

# The effect of Expanding Maternal and Neonatal Survival interventions on improving the coverage of labor monitoring and complication prevention practices in hospitals in Indonesia: A difference-in-difference analysis

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## Abstract

**Objective:** To assess whether the Expanding Maternal and Neonatal Survival (EMAS) program was associated with improved care provided during hospital-based childbirth.

**Methods:** A quasi-experimental study with two rounds of data collection examined whether EMAS interventions improved facility-based labor and childbirth care. Direct clinical observations were conducted for 1208 deliveries across 13 hospitals in 12 districts. Primary outcome measures included implementation of standard practices to reduce the risk of complications during labor and childbirth for both women and newborns.

**Results:** Adjusted difference-in-difference analysis compared the mean difference in quality scores between EMAS intervention hospitals and comparison sites and consistently found significantly better performance in EMAS sites: 14 points higher for labor monitoring ( $\beta$ -coefficient 14.1; 95% confidence interval [CI], 7.1–21.0); 38 points higher for newborn resuscitation readiness ( $\beta$ -coefficient 38.1; 95% CI, 31.1–45.2); and 33 points higher for infection prevention practices ( $\beta$ -coefficient 32.6; 95% CI, 28.5–36.8).

**Conclusion:** EMAS approaches emphasizing facility readiness and adherence to performance standards significantly improved labor monitoring and complication prevention practices during childbirth.

## KEYWORDS

Indonesia; Infection prevention; Labor monitoring; Newborn resuscitation readiness; Quality of care

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## 1 | INTRODUCTION

High facility-based childbirth rates and increases in skilled attendance at birth do not preclude negative health outcomes, especially when there are gaps in the quality of care provided.<sup>1,2</sup> The World Health Organization's (WHO) quality of care framework defines quality care across multiple domains under two general areas: provision of care and experience of care.<sup>3</sup> Ideally, such care provision is guided by best practices and is standards based.

Within the intrapartum and postpartum period, the use of recommended and evidence-based practices is critical to optimize maternal and newborn outcomes.<sup>4</sup> Effective labor or intrapartum practices rely on assessment and monitoring of maternal and fetal health, including maternal vital signs and fetal heart rate, and use of a partograph to facilitate decision making.<sup>5</sup> Routine monitoring practices play an important role in the continuum between normal labor and childbirth management and early detection and management of emergency complications.<sup>6</sup>

Practices to reduce complications complement labor monitoring practices as do readiness activities, which enable a time-sensitive response to an adverse event. For example, infection prevention practices reduce the likelihood of maternal sepsis, one of the five main direct causes of maternal deaths.<sup>7</sup> And readiness to intervene when a newborn is not breathing at birth relies on having appropriate equipment immediately on hand to minimize any delays in care—birth asphyxia accounts for nearly a quarter of all newborn deaths, globally.<sup>8,9</sup>

In Indonesia, maternal death rates remain unacceptably high and newborn death rates have stagnated despite a high proportion of births occurring within health facilities (63%) and 80% of births being attended by skilled birth attendants. These unfavorable death rates are also incongruent with the country's economic and development profile in the Southeast Asia region.<sup>10</sup> The factors contributing to Indonesia's persistently high mortality rates are not fully understood; however, the causes of maternal and newborn mortality are known. Mirroring global trends, the leading direct causes of maternal mortality in Indonesia are hypertensive disorders of pregnancy, postpartum hemorrhage, and sepsis.<sup>11</sup> Among newborn deaths, preterm birth complications, birth asphyxia, and sepsis are key contributors.<sup>11,12</sup> These complications are largely preventable with sufficient coverage of evidence-based and high-impact interventions.<sup>3</sup>

Indonesia focused much of its previous efforts to improve care on increasing the coverage of trained skilled birth attendance and encouraging facility-based deliveries. More recently, attention is being given to improving quality of services, through workforce development training and improved governance.<sup>13</sup>

The United States Agency for International Development (USAID) funded the Expanding Maternal and Neonatal Survival (EMAS) program, which was implemented by Jhpiego from September 2011 to March 2017, to support the Government of Indonesia in reducing maternal and newborn mortality. The EMAS program is described in the overview paper in this Supplement.<sup>14</sup>

A study was conducted in the last 2 years (Phase 3) of the program to assess the two main program objectives: improved quality

of care and more effective referrals to emergency obstetric and newborn care. This paper presents an analysis of data from clinical observations collected in hospitals to determine adherence to provision of evidence-based practices emphasized by mentors and to performance standards in EMAS interventions, in accordance with Indonesian Ministry of Health guidelines and international evidence-based practices.

## 2 | MATERIALS AND METHODS

### 2.1 | Design

A nonrandomized, quasi-experimental design was used to compare the provision of routine labor and childbirth practices and management of emergency complications according to standards and evidence-based practices in six intervention districts from the EMAS program with six comparison districts in the same provinces that were part of the EMAS program's scale up mid-way through the program. Data were collected during two time periods: in 2015 (baseline) and 14 months later (endline) in 2016.

### 2.2 | Study sites

The evaluation included representation from the six provinces targeted by the EMAS project. The selection of the intervention districts for the evaluation within each of these provinces was made through purposive sampling based on consultations with EMAS technical team members and the timing of intervention activities. The comparison districts were selected to match each intervention district based on key characteristics: (1) population size; (2) availability of a similar sized district hospital; and (3) location geographically distant enough from the intervention areas to avoid the influence of intervention activities. Hospital selection within each district (intervention and comparison) was based on similar criteria: (1) number of labor and childbirth cases from the previous year ( $\geq 25$  deliveries per month); and (2) willingness to participate in the study. Facilities with the largest number of births were targeted to increase the likelihood of observations of obstetric or newborn complications. Hospital types included both public and private facilities. Ministry of Health public hospitals are categorized type A–D, based on population served, and are staffed accordingly. Type A hospitals are large teaching hospitals and were not included in this study. Type B hospitals are found in districts with the largest populations, type C hospitals provide limited specialist services, and type D hospitals include the smallest hospitals. Based on their volume of childbirths, in this study private hospitals were grouped with type D facilities.

The largest government district hospital, *Rumah Sakit Umum Daerah* (RSUD), in each study district was invited to participate in the study. Three private hospitals, which each met the threshold of conducting a minimum of 25 deliveries per month, were also invited. A total of 13 hospitals were included in the study (six comparison and seven intervention sites).

## 2.3 | Sample

The cases included in this study were all observed births (n=1208) that occurred in intervention and comparison hospitals during a specified 4-week observation period. Baseline data were collected between May and August 2015 and endline data were collected between July and September 2016.

## 2.4 | Data collection

Data collection focused on observations of care provided for women who presented for childbirth at each study hospital. Additionally, observations were made of women in labor who presented to a hospital with a complication. This paper focuses on practices initiated at the active stage of labor through the birth process and at least 1 hour postpartum. Data collection was conducted using a structured clinical observation checklist. This checklist was developed based on previously field-tested tools used in quality of care studies conducted by the USAID-Maternal and Child Health Integrated Program (MCHIP), adapted and expanded for the Indonesian context in consultation with EMAS clinical staff and specialists from *Lembaga Kesehatan Budi Kemuliaan* (LKBK), a nonprofit private hospital and training institution located in Jakarta.

Samsung tablets (Samsung, Seoul, South Korea) programmed using Enketo webform software (Enketo LLC, Denver, CO, USA) were used to collect clinical observation data in real time.

## 2.5 | Procedures

Data were collected in each province by a different data collection team under the supervision and guidance of the Summit Institute of Development, as the subcontractor for the implementation of the EMAS study. Each data collection team consisted of one field manager, four clinical observers (all of whom were professionally trained as midwives), and one research assistant.

All study staff completed technical training for the data collection, which included general study information and clinical components. The study information component introduced the research instruments, research ethics, field implementation logistics, and the use of tablets.

Clinical observers were oriented and trained over a 2-week period to conduct standardized clinical observations using a combination of role play, facility rotations, and training videos from the Clinical Observer Learning Resource package developed and validated in previous MCHIP-sponsored studies.<sup>15</sup>

### 2.5.1 | Direct clinical observation

Clinical observations of childbirth practices were conducted in each district over a 2-week period. Three clinical observers rotated in 8-hour shifts to provide 24-hour coverage in study hospitals. Data collection teams conducted observations 6 days per week with the off day randomly selected on a weekly basis. Observations were

conducted in both the labor and delivery room and in the emergency room. Observers were trained to observe practices and to mark a given activity as “conducted” or “not conducted.” Medical record review was not part of the process nor was verbal communication with providers or patients during the childbirth process, although providers were consulted for clarification of some items, if necessary, following the birth. Questions related to infection prevention practices were asked at the end of the clinical observation checklist. If an obstetric or newborn complication occurred or if a woman was referred for a cesarean delivery, the observation items for infection practices were not used owing to skip patterns in the observation tool.

### 2.5.2 | Data management and quality control

Data collected on the tablets were transferred directly to online servers. A field manager conducted quality control checks for data completeness. The manager also reviewed coding and flagged items requiring follow up.

## 2.6 | Data analysis

### 2.6.1 | Outcomes of interest

The analysis in this study focuses on observed maternal and newborn management practices pertaining to labor monitoring and complication prevention. On a quarterly basis, EMAS staff, together with hospital staff, assessed these practices for adherence to performance standards, which were consistent with both the Indonesian Ministry of Health guidelines and international evidence-based practices. Key variables are included in Table 1.

**TABLE 1** Key variables for labor monitoring, resuscitation readiness, and infection prevention.

Selected labor monitoring	Readiness and prevention
<ul style="list-style-type: none"> <li>• Provider observed using a partograph during labor</li> <li>• Uterine contractions checked</li> <li>• Fetal heart rate monitored</li> </ul>	<p><b>Postpartum hemorrhage prevention</b></p> <ul style="list-style-type: none"> <li>• Uterotonic provided in the third stage of labor</li> </ul> <p><b>Facility readiness for newborn resuscitation</b></p> <ul style="list-style-type: none"> <li>• Ambu bag available</li> <li>• Suction equipment available</li> <li>• Hard surface/table available</li> </ul> <p><b>Infection prevention</b></p> <ul style="list-style-type: none"> <li>• Provider washed hands</li> <li>• Personal protective equipment worn: apron, gloves, mask, eye protection, and shoes</li> <li>• Instruments placed in chlorine solution after use<sup>a</sup></li> <li>• Sharps placed in sharps container</li> </ul>

<sup>a</sup>Placing medical instruments in chlorine solution after use is no longer recommended.

## 2.6.2 | Statistical method

As the number of patients enrolled at health facilities differed substantially between the study arms and between the study rounds (Table 2), we used inverse probability weighting for adjusting these differences to reduce selectivity bias during the analysis.

To assess overall effective management of labor and childbirth practices, we created composite scores of related practices for key assessment areas (i.e. selected labor monitoring practices, resuscitation readiness, and infection prevention), expressed as percentiles of a perfect score. The composite score for selected labor monitoring incorporated provider partograph use, which included monitoring of frequency and strength of uterine contractions, maternal vital signs, and fetal heart rate. Difference-in-difference (DID) analysis adjusting for hospital type and province was conducted using each of the three composite scores to examine changes between EMAS intervention and comparison hospitals at baseline compared with endline. Significance was set at  $P=0.05$ .

Stata14 (StataCorp LLC, College Station, TX, USA) was used to manage and analyze all study data.

## 2.7 | Ethics

This project received approval from the Indonesia Ministry of Health, National Institute of Health Research and Development (#LB.02.201/5.2/KE/213/2015) and was deemed exempt by the Johns Hopkins Bloomberg School of Public Health institutional review board (IRB No: 00005912). Data collectors obtained written permission from the hospital management to conduct clinical observations of provider practices during labor and childbirth or newborn services provided in the emergency room, labor and delivery ward, or perinatal ward. Prior to each round of data collection, the study team conducted information sessions for the heads of these units and with healthcare providers from these wards regarding the facility observation process.

An information sheet explaining the purpose of observing the management of these cases was provided.

A provider's consent to participate was obtained prior to the start of a clinical observation. Only one provider among the 13 hospitals declined to be observed during the two rounds of data collection.

All personnel involved with the evaluation received a session on ethical interaction with participants as part of the orientation and training schedule. Every effort was made to ensure the confidentiality of providers and the women and their newborns experiencing complications.

## 3 | RESULTS

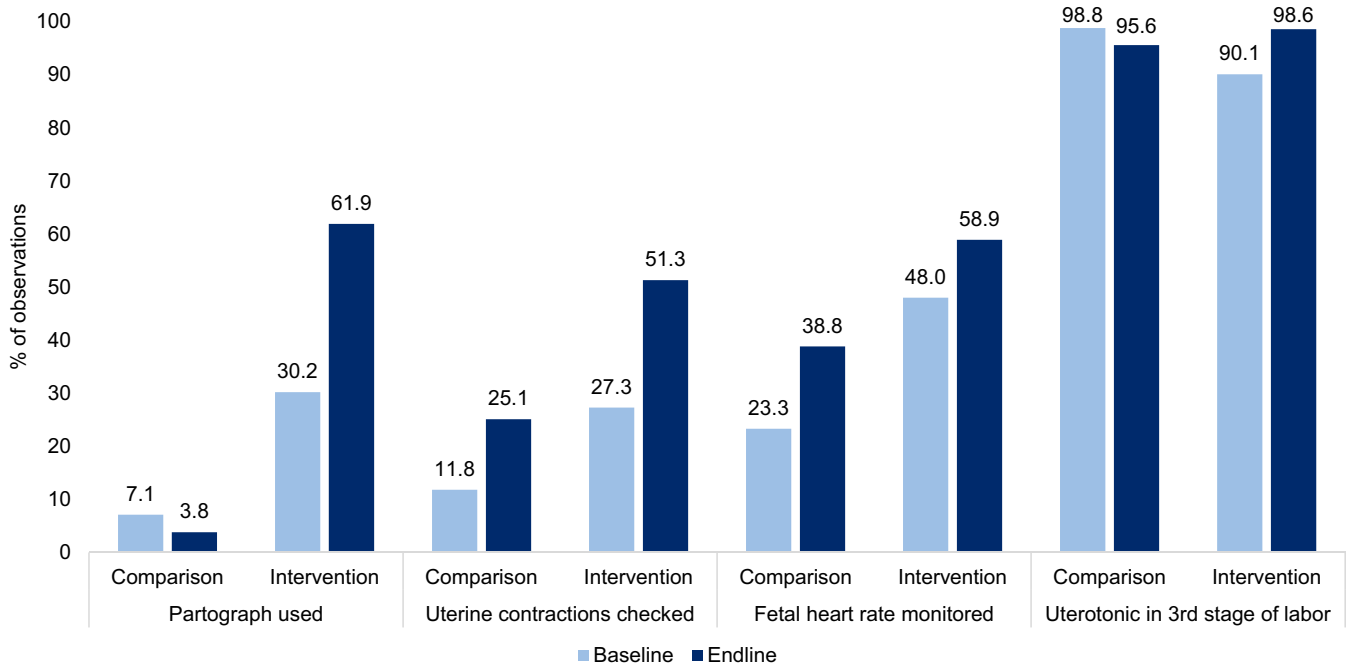
A total of 1208 observations were made of labor and childbirth cases starting in the active stage of labor. Table 2 describes these cases by study arm in terms of hospital types and province and birth outcomes. Despite using the same duration for conducting clinical observations, there was an overall reduction in the number of childbirths starting at the active stage of labor between the two rounds of data collection. There were more type B facilities in the intervention arm and more type C hospitals in the comparison arm.

### 3.1 | Selected labor monitoring and uterotonic administration

Selected labor monitoring practices, including use of a partograph during labor (for regular checking of uterine contractions, maternal vital signs, and fetal heart rate) were not routinely done in either EMAS intervention or comparison sites at baseline. At the end of the study, a two-fold increase in partograph use occurred in the intervention arm (30.2%–61.9%), while there was no improvement in the comparison sites (Fig. 1). Similarly, in EMAS intervention arm hospitals, uterine contraction monitoring increased from 27% to 51% and fetal heart monitoring increased about 11 percentage points, from 48% to 59%.

**TABLE 2** Distribution of study population by hospital type and geography.

	Total	Intervention		Comparison	
		Baseline No. (%)	Endline No. (%)	Baseline No. (%)	Endline No. (%)
Number of observations	1208	421 (34.9)	237 (19.6)	317 (26.2)	233 (19.3)
Number of observations by hospital type					
Type B	617	320 (51.9)	164 (26.6)	77 (12.5)	56 (9.1)
Type C	415	64 (15.4)	48 (11.6)	166 (40.0)	137 (33.0)
Type D/Private	176	74 (42.0)	40 (22.7)	37 (21.0)	25 (14.2)
Number of observations by province					
Banten	239	97 (40.6)	61 (25.5)	54 (22.6)	27 (11.3)
Central Java	237	73 (30.8)	51 (21.5)	56 (23.6)	57 (24.1)
East Java	226	76 (33.7)	36 (15.9)	74 (32.7)	40 (17.7)
North Sumatra	29	3 (10.2)	17 (58.8)	2 (6.6)	7 (24.1)
South Sulawesi	192	61 (31.8)	31 (16.1)	54 (28.1)	46 (24.0)
West Java	285	111 (39.0)	41 (14.4)	77 (27.0)	56 (19.6)



**FIGURE 1** Observed selected labor monitoring practices and uterotonic provision.

However, increases in uterine contraction monitoring and fetal heart monitoring were also observed in the control area hospitals. The administration of a uterotonic in the third stage of labor was already very high (>90%) in both intervention and comparison facilities, but still increased from 90% to 99% in EMAS intervention sites over time.

Table 3 presents composite labor monitoring scores using three labor monitoring activities and mean scores expressed as percentages for each study arm. At endline, EMAS intervention sites had a composite labor monitoring score of 61.0% versus 32.9% in the comparison site. Table 4 presents a DID analysis, adjusting for hospital type and province, which found that the net score difference was significantly 14 points higher in intervention sites ( $\beta$ -coefficient 14.1; 95% confidence interval [CI], 7.1–21.0). South Sulawesi ( $\beta$ -coefficient 41.2; 95% CI, 32.9–49.6) and Central Java ( $\beta$ -coefficient 19.2; 95% CI, 11.5–26.9) provinces showed the most significant improvement in labor monitoring. Type D hospitals (those that serve the smaller population groups) improved significantly more than larger hospitals ( $\beta$ -coefficient 24.3; 95% CI, 15.2–33.4), even after taking into account differences in facility caseload (Table 4).

### 3.2 | Newborn resuscitation readiness

Newborn resuscitation readiness was assessed during the direct clinical observation of 1208 births. The availability of three preparatory essential components was assessed: a bag valve mask, also referred to as an artificial manual breathing unit or Ambu bag and mask; suction equipment; and a table or hard surface platform on which to perform resuscitation. The availability of these materials ranged from 50% to 72% at baseline (2015) in both intervention and comparison sites. No change over time was observed in comparison facilities; however, readiness for resuscitation at endline was nearly 100% in intervention sites (Fig. 2).

A composite newborn resuscitation score for resuscitation readiness was created using the three readiness items and mean scores were created for each group (Table 3). At endline, cases in EMAS intervention sites had a composite resuscitation readiness score of 98.9% versus 65.5% in the comparison site. DID analysis adjusting for hospital type and province, found that the net score difference was 38 points higher in EMAS sites ( $\beta$ -coefficient 38.1; 95% CI, 31.1–45.2) (Table 4). Central Java

**TABLE 3** Composite scores for labor and childbirth practices.

	Comparison		Intervention	
	Baseline	Endline	Baseline	Endline
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Selected labor monitoring (n=1208)	14.6 (6.1–23.1)	32.9 (10.3–55.5)	41.2 (22.7–59.7)	61.0 (37.1–85.0)
Newborn resuscitation readiness (n=1208)	72.0 (48.5–95.5)	65.5 (37.2–93.9)	84.9 (70.5–99.3)	98.9 (97.6–100)
Infection prevention practices (n=947) <sup>a</sup>	51.4 (39.5–63.4)	48.2 (38.1–58.2)	58.4 (47.7–69.0)	81.5 (74.1–88.9)

<sup>a</sup>Questions related to infection prevention practices were asked at the end of the clinical observation checklist. If an obstetric or newborn complication occurred or if a woman was referred for cesarean delivery, the observation items for infection practices were not assessed owing to skip patterns.

**TABLE 4** Factors associated with composite scores for selected labor monitoring, newborn resuscitation readiness, and infection prevention practices.

Characteristics	Adjusted $\beta$ -coefficient (95% CI)	P value <sup>a</sup>
<b>Pregnancy monitoring composite score (n=1208)</b>		
Study arm		
Intervention	15.9 (10.2–21.5)	<0.001
Comparison	–	
Data collection round—all cases		
All cases baseline	–	
All cases endline	7.7 (2.5–13.0)	<0.001
Data collection round—intervention case		
Intervention baseline	–	
Intervention endline	14.1 (7.1–21.0)	<0.001
Province		
Banten	–	
Central Java	19.2 (11.5–26.9)	<0.001
East Java	–41.6 (–52.0 to –31.3)	<0.001
North Sumatra	–11.4 (–19.8 to –3.1)	0.007
South Sulawesi	41.2 (32.9–49.6)	<0.001
West Java	–21.0 (–29.4 to –12.5)	<0.001
Hospital type		
Type B	–	
Type C	–15.5 (–24.4 to –6.6)	0.001
Type D/private	24.3 (15.2–33.4)	<0.001
<b>Newborn resuscitation composite score (n=1208)</b>		
Study arm		
Intervention	2.4 (–3.3 to 8.1)	0.407
Comparison	–	
Data collection round—all cases		
All cases baseline	–	
All cases endline	–1.6 (–6.9 to 3.8)	0.566
Data collection round—intervention case (n=947)		
Intervention baseline	–	
Intervention endline	38.1 (31.1–45.2)	<0.001
Province		
Banten	–	
Central Java	28.3 (20.4–36.1)	<0.001
East Java	–8.7 (–19.2 to 1.8)	0.105
North Sumatra	–5.2 (–33.7 to –16.7)	<0.001
South Sulawesi	14.0 (5.5–22.5)	0.001
West Java	–3.9 (–12.5 to 4.7)	0.369

(Continues)

**TABLE 4** (Continued)

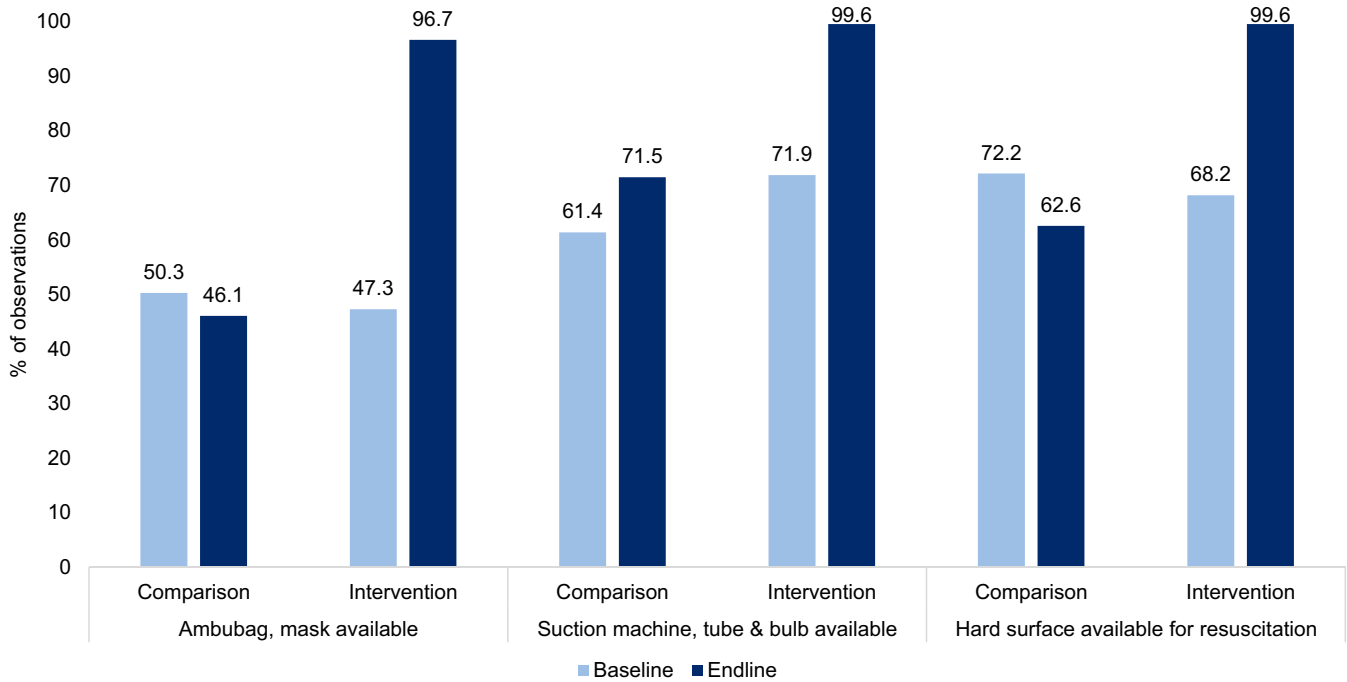
Characteristics	Adjusted $\beta$ -coefficient (95% CI)	P value <sup>a</sup>
Hospital type		
Type B	–	
Type C	–7.3 (–16.4 to 1.7)	0.113
Type D/private	16.0 (6.8–25.3)	0.001
<b>Infection prevention composite score (n=947)</b>		
Study arm		
Intervention	4.9 (1.7–8.1)	0.003
Comparison	–	
Data collection round—all cases		
All case baseline	–	
All cases endline	0.8 (–2.3 to 3.9)	0.617
Data collection round—intervention cases		
Intervention baseline	–	
Intervention endline	32.6 (28.5–36.8)	<0.001
Province		
Banten	–	
Central Java	7.5 (2.6–12.4)	0.003
East Java	–15.8 (–22.2 to –9.4)	<0.001
North Sumatra	–28.8 (–34.1 to –23.5)	<0.001
South Sulawesi	–3.4 (–8.7 to 1.9)	0.213
West Java	–2.5 (–17.8 to –7.3)	<0.001
Hospital type		
Type B	–	
Type C	0.7 (–4.8 to 6.3)	0.797
Type D/private	16.8 (11.4–22.3)	<0.001

<sup>a</sup>P value for  $\chi^2$  tested with significance level 0.05.

( $\beta$ -coefficient 28.3; 95% CI, 20.4–36.1) and South Sulawesi ( $\beta$ -coefficient 14.0; 95% CI, 5.5–22.5) were provinces showing the most significant improvement. Type D hospitals improved significantly more than larger hospitals ( $\beta$ -coefficient 16.0; 95% CI, 6.8–25.3).

### 3.3 | Infection prevention practices

The use of infection prevention practices by providers improved by a larger margin and to a higher degree among intervention sites than comparison sites. Certain practices, including wearing aprons or gloves for personal protection were high and remained high in both arms while other practices such as handwashing or wearing a mask were low at baseline in both arms but improved only in the intervention sites. EMAS intervention sites showed greater improvement in infection prevention measures between baseline and endline compared with comparison sites (Fig. 3).



**FIGURE 2** Observed newborn resuscitation readiness.

A composite infection prevention score was created using the eight practices and mean scores were created for each group (Table 3). At endline, intervention sites had a composite infection prevention score of 81.5% versus 48.2% in the comparison site. DID analysis, adjusting for hospital type and province, found that the net score difference was 33 points higher in intervention sites ( $\beta$ -coefficient 32.6; 95% CI, 28.5–36.8) (Table 4).

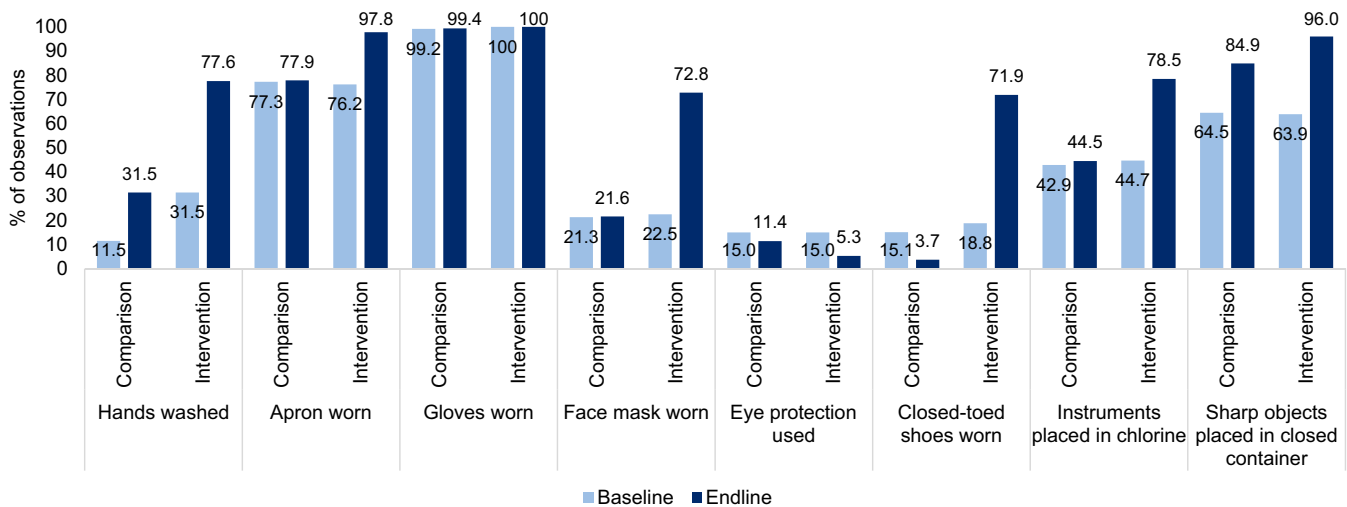
Central Java ( $\beta$ -coefficient 7.5; 95% CI, 2.6–12.4) showed the most significant improvement. Type D hospitals improved significantly more than larger hospitals ( $\beta$ -coefficient 16.8; 95% CI, 11.4–22.3).

Difference-in-difference analysis across the three composite scores indicated that Central Java and smaller facilities (type D) performed better than other provinces and larger facilities respectively.

#### 4 | DISCUSSION

According to the WHO, approximately 15% of all pregnant women will develop a complication requiring provision of care. Ensuring that labor monitoring and appropriate readiness and prevention practices are provided consistently during childbirth improves outcomes for both women and newborns.<sup>5,7,16</sup>

Expanding Maternal and Neonatal Survival approaches targeted improvements in facility self-monitoring and accountability (clinical governance) as a means to strengthen practices related to the prevention of obstetric and newborn complications. Interventions targeting health facility service strengthening included peer-to-peer mentoring in clinical governance, improving routine data collection practices to



**FIGURE 3** Observed infection prevention practices.



monitor coverage of high-impact interventions, use of relevant data to inform decision making, and quarterly assessments of facility readiness against optimal performance standards.<sup>14,17</sup> EMAS was not designed to strengthen all childbirth practices; the program targeted selected practices to increase the coverage of high-impact interventions and to prevent complications that contribute significantly to maternal and newborn mortality in Indonesia.

The selected practices assessed as part of this study should have been observed in all labors and births.<sup>7,16</sup> However, despite evidence on the efficacy of evidence-based practices in reducing maternal and newborn morbidity, implementation of these practices remains a challenge in many countries.<sup>1,3,18</sup>

Findings from the DID analysis of composite scores indicate that, between baseline and endline, EMAS-supported facilities were associated with improvements in labor monitoring practices (41.2%–61%), newborn resuscitation readiness (84.9%–98.9%), and infection prevention practices (58.4%–81.5%). Central Java Province and lower volume type D facilities showed greater improvement across all three areas relative to other provinces or larger facilities.

Comparison sites showed mixed results regarding changes in practices over time. EMAS-supported facilities achieved nearly 100% in all three assessed areas of newborn resuscitation readiness, indicating that material availability should not be a factor deterring timely intervention. Use of appropriate infection prevention attire (face mask, eye protection, and closed-toed shoes) was very low in both comparison and intervention sites at baseline and improved at endline in both arms; however, the increase was much more dramatic in the intervention sites. These changes were observed in a relatively short implementation period (14 months) highlighting the value and potential improvements in practice that may be achieved with governance approaches.

While EMAS-supported sites improved in all the labor monitoring and prevention practices observed, some key practices during monitoring (e.g. checking uterine contractions and fetal heart rate) were notably low even at endline, indicating that additional strategies beyond the EMAS-supported interventions may be needed to increase their coverage. Similarly, while there was marked improvement relative to comparison sites for a number of infection prevention practices (hand-washing, wearing a face mask, using eye protection, wearing close-toed shoes, and washing instruments with a chlorine solution), endline performance was still suboptimal. Behavior change is a complicated endeavor and changing provider behavior related to infection prevention, especially handwashing, can be challenging.<sup>19</sup> Provider behavior, insufficient training, shortages in staffing, and in some cases, limited supplies and resources influence whether care is provided as recommended and may have factored into the observed suboptimal coverage as well as the differences in performance by hospital type.<sup>19–21</sup>

In Indonesia, facility-based childbirth is the norm for a large proportion of the population and will continue to expand given supportive government policies, including the national health insurance scheme initiated in 2014.<sup>22</sup> Ensuring that care provided in these facilities is of sufficient quality to support improvements in maternal and newborn outcomes and reductions in mortality is vital.<sup>23</sup> Improved provider practices to monitor the intrapartum period and prevent

complications, as well as facility readiness to prevent and/or manage adverse events, have been the focus of various quality assessment and improvement efforts.<sup>21,24,25</sup> The success of EMAS interventions in improving some of these practices in Indonesia through strengthened clinical governance may assist wider efforts in Indonesia to achieve better health for women and their babies.

## 5 | LIMITATIONS

The EMAS evaluation study utilized a nonrandomized quasi-experimental design, rather than a randomized control trial design. Nonrandom selection of facilities introduced the risk of selectivity bias in the quasi-experimental EMAS study, which influenced the analysis techniques used.

The second round of data collection was scheduled just before the EMAS project ended. In some cases, this was after only 11 months of intervention exposure, which potentially limited the ability of the study to measure the true impact of the EMAS program.

There were more observations at baseline compared to endline for both intervention and comparison groups, despite the observation period remaining the same in duration. The decrease in clinical observations is believed to have occurred as a result of the new national health insurance introduction in 2014. The new policy required that routine deliveries be managed at health centers (*puskesmas*) while complications be managed at hospitals. This policy resulted in fewer clients coming directly to hospitals for routine labor.

Provider use of a partograph during labor and birth was observed; however, comprehensive or correct partograph use was not accessed, including recording of maternal vital signs and/or changes in cervical dilation. Records were not reviewed as part of the clinical observation process.

This study was able to perform direct clinical observations, providing an accurate assessment of selected aspects of the quality of care provided in facilities. However, the study did not measure direct EMAS intervention inputs (e.g. clinical mentoring, use of performance standards, or the fidelity of project implementation), which may have accounted for some differences in observed outcomes.

## 6 | CONCLUSIONS

Improved labor monitoring, resuscitation equipment readiness, and infection prevention practices contribute to enhanced care for women and newborns. Overall, observed outcomes indicate that EMAS-supported approaches made a significant difference in improving selected practices during labor and childbirth, which in turn may limit preventable deaths arising from maternal and newborn complications.

## AUTHOR CONTRIBUTIONS

All authors were involved in writing and review of the manuscript. DA, PK, MA, and AR participated in tool development and refinement. MT,



RS, AP, SQ, SS, ME, and SA contributed to data management, analysis, or interpretation.

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## CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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