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Maternal Death Review Through the Maternal Perinatal Death Notification Surveillance System: An Aggregate Analysis at Universitas Airlangga Hospital, Surabaya, East Java, Indonesia

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ABSTRACT

Background: Maternal mortality remains a major concern in Indonesia, particularly in referral hospitals that manage high-risk pregnancies. This study aimed to examine maternal deaths and assess contributory factors at Universitas Airlangga Hospital in 2024 using the maternal perinatal death notification (MPDN) system.
Subjects and Method: A retrospective-descriptive study was conducted, including all maternal deaths recorded from January to December 2024. Quantitative data were analyzed descriptively, and factors contributing to maternal mortality were classified using the Three Delays Model. A mixed method with multidisciplinary hospital staff provided qualitative insights into clinical and institutional gaps.
Results: A total of 11 maternal deaths occurred during the study period, resulting in an MMR of 557 per 100,000 live births. Most deaths occurred in women over 35 years (81.8%) and during the third trimester (81.8%). Non-obstetric complications were the leading cause (40%), followed by pregnancy-related infections (20%) and hypertensive disorders (10%). First, delay factors, particularly socio-cultural barriers, were present in 36.4% of cases, while third, delay factors, including delayed diagnosis and treatment, were identified in 45.5%. FGDs highlighted gaps in emergency preparedness, blood availability, and interprofessional communication.
Conclusion: These findings highlight the combined role of clinical complexity and systemic delays, emphasizing the need to strengthen referral readiness, rapid multidisciplinary response, and decision-making to reduce preventable maternal deaths.

Keywords: maternal death, referral hospital, maternal perinatal death notification, EmOC

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BACKGROUND

Maternal mortality remains a significant public health challenge in Indonesia, particularly in East Java, where socio-economic disparities and healthcare system inefficiencies contribute to persistently high maternal mortality rates. Despite national efforts, Indonesia's Maternal Mortality Ratio (MMR) remains at 305 per 100,000 live births far from the Sustainable Development Goals (SDGs) target of 70 per 100,000 by 2030 (Suparji et al., 2024). While antenatal care coverage has expanded, persistent gaps in emergency obstetric services, skilled birth attendance, and referral systems continue to hinder maternal health outcomes, especially in rural and underserved areas (Cameron, Contreras Suarez and Cornwell, 2019; Mahmood et al., 2021). Socio-economic barriers, including education and income disparities, further limit access to timely and adequate care despite the National Health Insurance program (Rosidah et al., 2023).

Universitas Airlangga Hospital is a Class B general hospital and a model academic hospital in Indonesia. As a secondary referral center and academic institution, it plays a strategic role in delivering comprehensive maternal health services and serves as a pilot site for the implementation of national health programs, including maternal death surveillance and response. Its dual function as a service and educational facility positions it uniquely to implement and evaluate evidence-based strategies such as the MPDN system within a tertiary referral setting.

Despite the establishment of surveillance systems such as the Maternal Perinatal Death Surveillance and Response (MPDSR) framework, significant challenges persist in translating maternal mortality data into effective health policies and interventions. One of the primary obstacles is the underreporting of maternal deaths, which undermines the accuracy of national statistics and limits the effectiveness of maternal health programs (Qomariyah et al., 2020). In many cases, healthcare facilities struggle with inconsistent reporting due to inadequate training, lack of awareness, and systemic inefficiencies in data collection mechanisms (Abouchadi, Zhang and De Brouwere, 2018). Within this context, Maternal Death Review (MDR) is implemented at Universitas Airlangga Hospital as part of the Maternal Perinatal Death Notification (MPDN) framework to systematically identify medical and non-medical causes of death, contributing delay factors, and opportunities for institutional improvement.

Previous studies on maternal deaths in Indonesia have largely been limited to descriptive analyses of mortality trends and clinical causes, often without comprehensive integration of system level delay factors or institutional responses. A recent systematic review on maternal mortality trends in Indonesia showed that most published work focused on MMR and causes of death at the population or regional level, with limited analysis of care processes within facility settings (Syairaji et al., 2024). Retrospective case series from multiple hospitals also primarily addressed clinical factors associated with death rather than linking delay factors and institutional actions (Baharuddin et al., 2019). Additionally, studies applying the Three Delays Model in tertiary referral hospitals have described delay contributions but did not incorporate

MPDN-based surveillance data for quality improvement or governance insights (Indarti et al., 2021). This gap limits the ability of maternal death surveillance systems to inform clinical decision-making, service quality improvement, and hospital governance in a comprehensive and actionable manner.

However, limited evidence exists on how MPDN-based maternal death reviews translate into actionable institutional responses in tertiary hospitals in Indonesia. Therefore, this study aims to conduct an aggregate analysis of maternal deaths reported through the MPDN-based (MDR) at Universitas Airlangga Hospital, Surabaya City, Indonesia. It focuses on identifying medical and non-medical causes, along with contributing factors, evaluating the implementation of the MDR process, and assessing the institutional response to maternal mortality cases. By bridging surveillance and intervention, this study contributes to improving clinical governance and informing strategies for reducing preventable maternal deaths in tertiary hospital settings.

SUBJECTS AND METHOD

1. Study Design

This study employed a retrospective descriptive mixed-methods design using an aggregate analysis approach within the MPDN-based MDR framework at Universitas Airlangga Hospital. The design was selected to systematically describe maternal death characteristics, causes, and contributing factors, while evaluating institutional processes without aiming to establish causal relationships. Quantitative data from MPDN records (2021–2024) were analyzed descriptively, with a nested in-depth analysis of 2024 cases to explore clinical and system-level factors using the Three Delays Model. Qualitative data from focus group discussions (FGDs) were integrated to provide contextual insights into institutional responses. This facility-based design supports quality improvement but has limited generalizability and is subject to inherent limitations of retrospective data, including incomplete records and potential misclassification.

2. Population and Sample

The target population comprised maternal deaths occurring in tertiary referral settings, with this study specifically focusing on cases from Universitas Airlangga Hospital. The source population included all maternal deaths recorded in the MPDN system and hospital medical records between January 2021 and December 2024. A total sampling approach was applied, including all identified cases (n=38), with each maternal death serving as the unit of analysis.

Inclusion criteria were all confirmed maternal deaths documented within the study period. No formal exclusion criteria were applied; however, cases with incomplete data were retained and reported descriptively. A focused sub-analysis was conducted on cases from 2024 (n=11) due to the availability of complete MDR data for detailed evaluation of contributing factors using the Three Delays Model.

As a retrospective facility-based study, the findings are subject to limitations including potential underreporting and incomplete documentation, which may affect data completeness and accuracy.

3. Study Variables

Variables in this study are pregnancy-related characteristics of maternal deaths, obstetric causes of death, and contributing factors to maternal deaths. The pregnancy-related characteristics of maternal deaths described by patient demographics, pregnancy history, clinical status, referral pathway, type of delivery, duration of hospital stay, location of death within the hospital, and pre-existing health conditions. The review

encompassed classifications of primary causes of death, organized into standard MPDN categories, including obstetric hemorrhage, hypertensive disorders, infections, abortive outcomes, and non-obstetric complications. Furthermore, contributing factors were identified and classified according to the three-delay model, which includes: (1) Delay in healthcare utilization (2) Delay in reaching a health facility, and (3) Delay in receiving appropriate treatment at the facility. Analyses of contributing factors using the Three Delays Model and qualitative synthesis were conducted with a focused analytic scope on maternal death cases in 2024 to allow a more detailed examination of service delivery processes and institutional responses.

4. Operational Definition of Variables

Maternal deaths defined as cases of maternal deaths reported through the Maternal Perinatal Death Notification (MPDN) system at Universitas Airlangga Hospital between January – December 2024.

Pregnancy-related characteristics of maternal deaths defined as individual and care-related attributes of deceased maternal cases, operationalized through recorded patient demographics (age), pregnancy history (parity, gestational age), clinical status at admission, referral status (referred from primary health center, governmental hospital, private hospital), gestateonal time of death, delivery method (abortive outcome, vaginal, sectio caesarea), length of hospital stay, location of death within the hospital (obstetric ward, HCU, ICU), and documented pre-existing medical conditions before pregnancy.

Obstetric causes of maternal deaths defined as the primary medical conditions directly or indirectly responsible for maternal death, classified according to standard MPDN categories, including obstetric hemorrhage, hypertensive disorders of pregnancy, pregnancy-related infections, abortive outcomes, and non-obstetric complications occurring during pregnancy, childbirth, and the postpartum period.

Contributing factors to maternal deaths defined as contextual and health-system–related conditions that contributed to the occurrence of maternal death, operationalized using the three-delay model: (1) delay in healthcare utilization, encompassing socio-cultural, geographic, and financial barriers to seeking care; (2) delay in reaching a health facility, including transportation challenges and referral-related delays; and (3) delay in receiving appropriate care at the facility, including limitations in human resources, delayed diagnosis, inadequate clinical management, insufficient equipment and supplies.

5. Study Instrument

Data about maternal deaths and its factors were obtained from MPDN documentation and institutional records, these includes pregnancy-related characteristics of maternal deaths, obstetric causes of death, and contributing factors to maternal deaths. Supporting qualitative data were collected using Focus Group Discussions (FGDs). Each focus group discussion included 6 to 8 participants and was conducted using a semi-structured guide. The focus group discussions were held in private settings utilizing a semi-structured guide to examine perspectives on contributing factors and case management. All sessions were audio-recorded with the consent of participants and subsequently transcribed for analysis.

6. Data Analysis

Quantitative data from MPDN records and hospital medical records were analyzed using SPSS version 27. Descriptive statistics were used to summarize all variables, presented as frequencies and percentages. Continuous variables, where applicable,

were summarized using median and range. Inferential statistical analysis was not performed due to the small sample size and the descriptive objective of the study.

The Maternal Mortality Ratio (MMR) was calculated as the number of maternal deaths per 100,000 live births within the hospital during 2024, representing a facility-based estimate. Causes of death and contributing factors were classified according to MPDN standards and the Three Delays Model, with the most dominant delay assigned to each case.

Cases with missing data were retained in the analysis, and the proportion of missing values was reported descriptively without imputation. Qualitative data from FGDs were analyzed using a structured framework-guided approach aligned with the MPDN-based MDR process. An explanatory sequential mixed-method approach was applied, where qualitative findings were used to contextualize and interpret quantitative results.

7. Research Ethics

This study adhered to national guidelines for maternal death review and to ethical standards for research involving human subjects. Ethical approval for the study was obtained from the Health Research Ethics Committee of Universitas Airlangga Hospital (Approval No: 157/KEP/2025). The principles of confidentiality, voluntary participation, and a non-blaming culture were upheld throughout the data collection and analysis process. All MPDN forms and hospital records were anonymized before use. FGD participants received full information about the study and provided written informed consent before participation. Discussions were conducted in a respectful and non-judgmental environment, ensuring that all contributions were treated confidentially and no individuals were identified in reporting the results.

RESULTS

(Figure 1) shows the annual pattern of maternal deaths at Universitas Airlangga Hospital between 2021 and 2024. The number of maternal deaths decreased sharply from 18 cases in 2021 to 3 cases in 2022, before increasing to 6 cases in 2023 and rising further to 11 cases in 2024. While the annual counts fluctuated, the overall pattern indicates an increase in maternal deaths over the past three years, providing context for the more detailed monthly distribution observed in 2024.

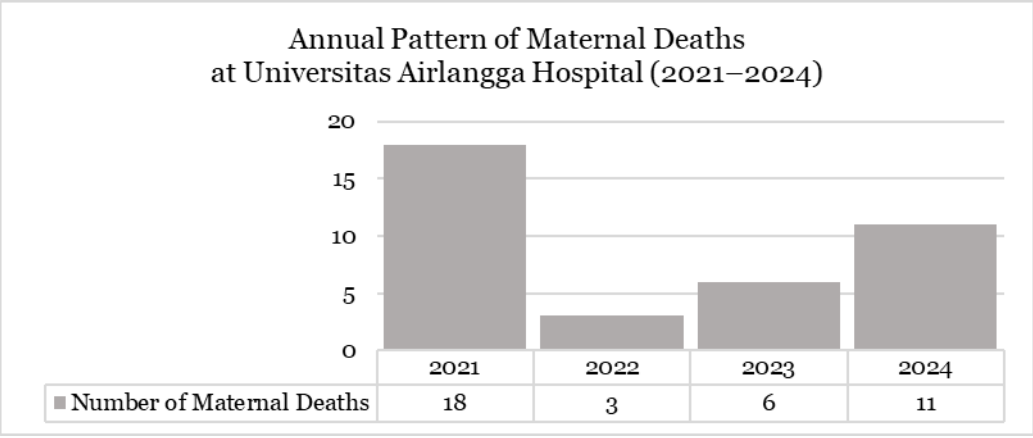

Figure 1. Annual Pattern of Maternal Deaths 2021-2024

During the period from January to December 2024, a total of 11 maternal deaths were recorded at Universitas Airlangga Hospital (Figure 2). Based on hospital statistics, there were 1,975 live births within the same timeframe, resulting in a Maternal Mortality Ratio (MMR) of 557 per 100,000 live births.

Basic characteristics of maternal death cases from 2021 to 2024 are presented in (Table 1) based on variables that were consistently available across all study years, namely maternal age group and parity. When aggregated across the four years, most maternal deaths occurred among women aged 20–35 years (57.9%), corresponding to the reproductive age group, and among multigravida women. This overall pattern reflects the distribution of cases across years and differs from the age profile observed when maternal deaths in 2024 were analyzed separately.

Table 1. Basic Characteristics of Maternal Deaths at Universitas Airlangga Hospital by Year (2021–2024)

Variables	Category	Frequency	Percentage
Age	20 – 35 years old	22	57.9 %
	>35 years old	16	42.1 %
Parity	Primigravida	12	31.6 %
	Multigravida	24	63.2 %
	Grande Multigravida	2	5.3 %

More comprehensive characterization of maternal death cases occurring in 2024 is presented in (Table 2), including maternal age and parity alongside clinical and health system variables that were not consistently available in earlier years. During the period from January to December 2024, a total of 11 maternal deaths were reported at Universitas Airlangga Hospital. In terms of maternal age, the majority of women who died were in the high-risk age category, with 81.8% aged over 35 years. Regarding parity, me than half (54.5%) of the women were multigravida, followed by primigravida (36.4%) and grande multigravida (9.1%), indicating that both first-time mothers and those with multiple previous pregnancies are vulnerable to complications that may result in death.

Table 2. Clinical and Health System Characteristics of Maternal Deaths at Universitas Airlangga Hospital (January – December 2024)

Variables	Category	Frequency	Percentage
Age	20 – 35 years old	2	18.2 %
	>35 years old	9	81.8 %
Parity	Primigravida	4	36.4%
	Multigravida	6	54.5 %
	Grande Multigravida	1	9.1 %
Referral Status	Referred from Primary Health Center (Puskesmas)	6	54.5 %
	Referred from Governmental Hospital	1	9.1 %
	Referred from Private Hospital	4	36.4 %
Gestational Time of Death	Antenatal	4	36.4 %
	Postnatal	7	63.6 %

Variables	Category	Frequency	Percentage
Delivery Method	Abortive Outcome	4	36.4 %
	Vaginal	3	27.2 %
	Sectio Caesaria	4	36.4 %
Duration of Stay in Hospital	<24 hours	2	18.2 %
	24 – 48 hours	6	54.5 %
	3 – 7 days	3	27.3 %
Place of Death	Obstetric Ward	1	9.1 %
	HCU	1	9.1 %
	ICU	9	81.8 %
Health Status Before Pregnancy	Anemia	3	27.2 %
	Hearth Disease	5	45.4 %
	Respiratory Disease	1	9.1 %
	HIV, Syphilis, Hepatitis B	1	9.1 %
	Unidentified	1	9.1 %

In terms of hospital stay before death, more than half (54.5%) of maternal deaths occurred within 24–48 hours of admission, suggesting that many patients arrived already critically ill. A smaller portion died within the first 24 hours (18.2%), and the remaining (27.3%) passed away between 3–7 days after admission. Notably, 81.8% of deaths occurred in the Intensive Care Unit (ICU), indicating the severity of complications and the advanced level of care required. Only one death occurred in the High Care Unit (HCU) and another in the obstetric ward. Assessment of maternal health status before pregnancy revealed that 45.5% of the women had a documented history of heart disease, while 27.2% had anemia. Other conditions included respiratory disease (9.1%), HIV/syphilis/hepatitis B (9.1%), and unidentified prior health status (9.1%). These findings reflect the increasing role of indirect causes and chronic health conditions in contributing to maternal mortality, even in tertiary-level care settings. The medical causes of maternal deaths in 2021-2024 are presented in Table 3. The leading cause was non-obstetric complications (65.8%), which included chronic cardiovascular and pulmonary diseases.

Table 3. Obstetric Causes of Maternal Deaths at Universitas Airlangga Hospital, Surabaya City 2021-2024

Variables	Frequency	Percentage
Pregnancy with Abortive Outcome	1	2.6 %
Hypertensive Disorders in Pregnancy, Childbirth, and Puerperium	3	7.9 %
Obstetric Haemorrhage	4	10.5 %
Pregnancy-Related Infection	4	10.5 %
Other Obstetric Complications	1	2.6 %
Non-Obstetric Complication	25	65.8 %

Obstetric hemorrhage and pregnancy-related infections were the second most common cause, contributing to 10.5% of cases. These included sepsis and other systemic infections that progressed rapidly and were not adequately controlled. Other direct obstetric causes were each responsible for three cases (7.9%), including hypertensive disorders of pregnancy, childbirth, and puerperium, and each responsible for

one case (2.6%), including pregnancy with abortive outcome, and other obstetric complications. The presence of both direct and indirect causes in equal proportion reflects the dual burden faced by clinicians managing high-risk pregnancies in referral centers. A summary of contributing factors based on the Three Delays Model is presented in Table 4. This summary was restricted to maternal death cases occurring in 2024, as complete MPDN-based maternal death review data required for delay classification were consistently available only for this year.

Table 4. Three Delay Factors to Maternal Deaths at Universitas Airlangga Hospital (January – December 2024)

Category based on Three Delay Model	Variables	Frequency	Percentage
Delay in Healthcare Utilization	Socioeconomic and Cultural Barriers	4	36.4 %
	Perceived Inaccessibility of Healthcare Services	1	9.1 %
	Concerns About Quality of Care	0	0 %
Delay in Accessing Healthcare Facilities	Inadequate Distribution and Location of Health Facilities	0	0 %
	Long Distance to Healthcare Facilities	0	0 %
	Transportation Challenges	0	0 %
	Financial Barriers to Accessing Care	0	0 %
Delay in Treatment Provision	Insufficient Skilled Healthcare Workforce	2	18.2 %
	Inadequate Medical Equipment and Supplies	0	0 %
	Limited Accessibility to Healthcare Facilities	0	0 %
	Non-Compliance with Operational Standards	0	0 %
	Delayed Diagnosis and Treatment	3	27.3 %
	Unidentified	1	9.1 %

Empirically, each maternal death case exhibited factors corresponding to only one delay domain, with no overlap across domains. The first delay delayed decision to seek care was present in 45.5% of cases. The most common fact within this category was socioeconomic and cultural barriers (36.4%), such as delayed recognition of danger signs, reliance on traditional care, and family indecision. One case (9.1%) reported perceived inaccessibility of health services, which could reflect cost concerns, prior negative experiences, geographic perceptions despite urban proximity. There were no maternal deaths attributed to the second delay, which involves challenges in reaching a health facility. The third delay delay in receiving adequate care upon arrival at the health facility was documented in several cases. The most commonly cited issues were delayed diagnosis and treatment (27.3%), often due to late clinical recognition and inefficient triage. Insufficient availability of skilled healthcare personnel was a fact in 18.2% of deaths, suggesting possible gaps in staffing capacity to manage complex emergencies. One case (9.1%) was attributed to incomplete data, undocumented institutional factors, limiting the ability to fully evaluate the cause.

To complement and contextualize the MPDN-based quantitative findings, an FGD

was conducted with multidisciplinary healthcare professionals involved in maternal care and death reviews at Universitas Airlangga Hospital, including obstetricians, anesthesiologists, general practitioners, internal medicine specialists, and hospital management. Participants reported that most patients arrived in critical condition, often already in irreversible shock due to inadequate pre-referral stabilization. They emphasized that early management, including appropriate fluid resuscitation, was frequently delayed or insufficient before referral, limiting the effectiveness of otherwise timely in hospital interventions.

Table 5. Thematic Summary and Recommendation of Focus Group Discussion Findings on Maternal Death Review at Universitas Airlangga Hospital

Thematic Area	Key Findings	Recommendations
Critical Patient Condition	Most patients arrived in irreversible shock with minimal prior stabilization	Improve stabilization protocols at referring facilities
Fluid & Blood Management	Crystalloid-only resuscitation was inadequate; delays in blood availability were noted	Use colloids early; revise emergency blood release policies
	Difficulty in rapid fluid access	Train GPs and residents in jugular/femoral line insertion
Mechanical Interventions	Aortic compression underutilized	Develop SOPs and simulation training for PPH management
Diagnostic Limitations	Delayed cardiac diagnosis in the emergency unit	Enable bedside echocardiography in Emergency Units
Communication and Interprofessional Collaboration (IPC) Gaps	Indirect coordination between units delayed care	Reinforce direct phone-based clinical communication
Combidity Management	Lack of early referral in high-risk pregnancies	Strengthen antenatal screening and early referral pathways

Another recurring concern was delays in blood product availability, even for urgent (cito) requests, with participants emphasizing that crystalloid fluids alone are insufficient in hemorrhagic shock and that early use of colloids should be standard while awaiting transfusion. Additionally, there was consensus on the need to improve emergency staff and general practitioners' skills in establishing large-bore venous access to enhance the speed and effectiveness of resuscitation.

DISCUSSION

This study provides a facility-based overview of maternal deaths at Universitas Airlangga Hospital, highlighting the interplay between clinical complexity and health system factors. The findings showed that non-obstetric complications were the leading cause of maternal death, with a substantial contribution from delays in seeking care (first delay) and delays in receiving appropriate treatment (third delay). These results underscore the dual burden of indirect medical conditions and systemic inefficiencies in tertiary referral settings.

The predominance of non-obstetric complications reflects an epidemiological shift in maternal mortality patterns, where indirect causes such as cardiovascular and chronic diseases increasingly contribute to

maternal deaths. This finding is consistent with previous studies indicating that advanced maternal age and pre-existing comorbidities are important determinants of maternal outcomes in high-risk referral hospitals. It also suggests that maternal health programs should extend beyond obstetric care to include early detection and management of chronic conditions during pregnancy.

The analysis of contributing factors using the Three Delays Model revealed that delays in healthcare utilization and treatment provision were the most prominent. Socio-cultural barriers and delayed decision-making at the community level contributed to the first delay, while delayed diagnosis and management within the hospital contributed to the third delay. Interestingly, no cases were attributed to delays in reaching healthcare facilities, which may reflect the urban setting and relatively adequate geographical access to referral services. However, this absence should be interpreted cautiously, as classification was based on the dominant delay factor and may not fully capture overlapping delays.

Findings from the FGD further support the quantitative results by illustrating critical gaps in pre-referral stabilization and emergency preparedness. Many patients arrived in severe or irreversible conditions, limiting the effectiveness of in-hospital interventions despite timely response. Delays in blood availability, suboptimal resuscitation practices, and gaps in interprofessional communication were identified as key institutional challenges. These findings highlight the importance of strengthening referral readiness, improving early stabilization at lower-level facilities, and enhancing clinical capacity in emergency obstetric care.

From a health system perspective, this study emphasizes the need to strengthen the integration between maternal death surveillance and quality improvement processes. The MPDN-based MDR system provides valuable insights into modifiable factors, but its impact depends on how findings are translated into actionable interventions. Targeted strategies such as improving referral protocols, ensuring timely access to blood products, and enhancing multidisciplinary coordination are essential to reduce preventable maternal deaths in tertiary care settings.

This study has several limitations. First, as a retrospective single-center study, the findings have limited generalizability beyond similar tertiary referral hospitals. Second, the relatively small sample size, particularly for the 2024 sub-analysis, restricts the ability to explore statistical associations. Third, reliance on MPDN and medical record data may introduce incomplete documentation and misclassification bias. Despite these limitations, the study provides important insights into both clinical and system-level contributors to maternal mortality.

In conclusion, maternal mortality in this setting is shaped by a combination of indirect medical conditions and systemic delays. Strengthening early detection of high-risk pregnancies, improving pre-referral stabilization, and enhancing the responsiveness of hospital-based care are critical steps toward reducing preventable maternal deaths. Future research should focus on evaluating the effectiveness of MDR-driven interventions and exploring strategies to better integrate community, referral, and hospital-level responses.

AUTHOR CONTRIBUTION

All authors contributed substantially to this study and approved the final version of the manuscript. Muhammad Ardian Cahya Laksana conceptualized the study, supervised the research process, and led the

manuscript writing. Nurani Zulfa Zakiya and Nur Sahila contributed to study design, data analysis, and interpretation of findings. Dyah Primaningrum was responsible for data curation and statistical analysis. Asti Alya Rahmahdia and Dinda Zhafira contributed to data collection, field coordination, and manuscript drafting. All authors were involved in critical revision of the manuscript for important intellectual content and have read and approved the final manuscript.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

REFERENCE

Abouchadi S, Zhang W, De Brouwere V, 2018. Underreporting of deaths in the maternal deaths surveillance system in one region of Morocco. PLOS ONE. 13(1): e0188070. Doi: 10.1371/journal-.pone.0188070.

Baharuddin M, Amelia D, Suhowatsky S, Kusuma A, Suhargono MH, Eng B, 2019. Maternal death reviews: A retrospective case series of 90 hospital-based maternal deaths in 11 hospitals in Indonesia. Int. J. Gynecol. Obstet. or Int J Gynaecol Obstet. 144(1): 59–64. Doi: 10.1002/ijgo.-12736.

Cameron L, Contreras Suarez D, Cornwell K 2019. Understanding the determinants of maternal mortality: An observational study using the Indonesian Population Census. PLOS ONE: 14(6): e0217386. Doi: 10.1371/journal.pone.-0217386.

Hoang PA, Nguyen TTH, Nguyen THH, Tran NT, Mai TTH 2024. Barriers to providing maternal health care services in a mountainous area. Sex Reprod Healthc. 41:100998. Doi: 10.1016/j.srhc.2024.100998.

Indarti J, Solihin AV, Suastika A, Wardhani, DP, Ramadhani MT, Afdi QF, Syafitri SM, Ikhsan M, Alda K 2021. Three-Delay Model on Maternal Mortality Cases in Tertiary Referral Hospital in Indonesia (in Indonesia). eJournal Kedokteran Indonesia. 9(2): 99. Doi: 10.23886/ejki.9.60.99.

Mahmood MA, Hendarto H, Laksana MAC, Damayanti HE, Suhargono MH, Pranadyan R, et al. 2021. Health system and quality of care factors contributing to maternal deaths in East Java, Indonesia. PLOS ONE. 16(2): e0247911. Doi: .1371/journal.-pone.0247911.

Maphosa M, Juru TP, Masuka N, Mungati M, Gombe N, Nsubuga P, Tshimanga, M 2019. Evaluation of the Maternal Death Surveillance and Response System in Hwange District, Zimbabwe, 2017. BMC Pregnancy and Childbirth, 19(1). Doi: 10.1186/s12884-019-2255-1.

Mbizvo MT, Say L 2012. Global progress and potentially effective policy responses to reduce maternal mortality. Int J Gynaecol Obstet. 119(S1). Doi: 10.1016-/j.ijgo.2012.03.009.

Qomariyah SN, Sethi R, Izati YN, Rianty T, Latief K, Zazri A, Besral, Bateman M, Pawestri EA, Ahmed S, Achadi EL

2020. No one data source captures all: A nested case-control study of the completeness of maternal death reporting in Banten Province, Indonesia. PLOS ONE. 15(5): e0232080. Doi: 10.1371/journal.pone.0232080.

Rosidah LK, Asdary RN, Komariyah S, Kusumawati W 2023. Determinants of National Health Insurance Membership among Indonesian Women with Live Births (in Indonesia). Jurnal Kebidanan. 12(1): 39–46. Doi: 10.35890/jkdh.v12i1.267.

Souza JP, Day LT, Rezende-Gomes AC, Zhang J, Mori R, Baguiya A, Jayaratne, K, et al., 2024. A global analysis of the determinants of maternal health and transitions in maternal mortality. The Lancet Global Health. 12(2): e306–e316. Doi: 10.1016/s2214-109x(23)00468-0.

Suparji S, Nugroho HSW, Sunarto S, Latif, A, Prayogi AS 2024. Impact, Implications, Challenges of Accelerating Maternal Mortality Rates in Indonesia. Health Dynamics. 1(3): 104–107. Doi: 10.33846/hd10306.

Syairaji M, Nurdiati DS, Wiratama BS, Prüst ZD, Bloemenkamp KWM, Verschueren KJC 2024. Trends and causes of maternal mortality in Indonesia: a systematic review. BMC Pregnancy and Childbirth. 24(1): 515. Doi: 10.1186/s12884-024-06687-6.