the cause of death could not be specified based on available information for three cases. Of these three, an autopsy failed to establish the cause of death for two of them.

The results also showed that of the 60 deaths, 31 cases (51.7%) died of direct obstetric causes. Among these 31 cases, the leading direct cause of maternal deaths comprised other obstetric complications due to obstetric embolism. This category was responsible for 20% of all deaths and included 10 cases of pulmonary embolism and two cases of amniotic fluid embolism. Obstetric hemorrhage came in third place with eight cases (13.4%) of all deaths, followed by hypertensive disorders in pregnancy that included five cases of preeclampsia, representing (8.3%) of all deaths. Pregnancy-related infections (6.7%) consisted of three cases of puerperal sepsis and one case of post-miscarriage infection. Finally, complications of anesthesia and sagittal sinus thrombosis caused one death each.

Of the 60 deaths, 26 cases were classified as indirect maternal death. Diseases of the respiratory system dominated the list of indirect causes, with 10 cases (16.7%). Among these 10 cases, COVID-19 was encountered in nine of the cases, and pneumonia in one case. Next came diseases of the digestive system with four cases (6.7%), consisting of two cases of liver cirrhosis and one case each of autoimmune hepatitis and mesenteric ischemia. There were four cases of cerebrovascular infarction, at (6.7%).

The remaining causes of indirect maternal deaths included one case (1.7%) each of aortic dissection, cardiomyopathy, breast cancer, brain tumor, systemic lupus erythematosus, thrombotic thrombocytopenic purpura, nephrotic syndrome, anaphylactic shock, severe sepsis with septic shock, and hyperemesis gravidarum.

Seventeen of the 60 cases underwent autopsy, representing (28.3%) of all cases. In two cases, the autopsy did not reach a final diagnosis. Of the 57 maternal deaths with known causes of death, 35 cases (61.4%) were identified as avoidable deaths. All of the deaths in the following cases were considered avoidable: the seven postpartum hemorrhages, the five hypertensive disorders, and the four pregnancy-related infections.

From the maternal death review (MDR) reports and case summaries, the NAG identified contributing factors that led to maternal deaths. The most common contributing factors identified were presented using the Three Delays Model. Delay III (receiving care) contributed to (33.3%) of cases out of the total 57 deaths with a known cause of death. All seven cases of postpartum hemorrhage deaths and four out of five cases of preeclampsia suffered delays in the Delay III category.

Delay I (seeking care) contributed to 10 cases, representing (17.5%) of the 57 deaths with a known cause of death**.** Seven cases (10.5%) had a combination of Delays I and III. No delays were reported for 21 cases (37.5%).

The high incidences of direct maternal deaths, avoidable deaths, and delays in receiving care put immense responsibility on the provision of medical services for failing to prevent a considerable number of maternal deaths.

Causes of and contributing factors to maternal deaths can only be identified and understood through the maternal mortality surveillance and review processes, thus emphasizing the great importance of the MDR. Improving and standardizing maternal mortality surveillance, continuing to improve the understanding of causes and contributing factors impacting maternal deaths, and continuing the work toward prevention are all crucial to eliminating preventable maternal deaths in Jordan. While the surveillance part of the JMMSR system seems to function well, there is a clear indication that the response part of the system is functioning inefficiently.

The JMMSR system is enabling Jordan to obtain the most accurate calculation of the national MMR and assist in identifying the leading causes and contributing factors for each maternal death. The findings provided in this report will guide the improvement of maternal health outcomes in Jordan.

The lessons learned throughout the five years of implementation require all stakeholders to continue improving the wide range of JMMSR system functions to prevent maternal deaths, with a special emphasis on response. Emphasis should also be placed on strengthening the existing continuum of maternal care and working collaboratively on sustainable improvements for the provision of accessible, high-quality maternal care through the public and private health sectors. It should be noted that the structured response to avert future maternal deaths started functioning satisfactorily in 2023, and the preliminary results seem promising.

INTRODUCTION

Over the past two decades, Jordan has made significant progress in improving the quality of safe motherhood services and maternal and child health outcomes. Jordan recognizes that maternal mortality constitutes a serious public health problem and has been adopting and implementing evidence-based policies, programs, and interventions to reduce maternal deaths. One of these interventions is Jordan's Maternal Mortality Surveillance and Response (JMMSR) system. The system is mandated by law and ensures that notifications are made about every death of a woman of reproductive age, and a maternal death review (MDR) is conducted.

Since the launch of the JMMSR system in 2018, the Ministry of Health (MOH) has continued its collaboration with stakeholders from the public and private health sectors to ensure a nationwide implementation of this system and its responses. This effort has included improving the quality of JMMSR data and strengthening the capacity of the central and Health Affairs Directorate (HAD) levels in the systematic collection, analysis, and interpretation of maternal death data.

The JMMSR system is designed to track all deaths among women of reproductive age in Jordan, identify each maternal death, conduct reviews at the facility and household levels, analyze data to assign a primary cause of death and contributing factors, and stimulate a response aimed at preventing similar deaths from occurring in the future. A detailed description of the JMMSR system is available in the first maternal mortality report from 2018.

Building on the momentum achieved and lessons learned during the first four years of the JMMSR system's implementation, in collaboration with national stakeholders and with technical assistance from projects supported by the United States Agency for International Development (USAID), the MOH used the JMMSR data collected from January through December 2022 and led the efforts for the development and finalization of this fifth annual report: "Jordan's National Maternal Mortality Report 2022."

METHODOLOGY

"Jordan's National Maternal Mortality Report 2022" is the fifth report providing comprehensive information about each maternal death that took place during the reporting period. It is based on active surveillance through the JMMSR system and provides an opportunity to strengthen the health system in Jordan with the aim of eliminating preventable maternal deaths and improving maternal health outcomes.

The JMMSR system is designed as a customization of the World Health Organization (WHO) "Maternal Death Surveillance and Response Technical Guidance," published in 2013.[1] The system's primary goal is to eliminate preventable maternal mortality by obtaining information on each maternal death to guide public health actions and monitor their impact.

Like the methodology followed for the development of the first four national maternal mortality reports — the reports for 2018, 2019, 2020, and 2021 — the findings presented in this report were drawn from the JMMSR Information System (JMMSR IS) after intensive reviews at different levels by trained multidisciplinary teams of healthcare providers and managers. The JMMSR IS was designed as a secure web-based application to standardize and facilitate the different stages of maternal death data collection, analysis, and reporting. Data is collected at different levels of the healthcare system to support the implementation and monitoring of different functions of the JMMSR system.

DATA COLLECTION AND FLOW

Information technology (IT) equipment and portable tablet devices have been used to standardize the data collection process and improve its efficiency in support of the JMMSR system implementation steps, as follows:

1. Notification of All Deaths Among Women of Reproductive Age

This step was carried out by trained focal points at all reporting sites (125) from 31 MOH hospitals, 11 Royal Medical Services (RMS) hospitals, two university hospitals, 64 private hospitals, and 17 forensic medicine departments. Notification was done by completing an electronic death notification form in the JMMSR IS within 24 hours of the time of death. Focal points were also responsible for submitting zero reporting through the JMMSR IS at the start of each week (on Sundays) if no deaths occurred in the previous week.

2. Identification of Maternal Death Cases

Once notifications were made of deaths among women of reproductive age, the second step of the JMMSR system required users from the Directorate Advisory Groups (DAGs) to identify which deaths were maternal (within 72 hours from notification). Identified maternal deaths included all deaths that occurred during pregnancy, labor, or within 42 days of the end of pregnancy, excluding deaths due to incidental or accidental causes (accidents or homicide). Deaths due to suicide during pregnancy were considered maternal deaths.

3. Review of Maternal Death Cases

Once a case was identified as a maternal death case, the next step was to conduct the MDR. It involved in-depth investigations of the causes and contributing factors that led to death, as well as two subsequent levels: The HAD level conducted by DAGs and then the national level conducted by the National Advisory Group (NAG). The DAG-level review comprised two steps: data collection and MDR sessions, which analyzed collected maternal death data.

Data collection was carried out using health facility and household surveys depending on the place of death and the availability of data sources. The questionnaires for these surveys were adapted and customized from the WHO "Maternal Death Surveillance and Response Technical Guidance" to establish a framework for an accurate assessment of maternal mortality.[1] Health facility reviews and surveys were required to be completed within 72 hours of a maternal death case's identification, and household reviews were required to be completed within one month of identification. Delays in conducting health facility and household surveys were observed across most locations.

At the health facility level, the main sources of information were the medical file, attending physicians, midwives, and nurses who provided healthcare services to the deceased woman. Medical staff were interviewed and asked to give full details of each woman's medical condition from admission to death. The health facility questionnaire was composed of questions on reproductive history, the pregnancy that led to death, antenatal care (ANC), main complaints, provisional diagnosis, cause of death, autopsy reports, and contributing factors associated with maternal death.

At the household level, the main sources of information were close relatives of the deceased woman and those who accompanied her during the time of her illness and up to the time of death. In-depth household interviews were conducted to ask questions regarding the woman's health and how the death occurred and to obtain additional relevant information that was unavailable during the health facility review.

Data linkages between the health facility and household reviews allowed for obtaining a better picture of the circumstances and contributing factors surrounding maternal deaths.

A. Directorate Advisory Group (DAG) Review

Following the completion of the health facility and household questionnaires, DAGs reviewed collected maternal death data during an MDR session to:

- Assign the main cause of the death.
- Identify contributing factors that led to maternal death.
- Classify the maternal death as avoidable or unavoidable, direct or indirect.
- Issue-specific recommendations (immediate and short-term responses) to address avoidable cases.

DAG members completed a DAG worksheet through the JMMSR IS for each reviewed maternal death case. The worksheet included the following components:

- Case summary
- Information on ANC
- Information on the pregnancy
- Information on delivery
- Information on the postpartum period
- The DAG decision on the cause of death, contributing factors, avoidability, and recommendations.

Once the DAG worksheet was completed in the JMMSR IS, the case was ready for the NAG to review.

B. National Advisory Group (NAG) Review

De-identified data on each maternal death was presented to NAG members. The NAG rapporteur presented the DAG worksheets and the health facility and household questionnaires to the NAG for review. Whenever needed, the NAG returned the case to the DAG to request more information. At the end of their review of each maternal death case, the NAG members completed the following tasks:

- Confirm the cause of death.
- Determine whether it was due to a direct or indirect obstetric death.
- Classify the maternal death as avoidable or unavoidable.
- Identify contributing factors that led to the maternal death.
- Issue-specific recommendations related to the maternal death case.

To improve data comparability, standardized cause of death aggregations were applied from "The WHO Application of ICD-10 to Deaths During Pregnancy, Childbirth, and the Puerperium: ICD-10 MM."[2] The NAG rapporteur then completed the NAG worksheet in the JMMSR IS with decisions on the above. Once completed, the individual maternal death case was closed.

MONITORING AND EVALUATION

To improve the timeliness, quality, and completeness of data collected through the JMMSR IS, a monitoring and evaluation framework was developed and implemented. This framework was used to monitor the main functions of the system and ensure that its major steps were functioning adequately. The monitoring was mainly done nationally by the National Registry of Maternal Mortality at the MOH Non-Communicable Diseases Directorate (NCDD). At the HAD level, DAG rapporteurs monitored the health facilities pertaining to their respective HAD through the system.

The JMMSR IS indicators allowed users to monitor the progress of each maternal death case as it went through all the implementation steps. They also enabled DAG rapporteurs to follow up with specific health facilities to ensure timely data collection.

At the national level, the JMMSR IS served as a data source for indicators of the JMMSR system implementation, allowing users to monitor and evaluate each step individually. The National Registry of Maternal Mortality at the MOH/NCDD monitored data quality and completeness by comparing data collected through the JMMSR IS with other data sources, such as health facility records and the Civil Status and Passport Department (CSPD) for validation purposes.

DATA ANALYSIS

1. Qualitative Analysis

Maternal death case summaries were developed and analyzed by DAGs and the NAG to understand the problems that led to maternal deaths. Each mother's pregnancy and descriptions of where and how care was provided were carefully studied. Moreover, essential interventions that took place at all levels and any problems that may have contributed to the mother's death were explored.

These qualitative analyses were used to analyze the main causes of maternal deaths, contributing factors, and avoidability. As part of the qualitative analyses, the DAGs and NAG deployed the Three Delays Model[3] to help identify common delays associated with three components: seeking care, reaching care, and receiving care.

2. Quantitative Analysis

The number of registered live births for the year 2022 was obtained from the CSPD to serve as the denominator of the maternal mortality ratio (MMR). The total number of maternal deaths, the background demographics, and clinical characteristics were obtained from the JMMSR IS. The Stata 15 statistical package was used to perform the descriptive analyses of relevant variables.

CONFIDENTIALITY AND ETHICAL CONSIDERATIONS

The JMMSR Bylaw guarantees that the information generated through the JMMSR system will not be used for litigation purposes. The JMMSR IS deployed high-security protocols to preserve the confidentiality of the collected and processed information at all levels. When conducting household reviews, family members were contacted ahead of time to arrange for the visit. During the visit, the main interviewer explained the purpose of the interview, voluntary participation, and the confidentiality of collected information. In the event of refusal to participate, the reason for refusal was captured. The data collection team also provided the respondents of household surveys with contact details in case they had any questions.

RESULTS

The results presented in this section cover the reporting period from January 1, 2022, to December 31, 2022.

MATERNAL MORTALITY RATIO (MMR)

During the reporting period, **1,425** deaths occurred among women of reproductive age, with **60** deaths identified as maternal. The JMMSR IS reported 1,093 deaths among women of reproductive age and all 60 of the maternal deaths. The remaining 332 deaths among women of reproductive age were obtained from the CSPD, of which none were identified as maternal death.

DAGs and the NAG conducted MDRs for all maternal death cases at the HAD and national levels, respectively. The total number of live births in 2022 was **181,991**,[4] and the total number of maternal deaths during the same period was **60** deaths, corresponding to an MMR of **33 maternal deaths per 100,000 live births** (Table 1). A breakdown of MMR by age group, governorate of residence, and nationality is provided in relevant sections later in this report.

Table 1 presents the MMR and the non-COVID MMR to demonstrate the contribution of COVID-19 to maternal deaths over the last five years. The 2022 MMR was about 2% higher than 2019 and about 10% higher than 2018, while it was about 17% and 158% lower than 2020 and 2021, respectively. In contrast, the non-COVID MMR of 2022 was the lowest over the five years of reporting, at **28 maternal deaths per 100,000 live births**. The MMR variation over the last three years followed the course of the COVID-19 epidemic in Jordan, with the peak of cases in Jordan during 2021 consistent with the highest MMR of 85.2 per 100,000 live births. The effect of COVID-19 on maternal mortality in Jordan was consistent with data on MMR in many countries around the globe.[5 6 7]

Table 1: MMR and Non-COVID-19 MMR by Year

Year	Number of Live Births	Total Number of Deaths	Non-COVID-19 Deaths	MMR	Non-COVID-19 MMR
2022	**181,991**	**60**	**51**	**33.0**	**28.0**
2021	187,722	160	56	85.2	29.8
2020	176,557	68	53	38.5	30.0
2019	194,643	63	63	32.4	32.4
2018	207,917	62	62	29.8	29.8

DEMOGRAPHIC CHARACTERISTICS OF MATERNAL DEATHS

The analysis presented in this section is based on descriptive statistics that describe certain characteristics of deceased women but cannot establish statistical association or causal inference. Nevertheless, understanding the demographic characteristics of maternal death cases may assist in explaining certain aspects of maternal mortality. The comparison of demographic characteristics of deceased women with national figures based on data from the 2023 Demographic and Health Survey will help identify possible risk factors.

1. Maternal Death by Age at Death

The mean age of deceased women was 30.2 years, and the median age was 30.5 years, representing a symmetrical distribution, with the highest age being 45 and the lowest being 16.

Table 2 shows that the percentage of maternal deaths was the highest in women 30-34 years old, accounting for (30%) of all deaths. The second and third largest proportions of deaths took place among women 25-29 years old (25%) and 35-39 years old (18.3%). The lowest percentage of deaths (6.7%) occurred for two different groups: the youngest age group of women 15-19 years and the oldest age group of women 40-49 years. As fertility is age-dependent, the distribution of death cases by age does not reflect the risk of maternal death.

Table 2: Maternal Deaths by Age Group

Age Group	Number of Maternal Deaths	Percent
15-19	4	6.7
20-24	8	13.3
25-29	15	25.0
30-34	18	30.0
35-39	11	18.3
40-49	4	6.7
Total	**60**	**100**

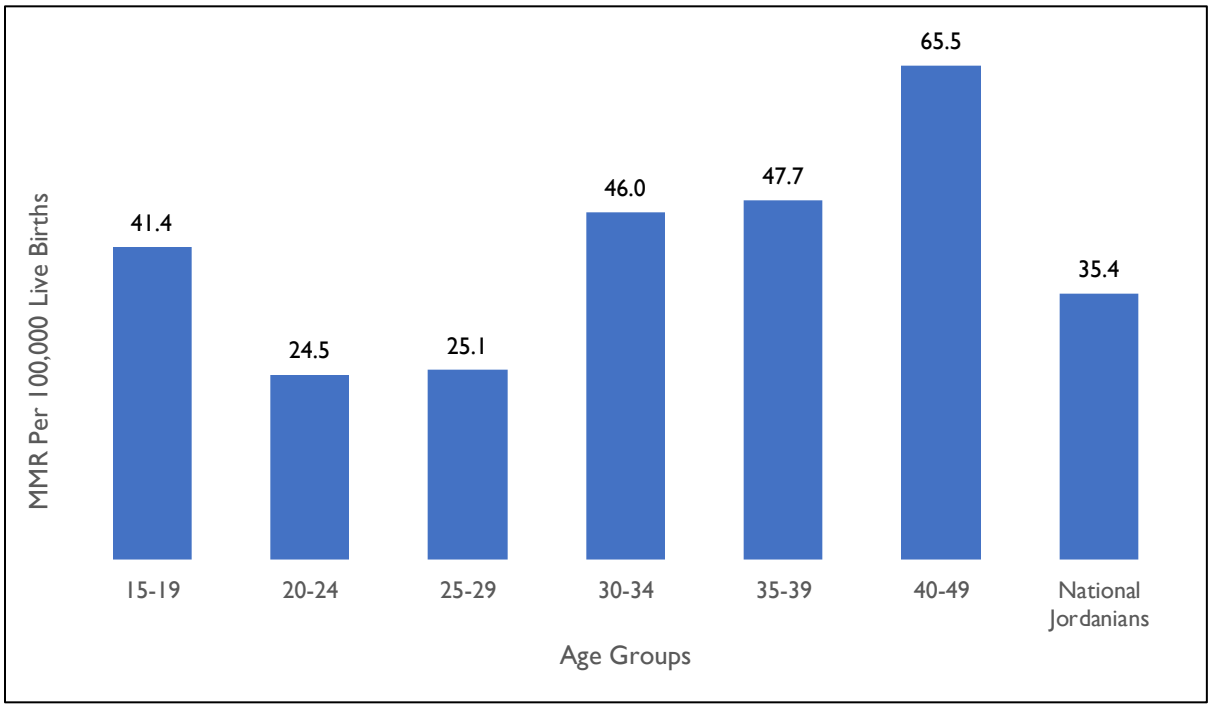
The CSPD database does not provide the distribution of live births by age groups of women of reproductive age for foreigners (non-Jordanians) living in Jordan. Figure 1 shows the distribution of MMR by age group for Jordanian women only. The MMR for Jordanian women was 35.4 deaths per 100,000 live births. Excluding the youngest age group of 15-19 years, the MMR showed an increasing trend with age, starting at 24.5 deaths per 100,000 live births in the age group of 20-24 years and reaching 65.5 for the age group 40-49 years. The adolescent age group 15-19 years suffered a higher MMR 41.4 than the subsequent age groups of 20-24 and 25-

29 years, at 24.5 and 25.1 deaths per 100,000 live births, respectively. No COVID-19 deaths were noted among adolescent women.

Several studies point to the increased probability of maternal death with age, excluding young adolescents (10-14 years).[8 9 10] In one study in the U.S., the rate of maternal mortality for women aged 40 and over was 6.0 times higher than the rate for women under age 25.[9] The MMR in this report for women aged 40 and over 65.5 was more than double the ratio for women under 25 years of age 27.6.

Adolescents are quite often stated to have an increased risk of death during pregnancy, but one study calculated the MMR by age groups for 144 countries and found that pregnant women aged 15-19 years are only at slightly higher risk of dying during pregnancy compared to women belonging to the age group 20-24 years.[11] Jordanian data for 2022 showed that the risk of maternal death among adolescent women was about 1.7 times higher than women in their early 20s.

Figure 1: Distribution of MMR by Age Groups for Jordanians Only



Age Group	15-19	20-24	25-29	30-34	35-39	40-49
Number of Maternal Deaths	3	8	13	17	10	4
Live Births	7245	32600	51695	36943	20983	6105

2. Maternal Death by Nationality

Figure 2 demonstrates that of the 60 maternal deaths during the reporting period, 55 cases (91.7%) were Jordanian, while the remaining five deaths included two Syrian, two Palestinian, and one Pakistani women.

Figure 2: Maternal Deaths by Nationality

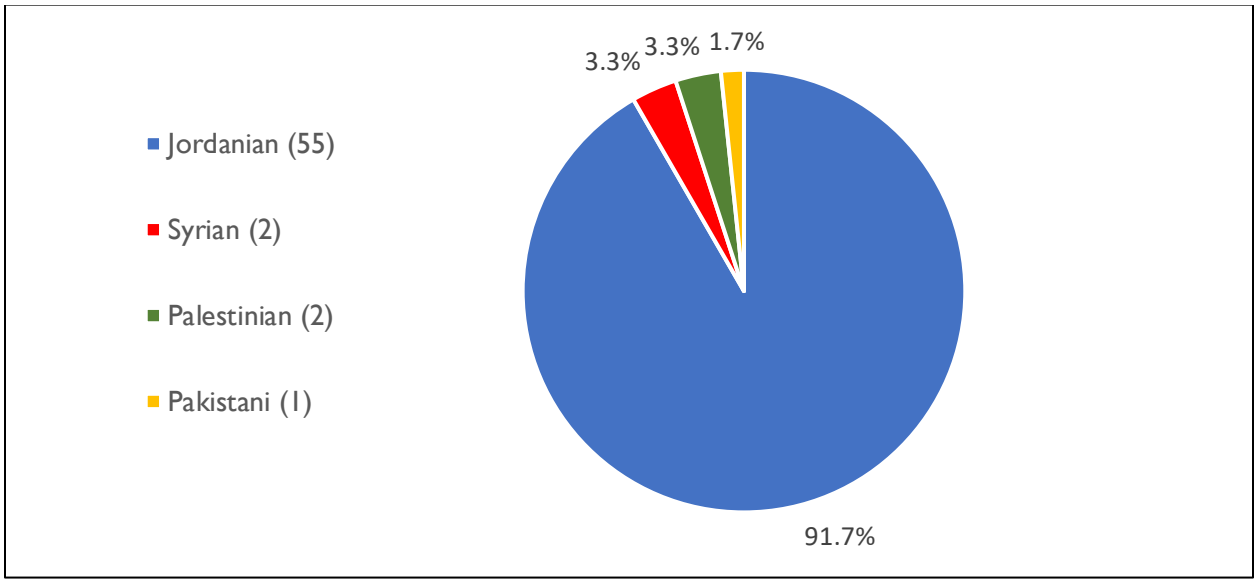
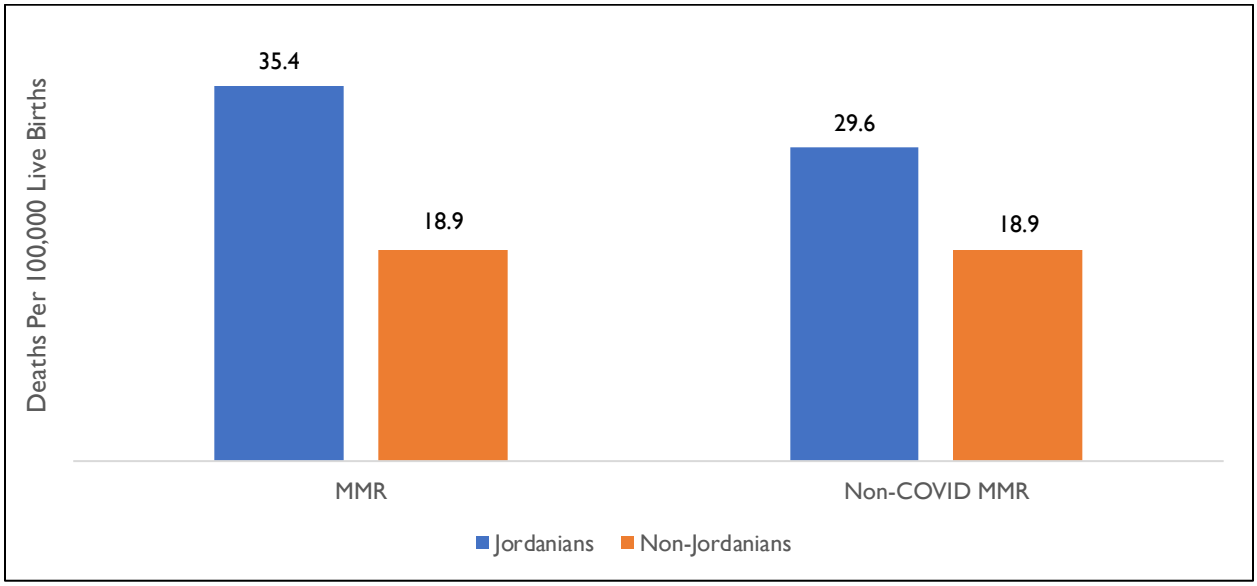


Figure 3 shows that the MMR for Jordanian women was 35.4 compared to 18.9 for non-Jordanian women. Jordanian women had a 1.9 times higher MMR compared to non-Jordanians, while non-COVID-19 MMR was about 1.6 times higher for Jordanian compared to non-Jordanian women, at 29.6 and 18.9, respectively. The non-Jordanian MMR and non-COVID-19 MMR were the same, as COVID-19 infections leading to death took place among Jordanian women only.

Figure 3: MMR and non-COVID-19 MMR by Nationality

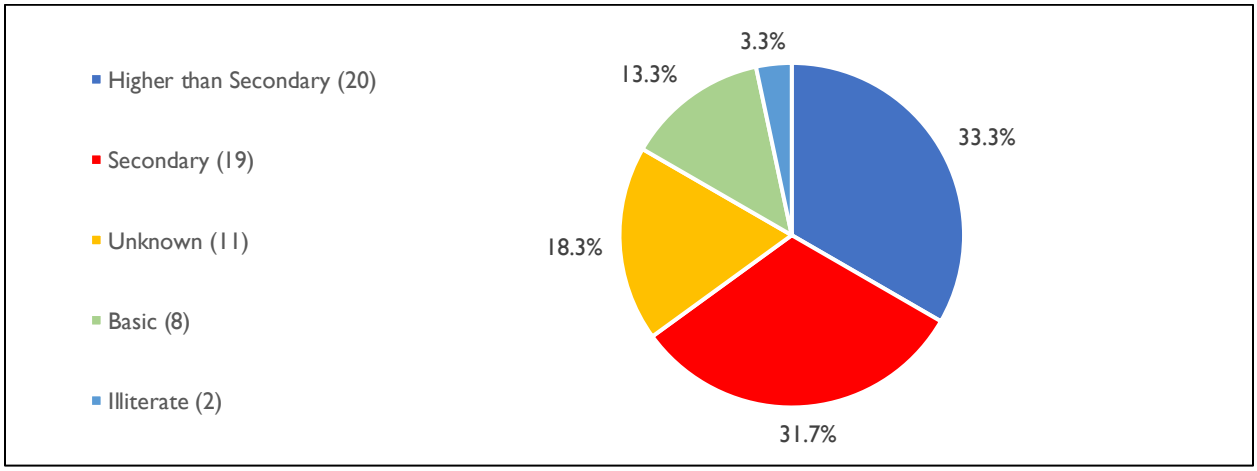


3. Maternal Deaths by Educational Level

Of the 60 maternal deaths, only 49 had available information on educational level. Information on the level of education was difficult to ascertain due to discrepancies between the health facility and household reviews. Household information was relied upon more when discrepancies arose.

Figure 4 shows that one-third of the women (33.3%) in the 60 cases had higher than a secondary educational level, followed by secondary-level education (31.7%), basic education (13.3%), and an illiterate status (3.3%). All illiterate women and 20% with a basic education were non-Jordanians.

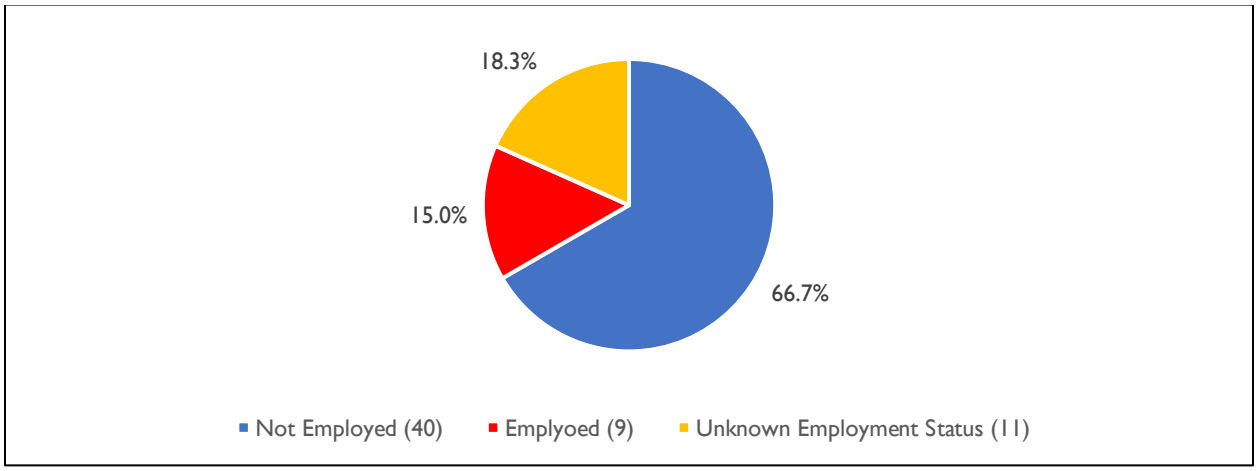
Figure 4: Maternal Deaths by Educational Level



4. Maternal Death by Employment

Information on employment status was captured for only 49 cases. Two-thirds of all 60 death cases occurred among mothers who were unemployed, corresponding to about (82%) of the 49 deaths with known employment status (Figure 5).

Figure 5: Distribution of Maternal Deaths by Employment Status



5. Maternal Death by Place of Residence and Place of Death

Information on the place of residence and place of death of the deceased women was collected from both the health facility and household questionnaires. Table 3 presents the percentage distribution of maternal death cases according to the location of residence and location of death for regions and governorates.

While (50%)of deaths occurred among women residing in the central region, about two-thirds (63.3%) of the deaths took place in the central region due to referrals. While (40%) of deaths occurred among women residing in the north, only (33.3%) died in the same region. Women residing in the south accounted for only (10%) of deaths, while only (3.3%) died in the same region.

Most maternal deaths took place in the largest four governorates of Amman, Balqa, Irbid, and Zarqa. While only (25%) of deceased women resided in Amman, about (52%) of maternal deaths took place in the same governorate. Amman is the most populated governorate, representing (42%) of Jordan's population. It had the largest number of public and private referral hospitals in this reporting period, leading to an influx of referred complicated cases from all over the country. Table 4 shows that about (52%) of the deaths that took place in Amman governorate pertained to women residing in seven other governorates.

Table 3: Distribution of Maternal Deaths by Location of Residence and Location of Death

Location	Place of Residence Number (Percent)	Place of Death Number (Percent)
Region		
Central	30 (50)	38 (63.3)
North	24 (40)	20 (33.3)
South	6 (10)	2 (3.3)
Governorate		
Ajloun	2 (3.3)	3 (5.0)
Amman	15 (25.0)	31 (51.7)
Aqaba	3 (5.0)	1 (1.7)
Balqa	7 (11.7)	4 (6.7)
Irbid	16 (26.7)	14 (23.3)
Jerash	3 (5.0)	2 (3.3)
Karak	3 (5.0)	1 (1.7)
Maan	(0.0)	(0.0)
Madaba	2 (3.3)	(0.0)
Mafraq	3 (5.0)	1 (1.7)
Tafilah	(0.0)	(0.0)
Zarqa	6 (10.0)	3 (5.0)
Total	**60 (100.0)**	**60 (100.0)**

Table 4: Maternal Deaths Reported in Amman According to Place of Residence

Governorate	Place of Residence	Percent
Amman	15	48.4
Aqaba	2	6.5
Balqa	3	9.7
Irbid	2	6.5
Karak	2	6.5
Madaba	2	6.5
Mafraq	2	6.5
Zarqa	3	9.7
Total	**31**	**100**

Table 5 shows the distribution of MMR by the location of residence and location of death for regions and governorates. The lowest MMR by region of residence occurred in the central region, at 27.7, and the highest in the north, at 42.8 deaths per 100,000 live births. Mostly due to referrals to Amman governorate, the MMR by region of death in the central region was 35.1, which was close to the north region's MMR of 35.7 and much higher than the south region's MMR of only 11.4 deaths per 100,000 live births. The low MMR for the south region was due to two-thirds of the region's cases being referred to another governorate, mainly to Amman.

The lowest MMR by the governorate of residence (excluding zero numbers) was reported among women residing in Amman governorate, at only 19.5, while the highest MMR 95.1 was reported for Jerash governorate, which was about three times higher than the national MMR of 33. In addition to Amman, only Mafraq and Zarqa governorates showed values lower than the national figure, while Maan and Tafila governorates did not have any maternal deaths.

Aside from the zero values in Maan, Tafila, and Madaba, the distribution of MMR by the governorate where the death took place showed that Aqaba, Karak, Mafraq, and Zarqa had the lowest values, ranging from 8.3 in Mafraq to 20.3 deaths per 100,000 live births in Aqaba. The rest of the governorates showed values above the national level, with Ajloun and Jerash leading, each above 60 deaths per 100,000 live births. The MMR difference based on residence and place of death is related to transfers of complicated cases to nearby referral hospitals.

Table 5: Distribution of MMR by Location of Residence and Location of Death

Location	Number of Live Births	# Deaths by Residence	# Deaths by Place of Death	MMR by Residence	MMR by Place of Death
Region					
Central	108,429	30	38	27.7	35.0
North	56,071	24	20	42.8	35.7
South	17,491	6	2	34.3	11.4
Governorate					
Ajloun	4,852	2	3	41.2	61.8
Amman	77,074	15	31	19.5	40.2
Aqaba	4,925	3	1	60.9	20.3
Balqa	7,921	7	4	88.4	50.5
Irbid	35,985	16	14	44.5	38.9
Jerash	3,154	3	2	95.1	63.4
Karak	7,400	3	1	40.5	13.5
Maan	2,994	0	0	0.0	0.0
Madaba	4,440	2	0	45.0	0.0
Mafraq	12,080	3	1	24.8	8.3
Tafila	2,172	0	0	0.0	0.0
Zarqa	18,994	6	3	31.6	15.8
Total	**181,991**	**60**	**60**	**33.0**	**33.0**

Note. Figures in red are above the national MMR.

CLINICAL CHARACTERISTICS OF MATERNAL DEATHS

1. Maternal Deaths by Parity

Parity was defined in this report as the number of previous pregnancies carried to a viable gestational age (24 weeks and above) and resulting in live births or stillbirths, including the pregnancy that led to the woman's death. Data presented in Table 6 clearly indicates that most deceased women (48.3%) were multiparous (gave birth two to four times). About (28%) of deceased women were para 1, followed by grand multiparous at about (13%). The nulliparous

and great grand multiparous women died at the lowest rate of (5%). The nulliparous women were in the age group 20-29 years.

Table 6: Distribution of Maternal Deaths by Parity

Parity	Number of Maternal Deaths	Percent
Nullipara (0 parity)	3	5.0
Para 1	17	28.3
Multipara (2-4)	29	48.3
Grand Multipara (5-6)	8	13.3
Great grand multipara (≥ 7)	3	5.0
Total	**60**	**100**

2. Maternal Deaths by Gestational Age

The mean gestational age at death was about 31 weeks, with a minimum of six and a maximum of 41 weeks. Table 7 shows that 35 deceased women (58.3%) died before the 37th week of gestation. The majority (70%) of all maternal deaths took place during the third trimester, about (23%) during the second trimester, and about (7%) during the first trimester.

Table 7: Distribution of Maternal Deaths by Gestational Age

Variable	Number of Maternal Deaths	Percent
Gestational Age		
6-23 Weeks	11	18.3
24-36 Weeks	24	40
37-41 Weeks	25	41.7
Trimester		
First Trimester	4	6.7
Second Trimester	14	23.3
Third Trimester	42	70.0
Total	**60**	**100**

3. Maternal Deaths by Time of Death

The NAG relied on the health facility and household questionnaires, in addition to their clinical expertise, to determine the time of a woman's death in relation to pregnancy. The majority (80%) of maternal deaths took place during the postpartum period. Death during pregnancy accounted for (11.7%) of events, while death due to abortions and post-miscarriages was observed in (8.3%) of mortalities (Figure 6).

Figure 6: Postpartum Time of Death

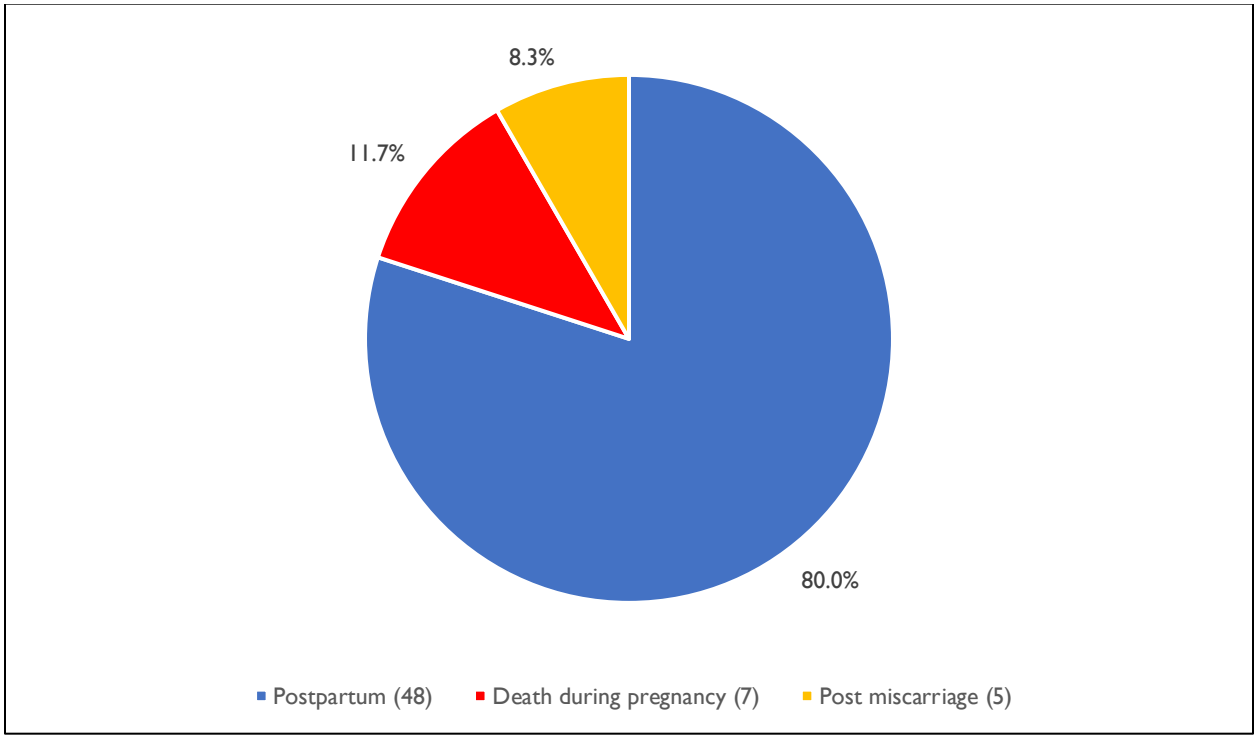


Table 8 shows that the timing of postpartum death was almost equally distributed among three categories: the first day after delivery, two to seven days after delivery, and eight to 42 days after delivery. A review of 32 studies revealed that almost half (49%) of deaths occurred during the first day compared to only about (31%) in this report.[12]

Table 8: Distribution of the Timing of Postpartum Maternal Deaths

Time of Death After Delivery	Number	Percent
First day after delivery	15	31.3
From 2 to 7 days	17	35.4
From 8 to 42 days	16	33.3
Total	**48**	**100**

4. Maternal Deaths by Antenatal Care (ANC)

A top priority service shown to be extremely impactful in reducing maternal mortality is universal access to quality ANC. Access to ANC services contributes to the reduction of maternal deaths, but the magnitude of the reduction depends on how well healthcare providers screen and manage cases of high-risk pregnancy. Extreme caution needs to be taken in interpreting the following results, as they do not reflect the quality and exact timing of provided ANC on maternal health outcomes.

The mean number of ANC visits was 6.7, and the median was seven. The minimum number of visits was one, and the maximum was 10. In 2016, WHO revised the recommended minimum number of ANC visits from four to eight at 12, 20, 26, 30, 34, 36, 38, and 40 weeks of gestation. This change was because of the increased opportunities to detect and manage potential complications, and it increases the likelihood of positive pregnancy outcomes.[13]

Table 9 shows that 54 cases (90% of the 60 maternal deaths) had documented ANC visits. The mean number of ANC visits was higher than the WHO-recommended number for each gestational age category except for the 40 weeks and above group. The minimum number of visits in three of the gestational age categories (from 26 to 35 weeks) was consistent with WHO recommendations, while the last three categories corresponding to gestational age 36 weeks and above had minimums less than what WHO recommends. The category 20-25 weeks also had a minimum lower than the WHO recommendation.

None of the six cases with an unknown number of ANC visits arrived dead at a hospital. A lack of data on ANC in the medical files is a major issue that requires immediate attention.

Table 9: Distribution of ANC Visits by Gestational Age and WHO Recommendations

Gestational Age	N	Mean	Min	Max	WHO Recommended
< 20 weeks	8	4.6	1	7	1
20-25 weeks	5	4.8	1	7	2
26-29 weeks	3	7.7	5	10	3
30-33 weeks	7	6.7	5	8	4
34-35 weeks	3	8.3	6	10	5
36-37 weeks	9	7.4	5	9	6
38-39 weeks	12	7.4	4	9	7
≥ 40 weeks	7	7.3	2	10	8
Total	**54**	**6.7**	**1**	**10**	**-**

Information regarding the sector that provided ANC was obtained for only 49 cases (81.7% of the 60 maternal deaths). Based on these cases where the sector for ANC visits was known,

Table 10 shows that (53.1%) of deceased women received ANC services from the private sector, (42.9%) from the public sector, and (4.1%) from both the private and public sectors.

Table 10: Maternal Deaths by Sector of ANC Provider

Place of ANC	Number of Maternal Deaths	Percent	Percent Excluding Unknown Visits
Private Sector	26	43.3	53.1
Public Sector	21	35.0	42.9
Mixed Public/Private	2	3.3	4.1
Unknown Sector	11	18.3	-
Total	**60**	**100***	**100***

**Totals differ by 0.1 due to rounding*

Table 11 shows that information on the ANC provider was obtained only for 48 cases (80%). Physicians provided approximately (83%) of ANC services among the cases with a known provider. Midwives' contribution to the provision of ANC care was minimal.

Table 11: Maternal Deaths by Type of Provider of ANC

Provider of ANC	Number of Maternal Deaths	Percent	Percent Excluding Unknown Provider
Doctor	40	66.7	83.3
Doctor + Midwife	5	8.3	10.4
Midwife	3	5.0	6.3
Unknown	12	20.0	-
Total	**60**	**100**	**100**

5. Maternal Death by Mode of Delivery

Table 12 shows that most deceased women (58.3%) had a cesarean delivery. Emergency cesarean was observed in (46.7%) of reported maternal deaths, while elective cesarean accounted for (11.7%). Vaginal deliveries constituted (21.7%) of maternal deaths, while (11.7%) of deceased women had no deliveries. A comparison of the cesarean and vaginal deliveries shows that cesarean section deliveries constituted (72.9%) of all deliveries compared to (27.1%) of vaginal deliveries.

A cesarean section is a major surgical procedure that can save the lives of both the fetus and the mother. However, a medically unnecessary cesarean section is associated with a higher risk of perinatal and maternal mortality compared to a vaginal delivery.[14] Due to the rising trend of cesarean section deliveries in Jordan, there is an urgent need to foster the national program for reducing unnecessary cesarean section deliveries.[15 16 17]

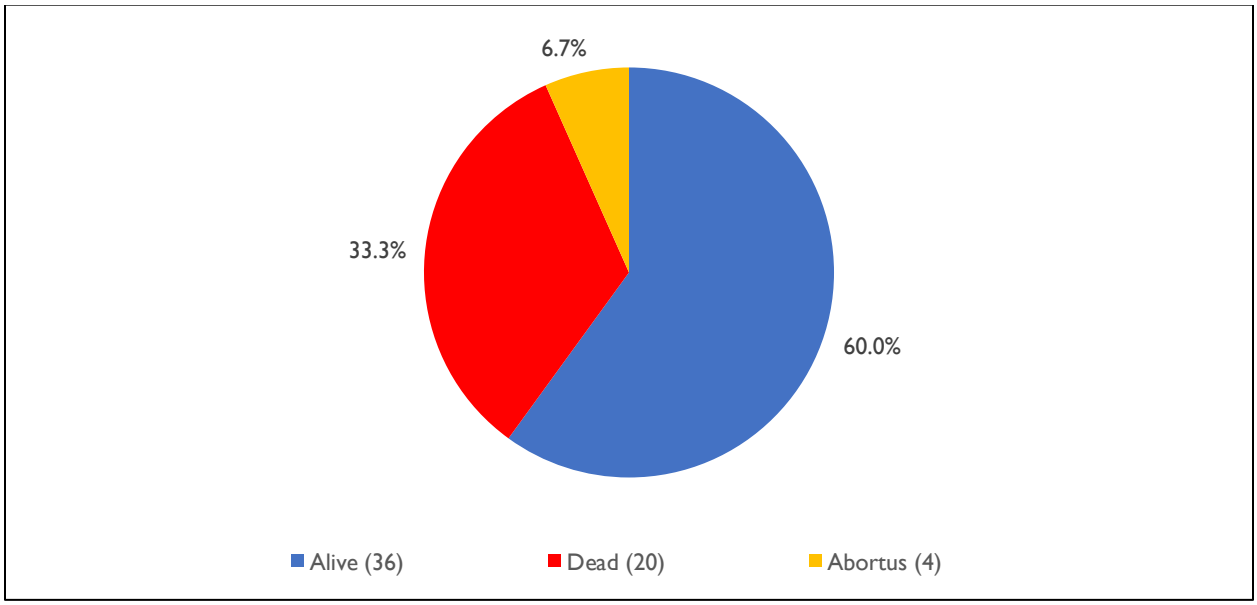
Table 12: Distribution of Maternal Deaths by Mode of Delivery

Mode of Delivery	Number of Maternal Deaths	Percent	Percent of Deliveries
Cesarean Section	**35**	**58.3**	**72.9**
• *Emergency Cesarean*	28	46.7	58.3
• *Elective Cesarean*	7	11.7	14.6
Vaginal Delivery	**13**	**21.7**	**27.1**
Postmortem Cesarean	1	1.7	-
Miscarriage	4	6.7	-
No Delivery	7	11.7	-
Total	**60**	**100**	**100**

6. Maternal Death by Fetal Outcome

Figure 7 presents the distribution of maternal deaths by fetal outcome. Of the 60 maternal deaths, (60%) of cases had live neonates, and the outcome of the remaining (40%) was dead.

Figure 7: Distribution of Maternal Deaths by Fetal Outcome



7. Maternal Death and Anemia

The mean hemoglobin value was 10.4 g/dl, with a minimum of 5.1 and a maximum of 13.5 g/dl. Table 13 shows that (46.7%) of cases had no anemia, (33.3%) had mild anemia, and (16.7%) had moderate anemia. Only two women (3.3%) suffered from severe anemia on admission.

Anemia in pregnancy is associated with severe maternal morbidity and is an indirect cause of maternal death in both low-income and high-income settings. Studies consistently reaffirm the association of maternal anemia with maternal mortality, emphasizing the need to reduce anemia during pregnancy and the postpartum period.[18] Therefore, the WHO global targets call for a 50% reduction in anemia in women of reproductive age by 2025.[19]

Table 13: Distribution of Maternal Death According to Anemia Status on Admission

Anemia Status	Number of Maternal Deaths	Percent
No Anemia (Hg>=11 g/dL)	28	46.7
Mild (Hg 10-10.9 g/dL)	20	33.3
Moderate (Hg 7-9.9 g/dL)	10	16.7
Severe (Hg <7 g/dL)	2	3.3
Total	**60**	**100**

CAUSE-SPECIFIC MATERNAL MORTALITY

Understanding the causes of and contributing factors to maternal deaths is critically important for the development of interventions to reduce maternal mortality in Jordan. The NAG used mainly the International Classification of Diseases, specifically the ICD-10, in assigning causes of death.[2] The NAG used the information obtained through the health facility and household questionnaires to agree on the classifications of causes of death to the levels of classes and subclasses.

Of the 60 maternal death cases, the NAG assigned the main cause of death to 57 cases, while the cause of death could not be specified for the remaining three cases. Autopsies were performed for (28.3%) of all deaths and for (75%) of the pregnant women found dead on arrival (Table 14).

Table 14: Distribution of Autopsy for all maternal Deaths

Variables	Autopsy Performed (Percent)		Total (Percent)
	Yes	No	
All Deaths	17 (28.3)	43 (71.7)	60 (100)
Dead on Arrival	3 (75)	1 (25)	4 (100)
Unknown Cause of Death	2 (75)	1 (25)	3 (100)

Table 15 provides a quick overview of the distribution of causes of death, while detailed descriptions are presented in the following section. Table 15 indicates that pulmonary embolism (10 cases) and COVID-19 infection (nine cases) stood as the top two causes of death, accounting for (31.7%) of all deaths. Postpartum hemorrhage came in third place, constituting (13.4%) of all deaths. Preeclampsia ranked fourth, with (8.3%) of total deaths. Thus, the aforementioned four diseases were responsible for over (53%) of all deaths.

Table 15: Distribution of Cause-Specific Maternal Mortality

Cause of Death	Number	(Percent)
Pulmonary Embolism	10	16.7
COVID-19	9	15.0
Postpartum Hemorrhage	8	13.4
Preeclampsia	5	8.3
Cerebrovascular Infarction/ sagittal sinus thrombosis/ and hyperemesis gravidarum	4	6.7
Puerperal Sepsis	3	5.0
Amniotic Fluid Embolism	2	3.3
Liver Cirrhosis/ hepatic failure	2	3.3
Anaphylactic Shock	1	1.7
Aortic Dissection	1	1.7
Autoimmune Hepatitis	1	1.7
Breast Cancer	1	1.7
Cardiomyopathy	1	1.7
Complications of Anesthesia During Labor	1	1.7

Cause of Death	Number	(Percent)
Infection Post-Miscarriage	1	1.7
Metastatic Brain Tumor	1	1.7
Mesenteric Ischemia	1	1.7
Nephrotic Syndrome	1	1.7
Pneumonia	1	1.7
Severe Sepsis with Septic Shock	1	1.7
Systemic Lupus Erythematosus	1	1.7
Thrombotic Thrombocytopenic Purpura	1	1.7
Unspecified	3	5.0
Total	**60**	**100***

**The exact total is 0.5 above 100 due to rounding.*

DIRECT AND INDIRECT CAUSES OF MATERNAL MORTALITY

According to the WHO definition, direct causes of death are those "resulting from obstetric complications of the pregnant state (pregnancy, labor, and puerperium), and from interventions, omissions, incorrect treatment, or from a chain of events resulting from any of the above." Indirect maternal deaths are those maternal deaths "resulting from previous existing disease or disease that developed during pregnancy and not due to direct obstetric causes but were aggravated by the physiologic effects of pregnancy." [20]

Table 16 presents the distribution of causes of maternal deaths according to the two categories of causes (direct vs. indirect). While the direct causes of death accounted for (51.7%) of all deaths, the indirect causes constituted (43.3%) of all maternal deaths, and the remaining (5.0%) represented the unspecified causes of death. The following subsections describe the causes featured in Table 16.

1. Direct Causes of Maternal Deaths

The leading cause of direct maternal deaths (20.0% of all deaths) was the category called "other obstetric complications, obstetric embolism" (pulmonary and amniotic fluid embolisms). Postpartum hemorrhage was the second-leading cause at (13.4%) of all deaths, followed by hypertensive disorders in pregnancy, childbirth, and the puerperium at (8.3%). Pregnancy-related infections accounted for (6.7%). Combined, the remaining direct causes of death accounted for (3.4%) of all deaths.

Other obstetric complications, obstetric embolism accounted for 12 (20%) of the maternal deaths, with 10 cases (16.7%) of pulmonary embolism and two cases (3.3%) of amniotic fluid embolism.

Of the 10 pulmonary embolism deaths, the diagnosis was based on autopsy in seven cases, and two cases were diagnosed with imaging scans, and one based on clinical manifestations. Neither of the two amniotic fluid embolism cases underwent autopsy. This finding raises concerns about the accuracy of diagnosing amniotic fluid embolism based solely on the clinical picture, but internationally amniotic fluid embolism remains a clinical diagnosis. Mortalities caused by embolism were observed across the parity, from nullipara to grand multipara. Ten out of the 12 cases took place during the postpartum period, while one woman died during pregnancy and one intrapartum.

Venous thromboembolism is a leading cause of severe maternal morbidity and mortality. Pregnancy and the postpartum period are very high-risk periods for thromboembolic events, the most common of which is pulmonary embolism. Pulmonary embolism is the leading cause of direct maternal deaths in developed countries worldwide.[21]

The incidence of venous thrombosis, pulmonary embolism, and subsequent maternal death can be significantly reduced by embracing prophylactic measures that should be implemented at both the primary healthcare and hospital levels.

Amniotic fluid embolism is a rare complication of pregnancy with a comparatively high mortality rate. It is considered to be an unpredictable and unpreventable event with an unknown cause.[22] [23] It often presents as a sudden onset of cardiovascular collapse, respiratory compromise, and disseminated intravascular coagulation.

As countries continue to work toward reducing their maternal mortality, conditions such as amniotic fluid embolism are likely to become more prominent.

Obstetric hemorrhage accounted for eight cases (13.4%) of maternal deaths, which is lower than the contribution of obstetric hemorrhage to maternal deaths in 2021, which was 13 cases. The NAG identified all eight obstetric hemorrhage deaths as avoidable. Half of the cases died within the first day after delivery. Seven out of the eight hemorrhage deaths (87.5%) underwent cesarean section, of which five cases had emergency cesarean intervention.

One case of obstetric hemorrhage had premature separation of the placenta. With placental abruption, the woman is at risk for hemorrhage and the associated need for blood transfusions, hysterectomy, bleeding disorders (specifically disseminated intravascular coagulopathy), and renal failure. Placental abruption is a significant contributor to maternal morbidity, with maternal death rates seven times higher than the overall maternal mortality rate.[24] [25]

Postpartum hemorrhage is known to be the leading cause of maternal deaths worldwide.[26] More than two-thirds of reported obstetric hemorrhage deaths globally are classified as postpartum hemorrhage.[27] A significantly high proportion (72%–90%) of the morbidity in obstetric hemorrhage cases is considered to be avoidable.[28] In this report, (100%) of the cases

were considered avoidable. This finding correlates with the adequate management of the condition through early recognition and then by selecting the most appropriate choices of therapy and adequate interventions, particularly in the early stages.[29 30] Despite improvements in management, early postpartum hemorrhage still remains a significant cause of maternal morbidity and mortality in developing countries.[31]

One of the ways to prevent postpartum hemorrhage is the active management of the third stage of labor (AMTSL). This is considered to be the gold standard in reducing the incidence of postpartum hemorrhage.[32 33 34] Over the last several years, with the support of USAID-led interventions, the public sector hospitals in Jordan have introduced and adopted AMTSL to decrease the incidence of cases with atonic postpartum hemorrhage. Future interventions should aim to improve AMTSL as well as clinical case management during the fourth stage of labor (the first two hours after delivery).

Hypertensive disorders in pregnancy, childbirth, and the puerperium accounted for five cases (8.3%) of the deaths. All five cases suffered from severe preeclampsia and died during the postpartum period. Two cases were para 1, and three cases were para 2-4.

Hypertensive disorders of pregnancy are one of the most common complications during pregnancy, significantly contributing to maternal mortality. WHO reported that (14%) of global maternal deaths are attributed to hypertensive disorders of pregnancy.[27]

Magnesium sulfate helps prevent eclamptic fits in pregnant women who are at increased risk. It reduces approximately half the risk of eclampsia and probably reduces the risk of maternal death.[35]

With USAID's support, the public healthcare system in Jordan took the initiative to implement and adopt the administration of magnesium sulfate for severe preeclampsia cases, reflecting a potential reduction of pregnancy-induced hypertension. Nevertheless, it is still crucial to make an early diagnosis of mild preeclampsia and refer these women to the appropriate care for comprehensive case management to decrease the probability of severity and complications. Unfortunately, all five deaths reported in this period took place in public sector hospitals, which hints at improper implementation of clinical guidelines, including the use of magnesium sulfate.

Pregnancy-related infection accounted for four cases (6.7%) of death, where three cases succumbed to puerperal sepsis, and one case suffered from post-miscarriage infection. The NAG considered all four infection cases to be avoidable.

Sepsis is a life-threatening condition that arises when the body's response to infection causes injury to its own tissues and organs. Despite being highly preventable, maternal sepsis continues to be a major cause of death and morbidity for pregnant or recently pregnant women.[27 36]

With technical assistance from USAID, the Jordanian MOH, and RMS took the initiative to adopt the clinical practice guidelines for the use of prophylactic antibiotics for cesarean section deliveries, a practice that needs to be institutionalized in all hospitals in Jordan.

Complications of anesthesia during labor and delivery included one case of death. Such complications leading to maternal death are not uncommon in medical practice. A paper studied 4,438 deliveries that had at least one anesthesia-related complication out of about one million deliveries. The study concluded that deliveries with anesthesia had a 22-fold increased risk of maternal mortality compared to deliveries without anesthesia.[37]

Other venous complications in pregnancy, first trimester included one case of sagittal sinus thrombosis that was diagnosed based on an MRI but not confirmed by autopsy. Cerebral venous thrombosis is a very rare complication during pregnancy, especially during the first trimester, with a high degree of mortality. Literature on cerebral venous thrombosis is scarce and does not go beyond case reports.[38] [39]

2. Indirect Causes of Maternal Deaths

The indirect causes of death accounted for 26 cases, corresponding to (43.3%) of all deaths. Diseases of the respiratory system dominated the indirect causes of all maternal deaths, followed by diseases of the digestive system and central nervous system (Table 16).

Diseases of the respiratory system accounted for 10 cases, equaling about (16.7%) of maternal deaths, with nine cases of COVID-19 infection and one case of pneumonia.

All nine COVID-19 cases, representing (15.0%) of all maternal deaths, received a diagnosis of SARS-CoV-2 infection by reverse transcription polymerase chain reaction (PCR) testing.

Five cases (55.6%) of COVID-19 deaths underwent emergency cesarean. Eight COVID-19 cases (88.9%) died during the postpartum period, and the remaining one case died post-miscarriage. The majority of COVID-19 deceased women (66.7%) delivered alive neonates, compared to (58.8%) of alive neonates among non-COVID-19 cases.

Globally, the COVID-19 pandemic has disrupted healthcare before, during, and immediately after childbirth. Current evidence suggests the possibility of severe maternal morbidity and indicates a consistent association between pregnant women with COVID-19 diagnosis and an increased risk of adverse outcomes, including maternal death.[40] [41] Some studies clearly indicate alarming results of maternal mortality due to COVID-19 infections. This increase could eliminate the last few decades of progress in reducing maternal mortality. In one study in Mexico, the confirmed COVID-19 cases constituted about 23% of all maternal deaths, leading to an increase of about (57%) over the expected ratio.[5] In another study in Bahia, Brazil, the MMR increased by over 59% above the expected ratio, where COVID-19 infection was reported in about (13%) of deceased women.[6] A third study in Peru demonstrated a sharp increase of (75%) in maternal deaths in 2020 compared to 2019, leading to a doubling of the MMR from 17 per 100,000 live births in 2019 to 34 per 100,000 live births in 2020.[42] A review of seven studies showed increased levels of maternal mortality due to COVID-19 infection documented in all studies, while statistical evidence was present in just four studies, where excess maternal mortality ranged from (8.5%-61.5%).[7]

Pneumonia that occurs during pregnancy is known to carry an increased risk of adverse outcomes when compared to pneumonia in nonpregnant women. Major factors predispose pregnant women to severe pneumonic infections, such as alterations in the immune and hormonal statuses and the decreased ability of pregnant women to clear respiratory secretions due to some anatomical changes that occur in the chest during pregnancy.[43]

Diseases of the digestive system included four cases (6.7%), comprising two cases of liver cirrhosis, one case of autoimmune hepatitis, and one case of mesenteric ischemia. The ICD-10 code for this disease is "vascular disorders of the intestine," and in this report, they were grouped under the digestive system. One known case of liver disease was admitted in hepatic coma due to complication from liver cirrhosis and was confirmed by autopsy.

Liver cirrhosis during pregnancy is associated with increases in maternal mortality and obstetric and fetal complications.[44] There is a paucity of data on maternal mortality and autoimmune hepatitis, with a low probability of dying from the disease during pregnancy.[45] [46]

Mesenteric ischemia seems to occur rarely worldwide, and the literature is limited to case reports.[47] [48]

Diseases of the central nervous system accounted for three cases (5%) of all deaths. The three cases suffered cerebrovascular infarctions and hyperemesis gravidarum. Pregnancy-associated stroke has been known to increase the risk of maternal mortality. The pregnant body undergoes physiological changes to promote the growth of the fetus and to prepare for delivery. Many of these changes may render the woman more vulnerable to thromboembolism and cardiovascular events.[49]

Diseases of the circulatory system included two cases (3.3%). One died of cardiomyopathy and the second case of aortic dissection. The aortic dissection did not undergo an autopsy, but the cardiomyopathy case did. Both deaths took place during the postpartum period.

Pregnant women with known cardiomyopathy are at an increased risk of maternal mortality, and quite often, they are advised not to conceive.[50] The risk of aortic dissection or rupture is elevated during pregnancy and the postpartum period.[51]

Neoplasms accounted for two cases (3.3%), with one death due to breast cancer and the other due to a metastatic brain tumor. Symptoms of neoplasms can mimic those of physiological pregnancy changes, which leads to a delay in accurate diagnosis.[52] This delay can lead to a more advanced stage of the disease, resulting in higher mortality. Neoplasms during pregnancy are relatively rare, but they are considered to be a potential threat to both maternal and fetal well-being. Globally, the incidence of cancer during pregnancy has been estimated to occur in 1 in 1,000 pregnancies; however, the incidence is rising globally due to increasing maternal age and the increasing incidence of risk factors for cancer.[53] [54] This finding should prompt further assessment of the frequencies of neoplasms among women of reproductive age in general and pregnant women specifically.

Diseases of the musculoskeletal system and connective tissues included two cases (3.3%). One was due to systemic lupus erythematosus (SLE), and the other suffered from thrombotic thrombocytopenic purpura (TTP). Women with SLE are at an increased risk for serious medical and pregnancy complications during pregnancy, including death. One study found that maternal mortality was 20-fold higher among women with SLE.[55]

TTP occurs more commonly in women, and accordingly, it can be associated with pregnancy. Furthermore, pregnancy can precipitate TTP. The latter increases the risk of maternal and neonatal mortality.[56]

Diseases of the genitourinary system included one case of nephrotic syndrome (1.7%). Pregnant women with nephrotic syndrome are at high risk for developing both maternal and fetal complications, even in the absence of significant renal impairment or uncontrolled hypertension at the time of presentation of nephrotic syndrome. Nevertheless, maternal mortality due to nephrotic syndrome is rarely reported in the literature, and only one death was found in a paper published in 1969.[57]

Other specified maternal diseases included one death of severe sepsis with septic shock and one death due to anaphylactic shock, each comprising 1.7% of total maternal deaths. Pregnancies complicated by severe sepsis and septic shock are correlated with increased rates of preterm labor, fetal infection, and preterm delivery.[58] [59]

The woman with anaphylaxis died in a hospital after an antibiotic injection and failure to resuscitate. Maternal mortality caused by anaphylaxis is extremely rare. In one study in Europe, the incidence of anaphylaxis was 1.1 to 1.9 per 100,000 pregnancies.[60] Another systematic review found that the incidence of anaphylaxis was 1.5 to 3.8 per 100,000 maternities and found that the maternal mortality due to anaphylaxis was 0.05 per 100,000 live births, which is more than 10 times lower than the anaphylaxis MMR in this report, at 0.55.[61]

3. Unspecified Causes of Maternal Deaths

The NAG was unable to assign a cause of death for three out of the 60 reported maternal deaths due to insufficient information from all sources, including autopsy.

Table 16: Maternal Deaths by Direct and Indirect Causes of Death

Cause of Death	Number	Percent
Direct Causes of Death	**31**	**51.7**
Obstetric Embolism	**12**	**20.0**
• *Pulmonary Embolism*	10	16.7
• *Amniotic Fluid Embolism*	2	3.3
Obstetric Hemorrhage	**8**	**13.4**
• *Postpartum Hemorrhage*	8	13.4
Hypertensive Disorders in Pregnancy,	**5**	**8.3**

Cause of Death	Number	Percent
Childbirth, and the Puerperium		
• *Preeclampsia*	5	8.3
Pregnancy-Related Infection	**4**	**6.7**
• *Puerperal Sepsis*	3	5.0
• *Post-Miscarriage Infection*	1	1.7
Complications of Anesthesia During Labor and Delivery	**1**	**1.7**
• *Complications of Anesthesia During Labor and Delivery*	1	1.7
Other Venous Complications in Pregnancy, First Trimester	**1**	**1.7**
• Venous Complications in Pregnancy – Sagittal Sinus Thrombosis	1	1.7
Indirect Causes of Death	**26**	**43.3**
Diseases of the Respiratory System	**10**	**16.7**
• *COVID-19 Infection*	*9*	15.0
• *Pneumonia*	*1*	1.7
Diseases of the Digestive System	**4**	**6.7**
• *Liver Cirrhosis*	*2*	3.3
• *Autoimmune Hepatitis*	*1*	1.7
• *Mesenteric Ischemia*	1	1.7
Diseases of the Central Nervous system	**3**	**5.0**
• *Cerebrovascular Infarction*	*2*	3.3
• *Hyperemesis Gravidarum*	*1*	1.7
Diseases of the Circulatory System	**2**	**3.3**
• *Aortic Dissection*	1	1.7
• *Cardiomyopathy*	1	1.7
Neoplasms	**2**	**3.3**
• *Breast Cancer*	1	1.7
• *Metastatic Brain Tumor*	1	1.7
Diseases of the Musculoskeletal System and Connective Tissues	**2**	**3.3**
• *Systemic Lupus Erythematosus (SLE)*	1	1.7
• *Thrombotic Thrombocytopenic Purpura (TTP)*	1	1.7
Diseases of the Genitourinary System	**1**	**1.7**
• *Nephrotic Syndrome*	*1*	1.7
Other Maternal Disease	**2**	**3.3**

Cause of Death	Number	Percent
• *Anaphylactic Shock*	*1*	1.7
• *Severe Sepsis with Septic Shock*	*1*	1.7
Unspecified	**3**	**5.0**
Grand Total	**60**	**100.0**

CONTRIBUTING FACTORS OF MATERNAL DEATH

1. Avoidability

The NAG identified contributing factors that led to maternal deaths from MDR reports and case summaries. Table 17 shows that of the 60 maternal death cases, about two-thirds (63.2%) were identified as avoidable deaths. Of the direct causes of death, (77.4%) were identified as avoidable, while (46.2%) of indirect causes were identified as avoidable.

The proportion of preventable maternal deaths is still high worldwide and is reaching over (80%) of all deaths in the U.S., given that U.S. MMR was about 28 and 33 per 100,000 live births in 2020 and 2021, respectively.[62] [63]

Table 17: Avoidability of Death by All Direct and Indirect Causes of Death

Avoidability	Direct Cause (Percent)	Indirect Cause (Percent)	Total	Percent
Yes	24 (77.4)	12 (46.2)	36	63.2
No	7 (22.6)	14 (53.8)	21	36.8
Total	**31 (100)**	**26 (100)**	**57***	**100.0**

** The three unspecified cases have been removed due to irrelevance.*

2. Three-Delay Model

Table 18 describes the most common contributing factors to maternal mortality identified in this reporting period using Thaddeus and Maine's Three Delays Model (1994).[3] Overall, approximately one-third of deaths with a known cause (36.8%) did not show any delays. Delay I pertained to seeking care and was observed in 11 cases (19.3% of known causes). Delay III, related to receiving care, was identified in 19 cases (33.3% of known causes), making it the most frequently encountered type of delay. Additionally, a combination of Delays I and III occurred in six cases (10.5% of known causes).

Table 18: Maternal Deaths by Level of Delay for All Deaths

Level Delay	Number	Percent	Percent of Known Causes
Delay in Seeking Care: Delay I	11	18.3	19.3
Delay in Receiving Care: Delay III	19	31.7	33.3
Delay in Seeking and Receiving Care: Delays I & III	6	10.0	10.5
No Delay	21	35.0	36.8
Unspecified	3	5.0	-
Total	**60**	**100**	**100**

3. Case Studies

The following case presents an example of Delay III, including clinical mishandling.

Case Study 1: Pulmonary Embolism, Representing Delay III

A Preventable Death Due to Pulmonary Embolism

Case Background: A 27-year-old primigravida, 36 weeks into a twin pregnancy, who conceived via in vitro fertilization (IVF), presented with a unique clinical scenario. The patient had no significant medical or surgical history. The first twin exhibited a breech presentation, complicating the delivery process.

Admission and Initial Treatment: The patient was admitted to the hospital through the emergency department, experiencing labor pains. An emergency cesarean section was deemed necessary and performed at 2:00 p.m., approximately 30 minutes after the decision was made. The procedure concluded without immediate complications.

Postoperative Complications: On the following day, the patient reported difficulty breathing and general fatigue. An abdominal ultrasound revealed significant fluid accumulation in the abdomen, and her hemoglobin levels were critically low at 7 g/dl. Urgent medical intervention included a blood transfusion and diagnostic laparotomy, which uncovered approximately 2 L of blood in the abdominal cavity. A Redivac drain was placed, and the patient received transfusions of 2 units of blood and 2 units of fresh frozen plasmas. Post-intervention, she showed signs of improvement; she was conscious and oriented, and her vital signs had stabilized.

Sudden Deterioration and Outcome: However, in the early hours (5:00 a.m.) of the third day after admission, the patient experienced severe shortness of breath and bradycardia, leading to cardiac arrest. Despite resuscitative efforts, she passed away at 6:00 a.m., and the autopsy findings revealed the cause of death as pulmonary embolism.

This condition was characterized by the obstruction of pulmonary arteries due to blood clots, likely went unnoticed, and was the pivotal factor leading to the sudden cardiac arrest. The discovery of pulmonary embolism in this context underscores the latent risks associated with postoperative recovery, especially in complex cases, such as twin pregnancies following an IVF procedure.

The following case demonstrates how improperly diagnosed postpartum hemorrhage, along with clinical mismanagement, led to a fatal outcome.

Case Study 2: Postpartum Hemorrhage, Representing Delay III

Case Background: A 27-year-old Gravida 3, at 38 weeks of gestation, presented on admission with hemoglobin of 12.3 g/dL, a platelet counts of 146 x 10^3/µL, and a positive fetal heart rate. The patient had no significant medical history. Her last menstrual period was recorded on November 8, 2021.

Admission and Initial Treatment: The patient was admitted for an elective cesarean section in the early morning hours at 7:45 a.m. The decision for elective cesarean section was made due to the patient's previous three cesarean sections. The elective cesarean section was initiated, resulting in the safe delivery of a newborn at 11:45 a.m. The neonate, a lively baby weighing 3.100 kg, exhibited positive vital signs with an Apgar score of 8/9. The baby's blood group was identified as A+, and initial postnatal observations of the mother revealed stable blood pressure (119/67 mmHg), a pulse rate of 85 bpm, a respiratory rate of 22 breaths per minute, and a normal temperature of 36.1 °C. The medical team administered Axon 1g, 100 mg Flagyl, and Clexane 4,000 IU as part of the postoperative care protocol, with no immediate complications noted.

Postoperative Complications: On the same day, the postpartum period took an unexpected turn at 3:45 p.m., when the patient reported sudden difficulty breathing (dyspnea). Clinical assessments unveiled a concerning scenario with severe bradycardia, registering a heart rate of 45 bpm and a distressing oxygen saturation level of 77%. More alarmingly, the patient experienced a sudden onset of asystole, followed by ventricular fibrillation. In response to the emergent situation, the medical team swiftly intervened, administering DC shock to revert the heart to a normal rhythm. This intervention successfully stabilized the patient's condition temporarily.

Sudden Deterioration and Outcome: Regrettably, the patient again lapsed into asystole, prompting renewed efforts from the medical team. Despite resuscitative efforts, she passed away at 6:00 p.m., and the autopsy identified postpartum hemorrhage as the cause of death.

This unforeseen postpartum hemorrhage raises critical questions about the underlying causes. Healthcare providers must reevaluate and strengthen their protocols for managing postpartum hemorrhage to prevent future maternal mortality; these protocols must consistently prioritize the well-being and safety of mothers during childbirth.

The following case study clearly demonstrates a delayed diagnosis of pregnancy-induced hypertension.

Case Study 3: Preeclampsia, Mainly Representing Delay I

Case Background: A 19-year-old primigravida with 38 weeks of pregnancy was admitted on December 18, 2022, at 4:33 p.m. as a compelling case of labor. On admission, the vital signs showed temperature: 36.7 ℃, pulse: 86 bpm, respiratory rate: 20 breaths per minute, hemoglobin: 12.3 g/dL, and blood group: A+. The patient had enjoyed an uneventful pregnancy. A vaginal examination revealed a cervical dilation of 5 cm with intact membranes, and fetal heart sounds were initially reassuring. However, a cause for concern arose as her blood pressure upon admission soared to 170/111 mmHg, accompanied by a persistent headache. The severe headache started four days before admission, and the patient did not seek care. She underwent only three ANC visits, while she should have had seven by 38 weeks of pregnancy.

Laboratory tests were conducted, revealing the following results: international normalized ratio (INR): 1.2, creatinine (CRE): 0.6, alanine transaminase (ALT): 12, aspartate transaminase (AST): 30, platelet count: 404,000, glucose: 79, proteinuria: +3, hemoglobin: 12.

Admission and Initial Treatment: In response to the elevated blood pressure, a strategic decision was made to administer one tablet of Adalat, effectively reducing the patient's blood pressure to a more manageable 150/100 mmHg. Subsequently, a decisive course of action was taken, involving the intravenous administration of a loading dose of 4 g of magnesium sulfate ($MgSO_4$) and 20 mg of intravenous labetalol.

As the clock neared 5:30 p.m., the primigravida progressed into the second stage of labor after a fully dilated cervix was confirmed. An unforeseen twist occurred when the fetal heart tones became bradycardic, prompting an urgent decision for vacuum-assisted delivery. The skilled medical team executed a single pull, resulting in the smooth delivery of a live baby with an impressive Apgar score of 8/10. Notably, there were no noteworthy complications, and an episiotomy repair was successfully carried out. The patient remained stable for an hour in the labor ward with a blood pressure of 100/60 mmHg, and no active bleeding was detected. The last recorded hemoglobin result was 10.

[continued on the next page]

Postoperative Complications: In the next phase of care, the patient was seamlessly transferred to the critical care unit for the continuation of the $MgSO_4$ maintenance dose. Vigilant monitoring of vital signs, vaginal bleeding, and heart rate ensued, demonstrating the dedication of the medical team to ensure her well-being. At 11 p.m., however, a concerning development manifested as the patient reported periorbital numbness. The $MgSO_4$ infusion was promptly withheld, and calcium gluconate was administered. Despite interventions, the patient succumbed to anuria over the next few hours (120 ml within the last four hours). Lasix 40 mg intravenous was given, but unfortunately, no response was observed. Intriguingly, her blood pressure held steady at 110/70 mmHg, and there was no active vaginal bleeding detected.

Sudden Deterioration and Outcome: On December 19, 2022, at 6 a.m., the patient experienced a harrowing eclamptic seizure. Swift action ensued, with the administration of Valium and 4 g of $MgSO_4$, successfully aborting the seizure. However, the patient collapsed again and required intubation. Despite the initiation of cardiopulmonary resuscitation and the patient briefly regaining a pulse, a series of two subsequent cardiac arrests unfolded. Tragically, the final arrest proved irreversible, and the patient's death was officially declared at 7:40 a.m.

Preeclampsia is a serious and potentially life-threatening condition during pregnancy that can affect both the mother and the unborn baby. It typically occurs after the 20th week of pregnancy and is characterized by high blood pressure and damage to organs such as the liver and kidneys. Getting regular prenatal checkups and promptly reporting any concerning symptoms are crucial for the early detection and management of preeclampsia. Ultimately, a collaborative approach between the expectant mother and her healthcare team is essential to ensuring the best possible outcomes for both the mother and the baby.

DATA LIMITATIONS

This report is limited to a descriptive analysis of the 60 maternal deaths that occurred during 2022. The JMMSR system does not collect data on appropriate controls that have a different outcome in terms of death. Thus, the descriptive analysis performed did not allow us to test for sound statistical associations or to establish causality. Accordingly, the presented results that hint at some probable associations with maternal deaths should be interpreted with caution. Further in-depth analysis of the JMMSR data by Jordanian scholars will better elucidate the important risk factors leading to maternal death.

Through the implementation of the JMMSR system, the MDRs relied on the information collected through verbal autopsies, healthcare provider interviews, and medical record reviews. The lack of documentation in medical records related to risk factors and exact timings of deaths prevented the NAG from defining and analyzing all risk factors associated with maternal deaths. The inconsistent documentation in medical records related to operative details following surgical interventions, ANC, level of education, and employment status also constituted a challenge for the NAG in presenting a complete analysis of these variables.

Although the women were able to access multiple healthcare providers in the public and private sectors before their deaths, the lack of linkages between these sectors and the inability to exchange patients' information about ANC resulted in inadequate data related to the ANC services provided to the deceased women. Moreover, it was difficult for the NAG to comment on the quality of ANC provided.

The lack of sufficient data, especially from medical files, was behind the inability of the NAG to assign a cause of death for three cases.

MATERNAL MORTALITY RESPONSE

Understanding the causes of maternal deaths is critically important for developing interventions that avert maternal mortality. Maternal deaths occur due to complications during pregnancy, childbirth, and the postpartum period. Most of these complications develop during pregnancy, while others may exist before pregnancy but become aggravated by the pregnancy. All women need access to high-quality care provided by competent, skilled healthcare professionals during pregnancy, childbirth, and the postpartum period since most of the maternal mortality could be prevented. Therefore, the MOH, with support from USAID and other stakeholders, will continue to lead efforts and influence change across all levels of Jordan's health sector through robust, practical, and evidence-based recommendations to be implemented jointly with relevant stakeholders, aiming to achieve the goal of eliminating preventable maternal mortality in Jordan. The structured response to avert future deaths started functioning satisfactorily in 2023, and the preliminary results of maternal mortality in 2023 seem promising.

The interventions formulated are intended for national implementation encompassing all health sectors and involving a wide array of national and international stakeholders dedicated to enhancing reproductive and maternal health in Jordan. This collaborative effort underscores our collective commitment to improving healthcare outcomes for mothers across the nation. It will include interventions to enhance the JMMSR IS's operation and strengthen the capacities of all DAGs to take the lead in implementing and monitoring the response action plan at their respective health facilities. Building capacity will empower DAGs to assist in further averting maternal deaths and to improve maternal health outcomes in Jordan. Furthermore, the MOH Maternal Mortality Registry Unit will play a crucial role in overseeing and evaluating system implementation, encompassing both surveillance and response components.

Based on the cumulative maternal mortality data for the years 2018-2022, the NAG members, proposed the strategies discussed in the next section, aiming to enhance maternal clinical practices' activities. These strategies apply across the continuum of healthcare and throughout the pregnancy, childbirth, and postnatal periods, even during preconception.

ENHANCING THE ONGOING ACTIVITIES OF MATERNAL CLINICAL PRACTICES

- **Mobile regional rapid response team**: The 2021 maternal mortality report for Jordan recommended establishing a mobile rapid response team at the regional level as a strategic initiative to enhance maternal care. This recommendation aimed to mobilize a regional response team rather than transferring patients from peripheral facilities to referral hospitals. Consequently, the MOH Hospital Technical Affairs Administration formed three regional multisectoral and multidisciplinary teams located in the north, center, and south regions of Jordan. These teams, each led by a senior obstetrics specialist, were called upon more than 15 times over the past year and have proven to be effective in managing complex cases and providing critical care to pregnant or postpartum women in need. Further work needs to be done to document the efficacy of the response teams and the outcomes of these interventions.
- **Monitoring and evaluation**: To improve the timeliness, quality, and completeness of information and ensure the functionality of the major steps of the JMMSR system, a monitoring and evaluation logical framework was developed and used to monitor progress and to evaluate the main system functions. The JMMSR system is monitored primarily at the national level; the MOH/NCDD monitors a cluster of indicators that were carefully selected and updated for this purpose. The JMMSR system's monitoring and evaluation is done for all system steps and functions, with particular attention given to the accuracy and timeliness of notifying, identifying, and reviewing all maternal death cases.
- **Blood bank establishment**: The Technical Affairs Administration of MOH Hospitals formally requested assistance from the USAID Activity to establish a mini blood bank at Al Bashir Hospital. The administration emphasized the urgency of addressing maternal mortality by implementing strategies to prevent avoidable deaths, particularly in response to postpartum hemorrhage, which has been identified as the leading cause of death over the past five years. Consequently, the establishment of a comprehensive blood bank accessible to all Jordanians was strongly recommended.
- **Maternal death review (MDR) at the health facility level**: A comprehensive plan for a new system of MDR is underway, starting with the enhancement of 22 hospitals across Jordan. Each hospital will establish an internal multidisciplinary team comprising obstetricians, midwives/nurses, and quality coordinators. The MOH, in collaboration with the USAID Activity, will build the capacity of these teams. Within one week of a maternal death occurrence, these teams will convene to analyze the primary causes and contributing factors, devising actionable strategies to prevent future avoidable deaths. This initiative aims to ensure swift and effective responses to maternal mortality, fostering a culture of continuous improvement in maternal healthcare delivery.
- **EmONC Assessment**: Jordan conducted the first ever comprehensive Emergency Obstetric and Newborn Care (EmONC) assessment in August 2022 with support from the UNFPA and HCAC. The primary objective of the assessment was to generate evidence on the current availability, utilization, and quality of EmONC services in the country. The assessment provides insightful information on the availability of infrastructure, equipment,

essential drugs, and supplies; the range of practices related to user fees; availability and current EmONC practices of human resources; quality of care and documentation of use of partographs, caesarean deliveries, maternal and newborn morbidities; geographic availability of critical services; status of routine and emergency obstetric and newborn services; availability and use of records for Maternal and newborn health (MNH) services; and the referral system.

- **Enhanced preconception care**: The MOH has begun to implement a comprehensive package of preconception interventions in collaboration with the USAID Activity. These interventions are designed to focus on the health and well-being of women and couples before they conceive, aiming to improve pregnancy and child health outcomes by proactively addressing potential risks and promoting healthy behaviors in the preconception period. Key components of this package include health screenings, counseling on lifestyle factors, and the management of the pre-existing health conditions of women of reproductive age.
- **Screening for high-risk pregnancies**: The MOH led the efforts to modify the High-Risk Screening Pregnancy Assessment tool in primary healthcare centers across the country (Coopland scoring) with the support of the USAID Activity. Using it as a simple, cost-effective scoring system for high-risk pregnancies enables healthcare providers to identify potential high-risk pregnancies. This identification triggers referral to a higher level of care and allows for the implementation of corrective measures to prevent or minimize complications.
- **Improved delivery of family planning services**: The MOH, with the support of the USAID Activity, continues to enhance the skills of healthcare providers in family planning by providing training on the insertion and removal of intrauterine contraceptive devices and Implanon. This training aims to increase the availability and accessibility of quality family planning methods.
- **Support for vaginal births and reductions in unnecessary primary cesarean section deliveries**: The MOH, in collaboration with the USAID Activity and the Multisectoral Oversight Committee to Reduce Unnecessary Primary Cesarean Section Deliveries, has updated the "National Guidelines to Support Vaginal Births and Reduce Unnecessary Primary Cesarean Section (CS) Deliveries in Jordan." Additionally, continuous training workshops will be conducted to build the capacity of healthcare providers on these updated guidelines.
- **Adoption of the WHO Safe Childbirth Checklist**: The MOH, with the support of USAID Activity, aims to enhance safe childbirth practices by advocating for the adoption and implementation of the WHO Safe Childbirth Checklist in 20 public hospitals, including the Active Management of the Third Stage of Labor (AMTSL). The checklist addresses the major causes of maternal death (hemorrhage, infection, obstructed labor, and hypertensive disorders) and intrapartum-related stillbirths (inadequate intrapartum care). This is being carried out with the support of USAID Activity.

- **Postpartum hemorrhage**: In collaboration with the JMMSR NAG and related partners, including the USAID Activity, adopted a Comprehensive-Focused Postpartum Hemorrhage Response Plan guided by the 4R principles: readiness, recognition, response, and reporting. This model will be tested and applied at the national level as part of JMMSR's response plan. The USAID Activity will develop a facility-based toolkit comprising tools, checklists, pathways, and flowcharts covering the 4R components, along with a training package for service providers to enhance their preparedness in dealing with postpartum hemorrhage. Additionally, the USAID Activity will work with selected hospitals to identify challenges related to the management of postpartum hemorrhage and advocate for having the necessary equipment, such as balloon tamponade, non-pneumatic antishock garments, and new drugs like tranexamic acid.
- **Advanced Life Support in Obstetrics (ALSO)**: The USAID Activity supported established labs to certify a growing number of obstetricians as ALSO providers, enhancing the pool of skilled professionals equipped to handle critical situations during childbirth and to respond promptly and efficiently to obstetric emergencies, thereby lowering the risk of maternal deaths. The USAID Activity will collaborate with the MOH and stakeholders to make ALSO training a prerequisite for Obstetrics and Gynecology board exams.
- **Forensic medicine capacity-building program**: The USAID Activity team will provide assistance to the MOH forensic medicine departments by enhancing the skills of forensic physicians in Jordan regarding maternal and neonatal death autopsies. This will include conducting theoretical and clinical sessions for obstetrics -gynecology physicians and forensic medicine specialists. The program will prioritize training on the primary causes of maternal deaths identified in the preceding five years' reports, ensuring targeted capacity development.

RECOMMENDATIONS

- **Establish Oversight Teams:** Create dedicated oversight teams within the maternal and perinatal units at all Ministry of Health directorates. These teams will ensure targeted monitoring and evaluation at the directorate level and facilitate comprehensive reporting to the central level, enhancing the implementation of the JMMSR system.
- **Revise and Enhance JMMSR Guidelines:** Update and improve the JMMSR System Guidelines and Bylaws to bolster their enforcement and support robust maternal death reviews at health facilities through the establishment of maternal death audit committees at the hospital level.
- **Ongoing Capacity Building:** Implement continuous training programs for all maternal health providers on the latest obstetric care practices, including the management of complications.
- **Simulation-Based Training:** Advocate for the implementation of simulation-based training in maternal and neonatal emergencies for all healthcare workers to improve preparedness and response skills.
- **Promote Community Education:** Encourage initiatives that educate communities about maternal health risks and the significance of early pregnancy registration and consistent antenatal visits. Recommend programs to increase awareness of the signs of pregnancy complications and the necessity of seeking timely medical care.
- **Address Social Determinants:** Focus on key social determinants like education, housing, and nutrition that influence maternal outcomes. Propose partnerships with local organizations to support social programs targeting these areas.
- **Monitor and Evaluate Interventions:** Establish a task force to monitor the effectiveness of implemented interventions and responses and suggest modifications based on observed outcomes.

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ملخص تنفيذي

لقد حقق الأردن خلال العقدين الماضيين تقدماً ملموساً في تحسين المخرجات الصحية للأمومة الآمنة وصحة المرأة والطفل. وقد أدرك الأردن مدى تأثير وفيات الأمهات على الصحة العامة وبدأ بتطوير وتطبيق مجموعة من السياسات المبنية على أدلة وبرامج ومداخلات تهدف إلى التقليل من وفيات الأمهات وتمكين الحكومة الأردنية من تحقيق أهدافها المتعلقة بالتنمية المستدامة. وكان إنشاء النظام الوطني للرصد والاستجابة لوفيات الأمهات أهم هذه البرامج حيث يتم رصد جميع وفيات النساء في سن الإنجاب فور حدوثها وحصر وفيات الأمهات في المملكة، وتحديد أسبابها، والاستجابة المناسبة لها لمنع حدوث حالات وفاة مشابهة. وقد تم إنشاء هذا النظام بعد تعديل قانون الصحة العامة الذي يفرض تشكيل النظام الوطني للرصد والاستجابة لوفيات الأمهات ويلزم جميع القطاعات الصحية بالتبليغ عن كل حالة وفاة للنساء في سن الإنجاب.

لقد دأبت وزارة الصحة ومنذ إطلاق النظام الوطني للرصد والاستجابة لوفيات الأمهات عام 2018 وبالتعاون مع جميع الشركاء في القطاع الصحي العام والخاص على التأكد من تطبيق هذا النظام في جميع أنحاء المملكة بما في ذلك الاستجابة لمخرجات هذا النظام بما يضمن عدم حدوث وفيات الأمهات التي من الممكن تجنبها. وفي هذا السياق عملت الوزارة على رفع كفاءة العاملين على النظام على مستوى الوزارة المركزي وعلى مستوى مديريات الشؤون الصحية في المحافظات بهدف تحسين نوعية البيانات المجموعة وتحليلها.

ويعتبر هذا التقرير لوفيات الأمهات عن عام 2022 خامس تقرير سنوي على التوالي. اعتماداً على بيانات نظام المعلومات الإلكتروني للنظام الوطني للرصد والاستجابة لوفيات الأمهات، يوفر هذا التقرير معلومات مفصلة عن كل حالة وفاة أمهات حدثت في الفترة من بداية كانون الثاني وحتى نهاية كانون الأول من عام 2022، مما يساهم في دعم النظام الصحي في الأردن بهدف التخلص من وفيات الأمهات التي من الممكن تجنبها وبالتالي تحسين مخرجات صحة الأم. وقد مرت بيانات نظام المعلومات الإلكتروني للنظام الوطني للرصد والاستجابة لوفيات الأمهات بمراحل تدقيق مختلفة وعلى أكثر من مستوى من قبل فرق متعددة التخصصات.

لقد تم التبليغ عن 1,425 وفاة لنساء في سن الإنجاب خلال عام 2022، كان منها 60 وفاة أمهات، في حين بلغ إجمالي عدد المواليد الأحياء 181,991 خلال الفترة نفسها وعليه يكون معدل وفيات الأمهات في الأردن **33 لكل 100,000 مولود حي**. وهذا المعدل كان 2.6 مرة أقل من معدل وفيات الأمهات في عام 2021، وذلك يعود بالدرجة الأولى إلى انخفاض عدد حالات الوفيات الناجمة عن مرض كورونا من 109 في 2021 ليصل إلى تسع حالات فقط في عام 2022.

من أصل 60 وفاة للأمهات، كان هناك 9 وفيات ناجمة عن الإصابة بمرض كوفيد-19 و51 وفاة ناجمة عن أمراض أخرى وعليه فإن معدل وفيات الأمهات غير الناجمة عن مرض كورونا كانت **28 وفاة لكل 100,000 مولود** حي. ويعتبر معدل وفيات الأمهات هذا هو الأقل منذ عام 2018، ولكن لم يكن هناك اختلاف كبير في معدل الوفيات عن السنوات السابقة بعد استثناء الوفيات الناجمة عن مرض كورونا.

من مجموع 60 حالة وفاة للأمهات، تمكنت اللجنة الوطنية من تحديد السبب الرئيسي للوفاة في 57 حالة، بينما لم يتم تحديد سبب الوفاة لثلاث وفيات نتيجة نقص في البيانات. تم فحص 17 حالة وفاة من

قبل الطب الشرعي أي ما نسبته 28.3% من مجموع الوفيات ولم يتمكن الطب الشرعي من تحديد الوفاة في حالتين.

من ضمن 57 حالة وفاة معروفة السبب، بينت اللجنة الوطنية أن 36 حالة وفاة (63.2%) كان من الممكن تجنب حدوثها. وقد توفيت 31 حالة (51.7%) نتيجة أسباب متعلقة مباشرة بالحمل والولادة، بينما كان هناك 26 حالة وفاة (43.3%) ناجمة عن أسباب غير مباشرة بالإضافة لثلاث حالات غير معروفة السبب.

وتصدرت مضاعفات الولادة الناجمة عن التخثر المرتبط بالولادة، الأسباب المباشرة للوفاة، حيث كانت هناك 12حالة وفاة (20%) من مجموع الوفيات (10 حالات انسداد بالشريان الرئوي وحالتين انسداد بالسائل الأمنيوسي)، تلتها في المركز الثاني أمراض نزف ما بعد الولادة مسجلة 8 حالات (13.4%)، ومن ثم جاءت أمراض ارتفاع ضغط الدم المتعلقة بالحمل (تسمم الحمل) مسجلة خمس وفيات (8.3%)، وأربع وفيات ناجمة عن الإنتانات المتعلقة بالولادة والإجهاض (6.7%) وحالة وفاة واحدة لكل من مضاعفات التخدير وجلطة دماغية وريدية.

أما بالنسبة لوفيات الأمهات غير المباشرة فقد تصدرت أمراض الجهاز التنفسي أسباب الوفاة بعشر إصابات (16.7%) حيث كانت تسع وفيات ناجمة عن الإصابة بكوفيد-19 ووفاة واحدة ناجمة عن ذات الرئة. وقد احتلت أمراض الجهاز الهضمي المركز الثاني (4 حالات) والجهاز العصبي المركز الثالث لقائمة الأسباب غير المباشرة للوفاة بثلاث حالات وفاة. وقد تلتها أمراض الجهاز الدوراني، والأورام السرطانية وأمراض الجهاز المناعي والأنسجة الرابطة بواقع حالتي وفاة لكل مجموعة. وقد سجلت حالة وفاة واحدة لكل من المتلازمة الكلوية، والصدمة التحسسية وصدمة الإنتان.

لقد قامت اللجنة الوطنية بتحديد العوامل المساهمة التي أدت إلى وفيات الأمهات من خلال مراجعة تقارير حالات وفيات الأمهات وملخصات هذه الحالات. تم عرض العوامل المساهمة للوفيات الأكثر شيوعاً باستخدام نموذج التأخيرات الثلاثة والتي تضم التأخر في طلب الرعاية الصحية والتأخر في الوصول إلى الرعاية الصحية والتأخر المتعلق بتلقي الرعاية الصحية الملائمة. حيث تبين أن التأخر الثالث المتعلق بتلقي الرعاية، ساهم في (33.3%) من حالات وفيات الأمهات معروفة السبب، واعتبرت جميع وفيات النزف المتعلقة بالولادة الثمانية ومعظم الوفيات الناجمة عن تسمم الحمل بسبب التأخر بتقديم الرعاية الطبية. بينما تبين أن التأخر في طلب الرعاية الصحية (التأخر الأول) قد ساهم في (19.3%) من وفيات الأمهات، ولم يكن هناك تأخير في (36.8%) من الوفيات معروفة السبب.

لقد بينت نتائج وفيات الأمهات الواردة في هذا التقرير الإشكاليات المتعلقة بوفيات الأمهات، وكذلك العوامل الاجتماعية والصحية التي تساهم في حدوث هذه الوفيات. بالرغم من أن مراجعة تقارير وفيات الأمهات عملية معقدة وتتطلب كثيراً من الجهد والوقت، إلا أن التعرف على أسباب وفيات الأمهات والعوامل المساهمة في حدوثها لا يمكن أن يتم بطريقة علمية وشاملة إلا من خلال رصد ودراسة وفيات الأمهات بالطريقة المعمول بها حالياً. ويعتبر تحسين وتطوير النظام الوطني للرصد والاستجابة لوفيات الأمهات والاستمرار في تطوير مفهومنا لأسباب وفيات الأمهات والعوامل المساهمة في حدوثها حجر الأساس في التخلص من وفيات الأمهات التي من الممكن تجنبها. ويعتبر الالتزام الرسمي بتخفيض وفيات الأمهات من أهم العوامل لديمومة وتحسين النظام الوطني للرصد والاستجابة لوفيات الأمهات. وعلينا استخلاص الدروس من عمل النظام في عامه الخامس مع التأكيد على ضرورة تحسين صحة الأم على جميع مستويات الرعاية والعمل الجماعي لتقديم رعاية صحية عالية الجودة للأم الحامل في كل من القطاعيين العام والخاص.