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Screening for Emergent Threats to Maternal and Newborn Health: A Literature Review

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Abstract

Introduction: Though global trends for maternal and newborn mortality have improved, the COVID-19 pandemic had a negative impact on maternal and newborn health (MNH), increasing risk of complicated births. Indonesia's Ministry of Health (IMOH) has made significant progress in expanding MNH services; however, challenges remain in improving screening for emergent threats (ET) to MNH, which includes emerging infectious diseases. This review aimed to compare antenatal care (ANC) standards in Indonesia to WHO guidelines and to evaluate the role of laboratory services and ultrasound (USG) for ANC.

Methods: A narrative literature review was conducted through PubMed and Google Scholar. Articles were also found from the IMOH and the World Health Organization (WHO). Search terms included antenatal care, laboratory, ultrasound, and doppler, yielding sixteen articles in total. Nine articles published between 2010 and 2023 were included for review.

Results: Compared to WHO standards of 8 ANC visits and 1 USG, Indonesia has a lower number of required ANC visits (6), but a higher requirement for USG visits (2); though, conflicting evidence exists for USG recommendations during pregnancy. One article evaluated standard laboratory tests administered during the first ANC visit, finding no records of testing at the *puskesmas* (primary healthcare center) level, while another cited improved infectious disease (ID) detection using screening questionnaires.

Conclusion: In comparison to global standards, Indonesia may benefit from an increased number of ANC visits, ID screening in non-endemic areas, and studies on adherence to national screening guidelines. Further research is needed to evaluate the optimal timing of USG during the prenatal period.

Keywords: antenatal care, diagnostic tools, laboratory, ultrasound

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Introduction

Indonesia has undertaken significant efforts to reduce its maternal mortality ratio (MMR) through the implementation of maternal health programs aimed at increasing both the number of births and antenatal care (ANC) visits attended by skilled professionals.[1] Despite considerable progress, Indonesia's MMR remains high at 173 deaths per 100,000 live births, contrasting with Eastern Asia's average of 74 deaths per 100,000 live births in 2020.[2]

ANC is vital to maternal and newborn health (MNH) and reducing adverse outcomes during the perinatal period. In Laos, it was observed that fewer than four ANC visits and late initiation of ANC (after the first trimester) were both associated with an increased risk for low birth weight (LBW) in newborns.[3] Similarly, Demographic Health Survey (DHS) data was analyzed in ten sub-Saharan African countries on the association between ANC visit frequency and LBW. Researchers noted that eight or more ANC contacts decreased the risk of LBW.[4] An additional study using DHS data from ninety-three countries found that attending at least one ANC visit significantly lowered the probability of infant mortality, LBW, and malnutrition including stunting and underweight infants.[5]

Additionally, the provision of MNH services can be challenging when impacted by outbreaks of emerging and re-emerging infectious diseases, which pose risks to pregnant women.[6] The novel coronavirus (COVID-19) pandemic brought to light the negative impact that infectious diseases can have on MNH, increasing the likelihood of severe maternal complications and maternal mortality.[7] Additional literature has cited that COVID-19 has also increased the burden of pre-term birth, low birth weight, and small size for gestational age. Other infectious diseases impacting MNH include the Zika virus, associated with microcephaly and congenital malformations, and the Ebola virus, which increases the risk of hemorrhage, spontaneous abortion, or maternal death.[8]

The risk of emerging infectious diseases, combined with a persistently high MMR, highlight the need to evaluate health system effectiveness in Indonesia to detect emergent threats (ET) to MNH. ET include emerging infectious diseases, such as COVID-19, as well as obstetric complications and non-communicable diseases. This review aimed to compare antenatal care (ANC) visit standards in Indonesia to World Health Organization (WHO) guidelines and to evaluate the role of laboratory services and ultrasound (USG) for ANC.

Methods

Search Strategy

A narrative literature review was conducted through PubMed and Google Scholar, with additional literature coming from Indonesia's Ministry of Health (IMOH) and the WHO. Search terms for key words in the title or abstract included antenatal care, laboratory, emerging infectious diseases, ultrasound, and doppler. The search was limited to include full text results published between 2010 to 2023. A timeline exceeding ten years was used due to the relatively limited amount of research conducted on emergent threats to MNH.

Inclusion and Exclusion Criteria

Though articles were hand selected, specific criteria were used to determine inclusion in the literature review. Articles were excluded if the information did not specifically address MNH or if they focused on MNH issues outside the ET definition. Additionally, articles that did not address ANC within the text were excluded. Exclusion criteria did not include research methodology or open access due to the use of an institutional PubMed account.

Results

The search conducted yielded sixteen results. Two guidelines and seven articles with varying methodologies were included for review. Figure 1 depicts the selection process, which adhered to inclusion and exclusion criteria. Table 1 shows a side-by-side comparison of the two guidelines included published by IMOH and WHO, representing national and global levels.

Table 2 provides an overview of findings and recommendations from each article. Article methodologies included systematic reviews, mixed-method studies, retrospective secondary data reviews, and clustered randomized trials.

The *Integrated Antenatal Care Guidelines* published by IMOH in 2020 mandate six ANC visits, divided by two in the first and third trimesters and one in the second. These visits should include ten tests (10Ts): measurement of maternal weight and height, measurement of maternal blood pressure, assessment of nutritional status using mid-upper arm circumference, examination of fundal height, determination of fetal presentation and heart rate, screening for tetanus immunization status, iron supplementation, routine or additional laboratory tests, case management, and counseling. Routine laboratory tests include human immunodeficiency virus (HIV), syphilis, hepatitis B, blood type, and hemoglobin, which should all be tested for at the first ANC visit. Proteinuria and blood glucose are measured during the second trimester to assess preeclampsia and gestational diabetes mellitus (DM). Additional laboratory tests are administered if the mother presents as symptomatic and the provider deems testing is necessary. USG is performed twice, in the first and third trimesters, and a doppler is used at every visit to check fetal heart rate.[9]

The most recent WHO guidelines, *WHO Recommendations for a Positive Pregnancy Experience*, were published in 2016 and provide thirty-nine recommendations covering six focus areas. These include nutritional interventions, maternal and fetal assessment, preventative measures, interventions for common physiological symptoms, and health system interventions to improve the utilization and quality of ANC. Within these guidelines was an increase in the number of recommended ANC visits from four to eight contacts. Contacts include any interaction between the mother and a healthcare provider. During the first contact, providers should test or screen for anemia, asymptomatic bacteriuria, HIV, syphilis, and tuberculosis (TB). Anemia and asymptomatic bacteriuria are tested for a total of three times during pregnancy regardless of symptoms. Additionally, gestational DM should be tested for at every contact. For diagnostic tools, USG is recommended to be performed once before 20 weeks, while fetal doppler is not recommended to improve MNH outcomes.[10]

The second objective for the review focused on the use of laboratory services for ANC. One article published in the *Journal of the International Federation of Clinical Chemistry and Laboratory Medicine* highlighted the importance of testing for anemia, HIV, syphilis, rubella antibodies, and hepatitis B.[11] Adherence to anemia, HIV, and syphilis testing in West Java, Indonesia. Researchers found no records of testing for these three potential complications at *puskesmas* (primary healthcare center). Midwives and cadres (community health workers) were not alarmed by the low adherence rate due to the belief that only women who were symptomatic needed to be tested for emergent threats. If midwives did refer mothers for testing, they cited barriers such as cost, time, and mother's perceived risk as inhibiting referral follow-through.[12] In contrast with symptom-based test referrals, a study in Italy evaluated infectious disease risk in non-endemic areas using a screening questionnaire on all pregnant women, regardless of symptoms. Researchers found one in four women was at risk and needed additional testing.[13]

Lastly, this review aimed to understand the role of USG for MNH. A randomized trial from 2018 measured the impact of USG on MNH outcomes in low- and middle-income countries, including utilization of various health care services and mortality rates. Though USG was used to diagnose multiple gestation, poly- and oligohydramnios, and fetal growth restriction in 9.3% of women in the cohort, USG did not impact overall maternal or neonatal mortality rates. Increased USG use was also not positively correlated with

an increase in ANC visit attendance or births in a hospital setting.[14] Conversely, the *International Society of Ultrasound in Obstetrics and Gynecology* recommends a second trimester ultrasound to be performed between 18 and 22 weeks to ensure proper fetal growth based on gestational age by taking eight key measurements: biparietal diameter, head circumference, abdominal circumference, femur diaphysis length, gestational age, fetal weight, fetal movement, and measuring amniotic fluid.[15]

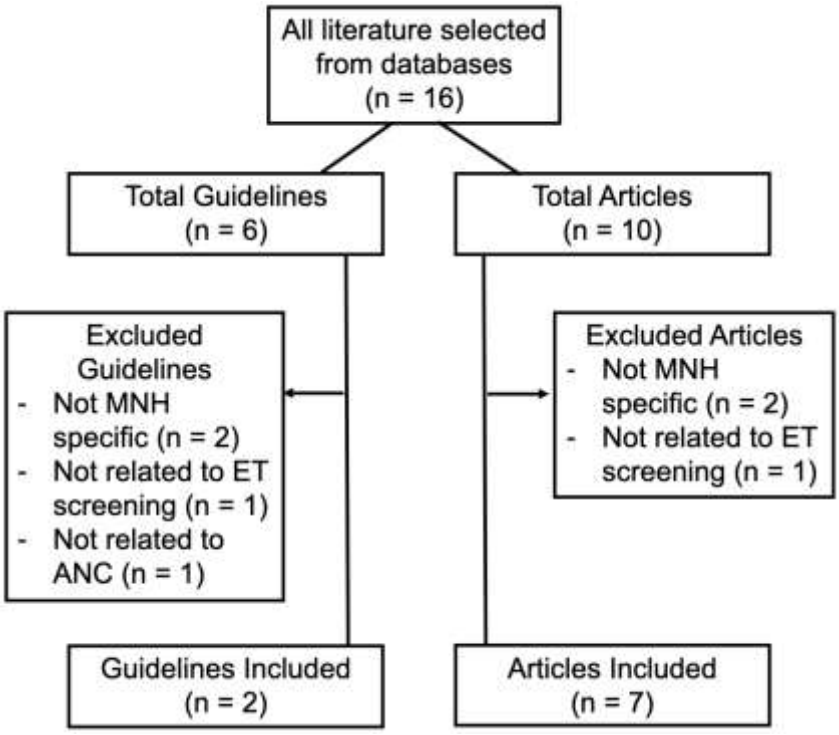

Figure 1. Article Selection Flow Chart

Table 1. ANC Guideline Comparison

Guideline	**Indonesia**	**World Health Organization**
Number of ANC Visits: **Total**	6	8
Number of ANC Visits: First Trimester	2	1
Number of ANC Visits: Second Trimester	1	2
Number of ANC Visits: Third Trimester	3	5
Number of Ultrasounds	2	1
Timing of Ultrasound	First and third trimester	Before 20 weeks gestation

Table 2. Literature Review Matrix

Authors	Title	Methodology	Findings and Recommendations
Alkhatib, A. [11]	The Role of Laboratory Medicine for Health During Pregnancy	Descriptive Article	- Describes blood and urine tests that should be performed during pregnancy, when to perform them, and the reason for each - Routine tests: CBC, blood group and antibody screen, rubella antibody, syphilis serology, hep B serology, HIV - Additional tests: varicella, chlamydia and gonorrhea, vitamin D, repeat CBC and antibodies, urine culture, GBS
Baker et al. [12]	Antenatal testing for anemia, HIV and syphilis in Indonesia – a health systems analysis of low coverage	Mixed Methods Study	- No records of HIV, syphilis, or anemia testing when surveying *puskesmas* or mid-wife records - Laboratory records did not correspond to a specific patient - Participants reported low rates of ANC testing coverage
Goldenberg et al. [14]	Routine antenatal ultrasound in low- and middle-income countries: first look – a clustered randomized trial	Clustered Randomized Control Trial	- Use of USG during ANC did not increase utilization of hospitals for skilled birth for complicated pregnancies or increase ANC visit attendance - Did not seemingly improve maternal or fetal outcomes
Malange et al. [8]	The perinatal health challenges of emerging and re-emerging infectious diseases: A narrative review	Narrative Literature Review	- Cited outbreaks of influenza, Ebola, measles, pertussis, Zika, MERS-CoV, and COVID-19 and their respective risks of causing poor MNH outcomes - Recommended continuous collection of re-emerging and emerging infectious disease data during the perinatal period to increase surveillance
Modi et al. [13]	Emerging Infectious Diseases in Pregnant Women in a Non-Endemic Area: Almost One Out of Four Is at Risk	Observational Study	- Questionnaire administration allows for a quick screening to identify if women are at risk for emergent threats - Recommended evaluating cost-effectiveness for a given region if screening is implemented
Plotkin et al. [19]	Systematic review of Doppler for detecting intrapartum fetal heart abnormalities and measuring perinatal mortality in low- and middle-income countries	Systematic Literature Review	- Higher detection of fetal heart rate abnormalities with using Doppler over Pinard - Did not note a reduction in perinatal mortality with use of Doppler over Pinard except for one study
Salomon et al. [15]	Practice guidelines for performance of the routine mid-trimester fetal ultrasound scan. Ultrasound in Obstetrics & Gynecology	Descriptive Article	- Recommends mid-trimester ultrasound (MTUSG) to be performed between 18 and 22 weeks of gestation to assess fetal growth abnormalities - Suggests MTUSG can be used as a baseline to compare USG later in gestation to assess proper fetal growth - Sonographer should assess biparietal diameter, head circumference, abdominal circumference, femur diaphysis length, gestational age, fetal weight, amniotic fluid and fetal movement

Discussion

Differences exist between IMOH and WHO guidelines, particularly regarding the number of contacts and timing of screenings throughout pregnancy. IMOH recommends six ANC contacts while the WHO recommends eight. As previously discussed, a low number of ANC visits or delayed initiation has been associated with adverse health outcomes such as LBW and newborn or infant mortality.[3,4,5] While the WHO recommends two more contacts compared to Indonesian guidleines,[10,9] increasing the number of visits may not impact MNH care due to evidence of low perceived risk for emergent threats among mothers[9]. Without increasing community education about the benefits of antenatal care, mothers may not utilize these services in a timely fashion, therefore missing out on ANC visits regardless of the required number from IMOH. A secondary data analysis performed in Nigeria found that maternal education was directly associated with a delay in initiating ANC.[16] These findings, supported by the results of this literature review, point to a need to increase ANC visit requirements, while also implementing an intervention to increase utilization of ANC visits by pregnant women.

For emergent threat screening timelines, the WHO recommends testing for anemia, asymptotic bacteriuria, and gestational DM more frequently than IMOH guidelines.[10,9] Notably, WHO does not provide guidance surrounding hepatitis B testing in their ANC recommendations, though information regarding its importance is published elsewhere.[10,17] Indonesia's ANC policy adhere to these separate recommendations with regard to prenatal testing and newborn vaccination.[9,17] Additionally, WHO recommends TB be tested for in areas with a prevalence higher than 100 per 100,000[10]. While Indonesia has a national prevalence of 196 per 100,000, as of 2019, variation among provinces exist.[18] Areas without a high prevalence are not required to screen pregnant women.[9] Findings from *Modi et al* suggest that women living in non-endemic provinces may still be at risk due to domestic or international travel and therefore should be screened as well.[13]

IMOH guidelines include an additional late-term USG compared to WHO recommendations.[9,10] The review conducted by a WHO committee to update ANC guidelines only recommended a late-term ultrasound if the women had not received one before 24 weeks of gestation. An additional USG does not pose a risk to pregnant women; however, they found there was no significant change in results or maternal and newborn outcomes between the two scans.[10] Though a change in national policy may not be warranted, it may be of use to evaluate the benefits and cost-effectiveness of an additional late-term ultrasound in Indonesia.

While this literature review was performed to contextualize the use of ANC to screen for ET, the research method chosen is not without limitations. The scope of this review and search terms used were quite broad, potentially clouding the results with irrelevant publications. In addition, a narrative literature review is prone to selection bias as the authors read through database results and selected articles based on relevance. Lastly, the publication dates used (2010- 2023) may have included outdated information, as policy and research around MNH is constantly evolving.

Conclusion

Despite strides to improve MNH, Indonesia has room to improve their national guidelines for ANC care to reflect international policies recommended by the WHO by increasing the number of required visits, frequency of laboratory testing, and screening for infectious diseases in non-endemic areas. However, a policy change may not be indicated for USG use due to conflicting evidence regarding its effectiveness to improve MNH outcomes. Further research is needed to evaluate optimal timing of USG during the prenatal period.

Ethics approval

Not applicable

Availability of data and materials
Not Applicable

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Author Contribution
Dr. Aulia Ulfah Mutiara Dewi, Dr. Aliva Nabila Farinisa, and Avery Morse contributed to article selection. Avery Morse was the primary author of this manuscript, while Dr. Sri Winarni and Dr. Martha Irene Kartasurya provided writing suggestions and performed editing duties. All authors read and approved the final manuscript.

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