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The Surveillance of Emergent Threats to Maternal and Newborn Health in Indonesia: A Scoping Review

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Abstract
Introduction: Indonesian Ministry of Health has emphasized the need to effectively identify and respond to emergent threats (ET) to maternal and newborn health (MNH), including non-communicable and infectious diseases. Improved ET screening, surveillance, and data management will reduce poor MNH outcomes including mortality, stillbirth, prematurity, and low birthweight. This scoping review examines practices of surveillance of ET to MNH, both globally and in Indonesia.
Methods: Fifty-nine articles published between 2011 to 2024, sourced from PubMed and Google Scholar were reviewed. Thirteen articles were included in the final scoping review. The key search terms included "emergent threat surveillance", "maternal and newborn health", "MNH surveillance", "PWS-KIA", and "SatuSehat".
Results: The review identified numerous gaps in MNH surveillance, including a need for comprehensive data sharing between health facility, district, provincial, and national levels. Additionally, midwives reported that the current MNH monitoring system, PWS-KIA (Local Area Monitoring Health of Mother and Child), is time-consuming and confusing, leading to poor data reporting. Finally, due to limited training of health workers, there is a lack of data analyzation at each level, leading to poor response.
Conclusion: An integrated, standardized, and user-friendly system is needed to detect and mitigate emergent threat to maternal and neonatal health. Data analysis and response to adequately identify and reduce emergent threat at each level is critical. Routine training is needed to improve health provider knowledge on data interpretation and use.

Keywords: Emergent Threat, Maternal and Newborn Health, Surveillance, local area monitoring.

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Introduction

As of 2020, Indonesia has a maternal mortality ratio (MMR) of 173 deaths per 100,000 women and a neonatal mortality ratio (NMR) of 11 deaths per 1,000 live deaths.[1] In alignment with SDG targets 3.1 and 3.2, Indonesia still must work to reduce MMR and NMR.[2] It is widely understood

that progress made towards reducing MMR and NMR should be monitored and reported.[1] Without proper investment in surveillance strategies and data collection, we will not achieve SDGs or ensure quality maternal and newborn health (MNH) care in Indonesia.[3] Surveillance and data collection on emergent threats has become prominent in the maternal and newborn health field.[4] After the COVID-19 pandemic, Indonesia's Ministry of Health has emphasized the need to effectively identify and respond to emergent threats (ET) to maternal and newborn health, including non-communicable and infectious diseases. Improved ET screening, surveillance, and data management will reduce poor MNH outcomes including mortality, stillbirth, prematurity, and low birthweight.

Collection and reporting of data during MNH services, including accurate reporting of births, stillbirths, neonatal and maternal deaths, and ANC and PNC visits, is critical to inform policy and improve pregnancy outcomes.[5] Notably, many facilities in Indonesia do not collect and report this data accurately or in a timely manner, leading to poor data-based responses.[6] Therefore, in Indonesia, population-level health outcomes at the district level are not well documented or understood.

Additionally, the Ministry of Health has recognized a need for integrated data sharing across district health levels but does not have methods in place to manage this.[7] The current siloed surveillance system prevents Indonesia from adequately analyzing and responding timely to data. An integrated surveillance system would allow the Ministry of Health to fully understand the effect of ETs to MNH and respond appropriately.[8]

This comprehensive scoping review on the current surveillance of ET to MNH in Indonesia will aim to highlight gaps in MNH service provision, creating opportunities for interventions to improve overall quality of services and coverage of MNH care in communities in Indonesia.

Methods

Search Strategy

This scoping review was performed to assess community, country, and global level standards for surveillance of emergent threats to maternal and newborn health. Peer-reviewed articles were sourced from PubMed and Google Scholar. Reports and guidelines were sourced from the World Health Organization, Centers for Disease Control and Prevention, and Indonesia's Ministry of Health (Kementerian Kesehatan). Articles were found through a simple scoping review using the key search terms "emergent threat surveillance", "maternal and newborn health", "MNH surveillance", "PWS-KIA", and "SatuSehat". An excel matrix was created and used to track the author, title, year of data collection, location, population of interest, methods, recommendations for future interventions, and citations for all literature.

Inclusion and Exclusion Criteria

The inclusion criteria for this scoping review were open access, full text, peer-reviewed articles written in both English and Indonesian and published between 2010 to 2024. Articles were excluded from the review if they fell outside of the publication requirements, did not address the specific search terms used, or were unrelated to MNH. This process is depicted in Figure 1.

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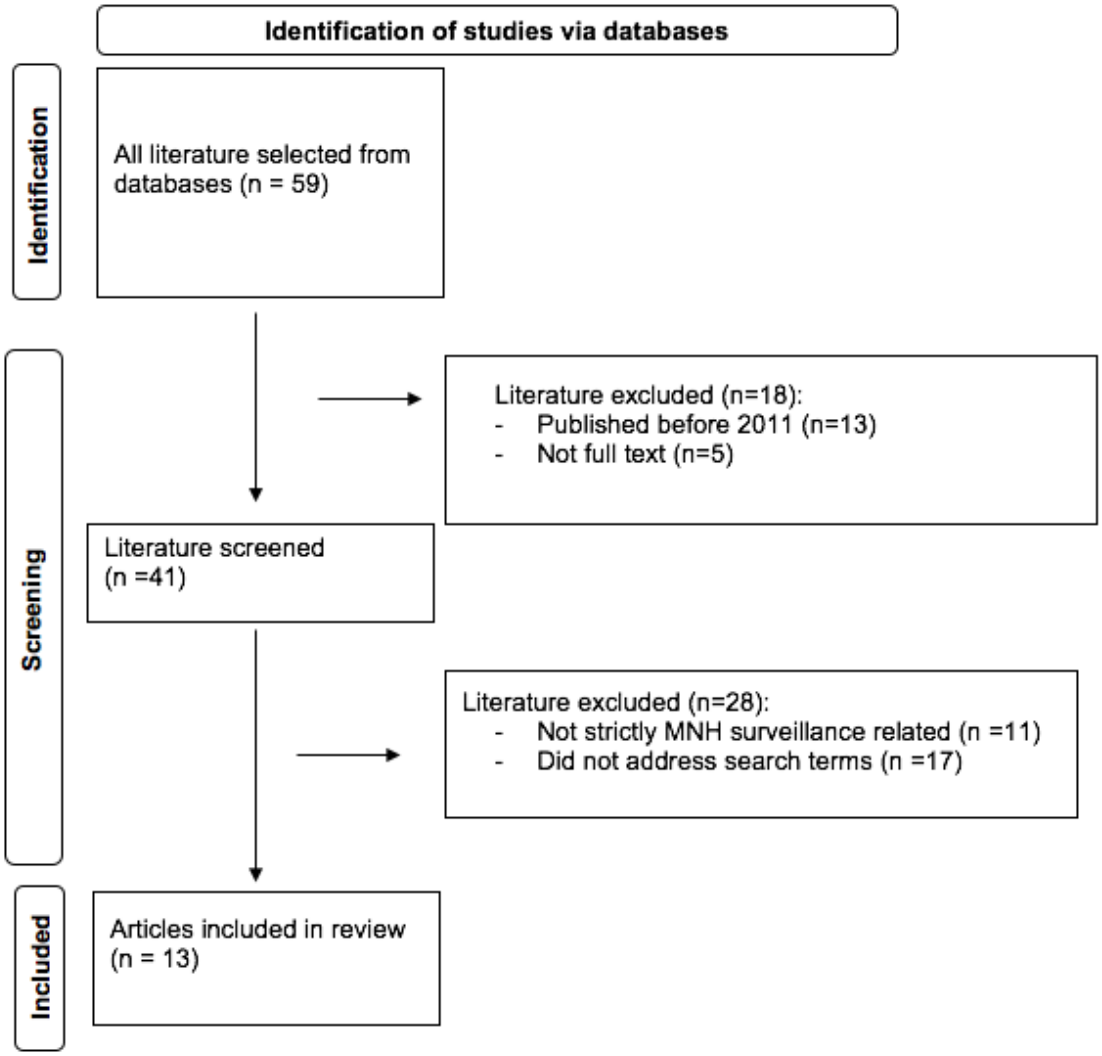

Figure 1. Article Selection Flowchart

Results

The search strategy yielded a total of fifty-nine articles. Literature screened included mixed methods studies, literature reviews, scoping reviews, evaluation studies, systematic reviews, cross-sectional observational studies, and grey literature, as well as existing guidelines and assessment tools. After screening, thirteen articles were included in the review. Table 1 depicts an overview of findings from each included article.

Emergent Threats to MNH in Indonesia

The scoping review identified the relevance of ETs to MNH in Indonesia, investigating the numerous environmental factors and risks to MNH posed by emerging infectious diseases. de Jong et al. reported that due to Indonesia's tropical climate and large populations of zoonotic hosts, like rodents, birds, monkeys, and pigs, emerging infectious diseases are frequent.[9] The Centers for Disease Control and Prevention explains that an emerging infectious disease within the MNH context can be defined as unexpected complications or conditions that can arise and potentially affect the health of the pregnant woman or the developing fetus. The complication or conditions can be caused by natural disasters, conflicts, and infectious disease outbreaks.[4,9] Through cohort studies, governmental data, and ProMED-mail, de Jong et al. found that there have been multiple outbreaks of emerging infectious diseases affecting MNH throughout Indonesia within the last two decades, including diseases such as

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avian influenza, dengue, chikungunya, and rabies.

Within the last two decades, the Indonesian Ministry of Health has devoted effort to better control and respond to outbreaks of these diseases by creating vector control programs and attempting to implement comprehensive surveillance systems.[9] However, after the COVID-19 pandemic, Indonesia's Ministry of Health emphasized that there was still a large need to effectively identify and respond to emergent threats, including both non-communicable and infectious diseases, that affect maternal and newborn health.

Need for Comprehensive Data Sharing

This scoping review identified three major gaps among MNH surveillance to ET in Indonesia. The first gap is a need for comprehensive data sharing between health facility, district, provincial, and national levels. In their 2017 case study, Braa et al. reported that health data in Indonesia is managed in vertical health program systems with minimal horizontal sharing, making it difficult for provincial systems to integrate within the national system. Additionally, St. Louis's report with the Centers for Disease Control and Prevention explained that many low to middle income countries face unique challenges in terms of surveillance, with their systems often siloed due to international assistance from donors and partners with their own unique interventions, funding, and monitoring.[10]

Frey et al.'s 2019 report also emphasized the need for an integrated surveillance system. To fully comprehend the effect of diseases and other threats to health on pregnant women and newborns, Frey et al. recommended an overarching surveillance system that gathers data on adverse maternal, pregnancy, and birth outcomes, includes clear connections between the mother and newborn dyad, and provides long term monitoring is recommended.[8]

To address this need for comprehensive data sharing and overall patient surveillance, the Indonesian Ministry of Health aims to roll out an E-health system known as *Satu Sehat* Originally a COVID-19 self-management application known as *Peduli Lindungi*, it was later transformed to *SatuSehat* after COVID-19 became endemic. Rachmani et al. found that while *SatuSehat* does not have the sole purpose of controlling diseases, it is aimed to be used by Indonesians as a citizen health application, making patients' medical histories accessible and transferrable between different healthcare levels.[11] The Office of Assistant to Deputy Cabinet Secretary for State Documents & Translation reported that *SatuSehat* would be the first major effort in Indonesia to fully digitize health data and would allow for data to be both integrated and standardized across the country.[12]

Poor Data Reporting and Data Accuracy

Another critical gap in the surveillance of MNH in Indonesia is poor completion and accuracy of data reporting. The United Nations Population Fund reported that in the past, midwives and staff at *puskesmas* would be placed on trial if a maternal or newborn death had occurred in their facility.[13] Indonesia has now shifted to a new reporting policy that emphasizes "no naming, no shaming, and no blaming" to increase consistent and accurate reporting of maternal and newborn deaths.[13] However, there are still problems within reporting that occur. Across the literature, we found that midwives in Indonesia are responsible for entering maternal and newborn health data into several reporting systems, including PWS-KIA, MPDN, and AMPSR.[6,14] *Pemantauan Wilayah Setempat - Kesehatan Ibu dan Anak (PWS-KIA)* serves as the monitoring system specific to maternal and child health. Perinatal Mortality Audit, Surveillance, and Response (AMPSR) and the Maternal and Perinatal Death Notification (MPDN) serve as systems to accurately capture maternal and newborn deaths, both globally and in Indonesia. Specifically, AMPSR is an audit that collects maternal and newborn mortality data, which is then uploaded and reported through the MPDN application.[13]

PWS-KIA serves as a local area monitoring system of several indicators for maternal and child health across Indonesia and is carried out through the village

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level.[14] Authors Mulya and Rani and Hargono found that is essential that health data collected through PWS-KIA is accurate and timely, as the goal of collecting the data is to inform MNH policy and decision making.[14,15] However, the literature reported problems with inaccurate data and reporting. Rani and Hargono found in their 2014 evaluation study that many facilities who claim to utilize PWS-KIA face issues in doing so. For example, health workers at Puskesmas Kaliwates found the PWS-KIA system to have low senstivity and low positive predictive value when it came to MNH diagnoses and reporting, deterring them from spending time to complete the forms. Additionally, within Puskesmas Kaliwates, midwives reported that they found the PWS-KIA system to be complicated and yet another task to complete on top of all their other work.[14]

Similar perceptions were found at Sukabumi District Health Center in Indonesia through a cross-sectional survey conducted by Alis Mulya in 2018. Midwives reported that entering data into the PWS-KIA form was not difficult, but they often have too many data entry forms to complete, and they run out of time.[15] To balance data entry and reporting with their other tasks, midwives stated they often work overtime and unpaid to ensure data is entered completely and accurately.[15] With all their responsibilities, there is low incentive for data reporting. Additionally, midwives at the puskesmas levels stated that village level midwives often are late to report data, delaying their own data recording process as well.[15]

In a 2023 scoping review, authors Ambarwati, Kartasurya, and Purnami found that a complete implementation of MPDN and AMPSR across Indonesia is challenged by inadequate surveillance infrastructure, lack of integration and communication between health levels, and an overall weak death registration system. The authors found that there is not a fully staffed and trained audit team in every city in Indonesia, not all audits consistently followed the AMPSR guidelines, and there are not standardized indicators used across Indonesia.[6] Additionally, midwives reported facing delays in completing audits, lacking access to the Maternal Verbal Autopsy (OVM) forms, and incorrectly and incompletely filling out Maternal Medical Record (RMM) forms.[6]

Lack of Training in Data Analysis

A final gap identified by the literature is a lack of data analyzation at each level of the health system in Indonesia, leading to poor responses and health data-based decision making. In a World Health Organization report from 2023, the Indonesian Ministry of Health identified a need to strengthen training both in data analysis and data quality at each level of the health system.[16] Author Kanti Laras elaborated on this, explaining that quality data is essential to improving health decision making, interventions, and outcomes.[16] The analysis of surveillance data can also help measure intervention success to guide future responses.

In a 2012 Centers for Disease Control and Prevention report, author St. Louis stated that low to middle income countries often lack the proper human resources for conducting surveillance and responding to data collected. Additionally, St. Louis found that lack of equipment such as accessible and accurate diagnostic tests can lead to inaccurate data and response.[10] Ambarwati, Kartasurya, and Purnami (2023) reported that most health workers in Indonesia had not been trained in proper data analysis or monitoring and evaluation skills to follow up on MNH data-based interventions.

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Table 1. Scoping Review Matrix

Author	Title	Method	Findings
Ambarwati et al.[6]	Implementation of Maternal Perinatal Surveillance and Response (AMP-SR) Audit in Indonesia: Scoping Review	Scoping Review	Implementation of MPDN and AMPSR is constrained by competence of the assessors, quality of assessment and the resulting recommendations, the commitment to follow up and the AMP implementation budget. Reporting deaths by midwives faced delays in filling out forms, unavailability of the Maternal Verbal Autopsy (OVM) and incomplete/ incorrect filling out of Maternal Medical Record (RMM) forms
Atiyah et al.[17]	Analyzing of implementation maternal audit program in community health center: a qualitative study	Qualitative case study	Four key factors determine the implementation of AMPSR at the community health center level. These are the knowledge of health workers, the involvement of workers in the AMPSR process, recommendations made form AMPSR results, and the implementation of follow-up.
Cahyanti et al.[18]	"Sharp downward, blunt upward": district maternal death audits' challenges to formulate evidence-based recommendations in Indonesia - a qualitative study	Qualitative study	Significant challenges to developing data based recommendations include the tool providing unreliable data for review, unstandardized clinical indicators, lack of accountability among hospital staff and leadership, and a blaming culture.
Mahmood et al.[19]	Root-Cause Analysis of Persistently High Maternal Mortality in a Rural District of Indonesia: Role of Clinical Care Quality and Health Services Organizational Factors	Root cause analysis	The root causes of maternal mortality were found to be poor quality of care and unpreparedness. Additionally, poor implementation of standard operating procedures was due to lack of skills, and inadequate planning, communication, and essential services.
D'Ambruoso et al.[20]	Maternal mortality and severe morbidity in rural Indonesia Part 1: The community perspective.	Qualitative study	Community views of problems with the health care system included poor birth preparedness, the lack of midwives, and lack of emergency transport.

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Author	Title	Method	Findings
Fahmi, MA[21]	Evaluation of the Maternal Perinatal Audit Program (AMP) in Temanggung Regency	Qualitative study	Issues with AMPSR included that while the village midwife used the OVM in reporting, the form is not often available at the puskesmas level. Additionally, there is no SOP or other written guidelines for conducting the AMPSR. There is also no monitoring and evaluation framework set up to see how decisions are made based on results.
Mardiah, H.H.[22]	Alternative operational policies for maternal perinatal Audit (AMP) in Barito Kuala District, South Kalimantan	Qualitative study	Problems with AMPSR included that it was not carried out according to guideline standards, data was not inputted correctly, and there is an overall lack of human resources.
Maryati et al.[23]	Program Analysis (Maternal Perinatal Audit) in Cianjur Regency in 2012	Qualitative study	Deaths from traditional birth attendants are not reported, OVM forms are often filled out incorrectly or just not filled out at all, and there was no formal training conducted on how to use the tools or refresh the midwives on what should be done.
Braa et al[7]	Health Information Systems in Indonesia: Understanding and Addressing Complexity	Descriptive Article	Health data in Indonesia is managed in vertical health program systems with minimal horizontal sharing. In low and middle income countries, NGOs and donors have their own parallel reporting structures which add to fragmentation.
Centers for Disease Control and Prevention Global Public Health Emergency Branch[4]	Mitigation of Emergent Threats to Pregnancy and Infant Linked Outcomes Initiative	Unpublished Manuscript	Emerging infectious diseases to MNH can be defined as unexpected complications or conditions that can arise and potentially affect the health of the pregnant woman or the developing fetus. The complication or conditions can be caused by natural disasters, conflicts, and infectious disease outbreaks.
de Jong et al.[9]	Endemic and emerging acute virus infections in Indonesia: an overview of the past decade and implications for the future	Mixed Methods Study	Zoonotic and vector-borne diseases are frequent due to climate and animal population in Indonesia. Re-emergent diseases include Zika, hepatitis E, and MERS-CoV. Surveillance systems should be adapted to include reference laboratories and increase resources to diagnose, treat, and follow up.

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Author	Title	Method	Findings
Frey et al.[8]	Surveillance for Emerging Threats to Pregnant Women and Infants	Descriptive Article	Surveillance is improved by consistent recording and timely reporting of pregnancy status as part of laboratory testing and case reporting. Integrated surveillance improves treatment and management of maternal conditions during the prenatal period, as it allows for seamless data transfers.
Laras, Kanti[16]	Enhancing health data quality: strengthening Indonesia's data quality assurance	World Health Organization Report	In Indonesia, data quality assessments and routine evaluation are essential for creating a comprehensive surveillance system. Going forward, evaluations of self-assessments should be conducted. Additionally, stronger integration of the data collected at various levels should be pursued.
Mulya, Alis[15]	Discipline of Midwives in Recording and Reporting Monitoring Local Areas of Maternal and Child Health (PWS-Kia) at Sukabumi Regency Health Center	Mixed Methods Study	PWS KIA serves as LAM for MCH. The recording and reporting of data by *gasurkes* for PWS KIA determines policy and decision making, so it must be accurate. Midwives report they must work unpaid and overtime to enter data completely and accurately, giving them poor incentive to do so. A stressful work environment and heavy workload are leading factors of poor reporting .
Office of Assistant to Deputy Cabinet Secretary for State Documents & Translation[12]	Health Ministry Launches '*SatuSehat'* Platform	Report	*SatuSehat* is a platform aimed at integrating and standardizing health data across Indonesia. With *SatuSehat* patients do not need to fill new forms when transferred to other health facilities. Within *SatuSehat* hospital medical records are safely documented in a digital system under the data owner's consent. It is the first major effort to completely digitalized health data in Indonesia. The original goal was for all health facilities to be integrated into *SatuSehat* by end of 2023.

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Author	Title	Method	Findings
Rachmani et al.[11]	Are the Citizens of Semarang ready for The Citizen Health App (*SatuSeha*t Mobile)? A Prediction Model from Decision Tree	Quantitative Survey and Predictive Model	*SatuSehat* doesn't have specific purposes of disease control, rather it is a method of keeping track of personal health records. E-health systems improve information and data interchange/ access, increase patient empowerment, lower costs, and promote research and policy. Factors that affect the usability of *SatuSehat* are health literacy level, digital health literacy, education, and gender.
Rani, Ika A., and Hargono, Arief[14]	Description the Activities of Recording and Reporting Maternal Health Monitoring in PWS-KIA Based on Surveillance Attributes	Evaluation Study	PWS KIA is carried out through the village level, but poor reporting is found in places that are supposed to utilize PWS KIA. Issues with PWS KIA include: system is complicated, lack of flexibility, low quality of data, low sensitivity, low positive predictive value, low representativeness, time consuming data cleaning, and uncertain timelines. Midwives say that filling out the PWS-KIA forms isn't hard, but there are too many to fill out and it is too time-consuming.
St. Louis, Michael[10]	Global Health Surveillance	Centers for Disease Control and Prevention Report	Countries are held to IHR standards to have surveillance in place for both infectious and emerging diseases. Low and middle income countries have historically had problems with establishing robust surveillance systems due to competing priorities and financing problems.
United Nations Population Fund[13]	Strengthening Data to Reduce Maternal Deaths in Indonesia	Report	AMPSR (Perinatal Mortality Audit, Surveillance, and Response) collects and stores maternal and infant mortality data through the Maternal and Perinatal Death Notification (MPDN) application. In the past midwives and *puskesmas* would be put on trial for maternal/ newborn deaths, but the policy is now 'no naming, no shaming, no blaming' to increase reporting.

Discussion

Creating an Integrated System

The literature identified significant gaps in surveillance of emergent threats to maternal and newborn health in Indonesia. The findings show that an integrated, standardized, and user-friendly system is needed to effectively detect and mitigate emergent threats to maternal and newborn health. Braa et al. (2017) highlighted the complexities caused by Indonesia's usage of siloed surveillance systems, including lack of coordination and data accessibility. With this siloed approach, it is difficult to adequately analyze and respond to data, making the identification and reduction of

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emergent threats to maternal and newborn health extremely difficult.[8] Additionally, the challenges that low to middle income countries face in structuring their surveillance systems were touched upon by St. Louis (2012). Issues such as competing international assistance from donors and partners with their own unique interventions, funding, and monitoring add challenges to creating an integrated surveillance system.

To combat the lack of integration and standardization within the health system, the Indonesian Ministry of Health has proposed the usage of Satu Sehat, an e-platform aimed at integrating and standardizing health data across Indonesia. The rationale behind an E-health application has been supported by literature. Rachmani et al. (2023) found that E-health systems often improve data sharing and access, strengthen patient empowerment, lower overall system costs, and better promote research and policy change. The Indonesian Ministry of Health has aimed to fully roll out the usage of SatuSehat by the end of 2023, but there has not been high uptake. Rachmani et al. concluded that low uptake of the E-health application is due to a combination of low health and digital literacy among both citizens and health professionals. Also, the role of health providers such as midwives in the application is unclear, leaving room for incomplete and inaccurate data reporting. With some parts of Indonesia utilizing SatuSehat and other parts not, there is still more progress to be made in terms of data integration and standardization. Rachmani et al. (2023) suggest comprehensive training on data entry and a higher emphasis on the detection and reporting of emergent threats to *Satu Sehat.* The Office of Assistant to Deputy Cabinet Secretary for State Documents & Translation (2022) recommends live demonstrations across Indonesia to show how to correctly use the *Satu Sehat* application and the features it has.

Improvements to Reporting

Despite the recent shift to the policy of “no naming, no shaming, and no blaming”, midwives in Indonesia still face major barriers in accurate and timely data collection and reporting. The literature showed that the current monitoring systems such as PWS-KIA, AMPSR, and MPDN are undermined by lack of training, low incentives to report, and intense workloads faced by many midwives.[6,14,15] The findings from Rani and Hargono in 2014, Mulya in 2018, and Ambarwati, Kartasurya, and Purnami in 2023 highlight the challenges stated above and provided suggestions for future solutions. Rani and Hargono (2014) suggest that training is mandated to familiarize midwives with the point and process of complete and accurate data reporting. They also recommend making standardized guidelines on how to complete data entry on applications such as PWS-KIA. Mulya (2018) recommends that data collection and reporting are added to job descriptions of midwives to ensure it is given the same importance as their other tasks. Additionally, applications used to collect and report data should be integrated and simple so that midwives are only responsible for entering data into a minimal number of databases. Lastly, Ambarwati, Kartasurya, and Purnami (2023) suggest similar solutions, focusing on increasing medical education and training of reporting among midwives to decrease errors and obstacles in reporting on maternal and newborn health.

Increasing Training and Data Analysis

Finally, the literature showed that timely analysis of surveillance data is essential to informing responses to public health emergencies, as explained by Frey et al. (2019). Routine training is needed to improve health provider knowledge on data interpretation and use. Ambarwati, Kartasurya, and Purnami (2023) highlighted a need to develop training for health workers in order to strengthen skills in data response and application. With this training, health workers would learn the necessary monitoring and evaluation skills needed to properly evaluate and respond to emergent threats and the interventions developed to mitigate them. Additionally, the 2012 report by St. Louis identified the unique challenges Indonesia faces in terms of health infrastructure and human resources within the surveillance system.

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Addressing these gaps and those mentioned previously will be essential for improving the surveillance of and response to emergent threats to maternal and newborn health in Indonesia.

Research Limitations

There were limitations in using this research methodology. As with any scoping review, selection bias occurred, as the authors chose the articles that they deemed most relevant to the topic. Additionally, while Indonesian sources were included, their translation into English may have diminished some of the cultural nuances and context inherent in the original texts.

Conclusion

There are several gaps in maternal and newborn health surveillance in Indonesia, especially on reporting and responding to emergent threats. The first key gap identified was a need for a fully integrated and standardized surveillance system that is designed to effectively detect and mitigate emergent threats to maternal and newborn health in Indonesia. The second gap identified was poor participation in the current maternal and newborn health monitoring systems, such as PWS-KIA, AMPSR, and MPDN. The final gap identified was that due to limited training of health workers, there was a lack of data analyzation at each level in the health system, leading to poor response to emergent threats. Additionally, there is a lack of funding provided in the field for data analysis training programs and essential equipment, such as diagnostic tests and programs needed for data aggregation.

Moving forward, an integrated, standardized, and user-friendly system is needed to effectively detect and mitigate ET to MNH. Data analysis and response to adequately identify and reduce ET at each level is critical. Satu Sehat, an e-platform aimed at integrating and standardizing health data across Indonesia, will require comprehensive training on data entry and a higher emphasis on the detection and reporting of ET to MNH. Routine training is needed to improve health provider knowledge on data interpretation and use. Identifying the gaps in surveillance is essential to create opportunities for future interventions that can be used to improve overall quality of services, coverage, and monitoring of maternal and newborn care in communities in Indonesia.

Ethics approval

Not applicable.

Availability of data and materials

Not applicable.

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Author Contribution

CJ conducted the scoping review and drafted the manuscript. PN conducted the scoping review and provided valuable cultural insight into the Indonesian health system. CP provided guidance on writing the abstract and editing the manuscript. CP also provided expertise in the field of surveillance both globally and in Indonesia. MM provided guidance on writing the abstract and editing the manuscript. MM also provided expertise in the field of surveillance both globally and in Indonesia. All authors read and approved the final manuscript.

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