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Strengthening maternal referral systems during public health emergencies: insights from Indonesia's COVID-19 response

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ABSTRACT

Introduction: Despite the World Health Organization (WHO) declaring the end of the Coronavirus Disease (COVID-19) Public Health Emergency of International Concern (PHEIC) in May 2023, the pandemic highlighted critical gaps in hospital emergency preparedness, particularly in maternal healthcare. East Java, Indonesia, was among the most severely affected provinces, reporting an 11.02% increase in maternal deaths. This study assesses hospital readiness in maternal referral hospitals six months after the onset of the pandemic, aiming to inform future public health emergency responses.

Methods: A descriptive and exploratory mixed-methods design was employed. Surveys and focus group discussions were conducted with 127 hospitals in the COVID-19 maternal referral hospitals by the East Java Provincial Government using the modified WHO hospital readiness checklist for COVID-19 2020. Quantitative data were analyzed descriptively, and qualitative data from focus group discussions were thematically analyzed to get deeper insights into the challenges faced by hospitals.

Results: A total of 105 hospitals (83%) responded to the survey. While PPE supplies were largely adequate, gaps in infrastructure, including negative-pressure rooms, isolation areas, and diagnostic capacity, persisted. Financial constraints, particularly delays in the National Health Insurance Scheme (BPJS Kesehatan) claims, further strained hospital operations. FGDs revealed that PCR delays, staffing shortages, and underdeveloped referral coordination systems hindered the delivery of maternal services.

Conclusions: Strengthening maternal referral systems requires improving diagnostic capabilities, investing in essential infrastructure, and ensuring timely financial reimbursement. Collaborative efforts among the Ministry of Health, BPJS Kesehatan, and healthcare facilities are crucial to enhancing maternal healthcare resilience during future public health emergencies.

Keywords: COVID-19, emergency management, hospital readiness, indonesia, maternal health

Introduction

The first COVID-19 cases in Indonesia were identified in March 2020, causing significant strain on healthcare systems nationwide. By June 4, 2021, Indonesia had reported 1,837,126 confirmed cases and 51,095 deaths. Notably, Java Island, home to 56.1% of the national population, accounted for approximately 66.1% of the country's cases (WHO, 2021). Alongside this burden, the pandemic had a profound impact on maternal healthcare services, contributing to a 25% increase in maternal deaths linked to non-obstetric complications, with even higher risks likely due to disrupted obstetric care in an overwhelmed health system (Syairaji et al., 2024). According to the Provincial Health Office (2020), East Java ranked second among provinces for COVID-19 caseload, with a significant number of pregnant women either confirmed positive or categorized as suspected COVID-19 patients. Additionally, Hud et al. (2021) reported an 11.02% increase in maternal deaths in East Java during the first half of 2020 compared to the same period in the previous year.

In response, the Indonesian Ministry of Health and the East Java Provincial Health Office issued comprehensive guidelines to safeguard maternal care during the COVID-19 pandemic. According to WHO (2021), maternal COVID-19 care is defined as the management of pregnancy, childbirth, and postpartum services during the pandemic, integrating infection prevention measures while maintaining essential maternal and newborn care according to established standards, including a referral system (WHO, 2021). These directives detailed referral pathways, triage protocols, and facility zoning to separate patients with COVID-19 from those with non-COVID-19 conditions, while preserving essential maternal and newborn services. However, many hospitals struggled to implement these measures effectively. A lack of critical infrastructure, including negative pressure isolation rooms, Personal Protective Equipment (PPE), and Intensive Care Unit (ICU) beds, contributed to disparities in service availability (Mahendradhata et al., 2021).

To operationalize these guidelines, the East Java Provincial Health Office designated 127 hospitals as COVID-19 referral centers. Nevertheless, maternal COVID-19 care remained concentrated in Surabaya, as many smaller and regional hospitals were not prepared to manage COVID-19 maternal cases, thereby restricting access for patients from peripheral regions (Akbar et al., 2022). Kartiningrum et al. (2023) highlighted that the disparities in healthcare accessibility across regions significantly affected maternal mortality and morbidity in East Java. This situation mirrors global trends observed during the pandemic. For instance, a study by Alabi et al. (2023) observed that in four sub-Saharan African countries with poor maternal health indicators, restricted access to essential services led to more than a 30% increase in maternal mortality. These global patterns align with the situation in East Java, where inadequate readiness among referral hospitals raised maternal health risks.

The disruption of maternal healthcare services was particularly evident in district hospitals, where healthcare worker infections led to temporary closures of operating rooms. As a result, emergency surgical procedures were frequently delayed, necessitating the transfer of critically ill pregnant women to Surabaya, further prolonged referral times, and access to life-saving interventions. In addition, while some hospitals lacked dedicated COVID-19 surgical facilities, others had no negative-pressure postoperative isolation rooms, exacerbating challenges in infection control and patient management. The difficulties in accessing emergency services due to diversion of health facilities for COVID-19 care contributed to poor maternal outcomes (Kamara et al., 2024).

The pandemic underscored significant weaknesses in hospital preparedness and maternal referral networks. This study evaluates hospital readiness six months following the initial outbreak in East Java, aiming to identify key factors that contributed to service disruptions and increased maternal mortality, using the modified WHO hospital readiness checklist for COVID-19 2020. The findings aim to inform the development of more effective crisis response strategies, thereby ensuring a resilient and well-coordinated maternal referral system in future public health emergencies.

Materials and Methods

Design

This study employed a descriptive and exploratory mixed-methods design, integrating a quantitative survey and qualitative focus group discussions to assess hospital readiness in managing referred cases of maternal COVID-19 in East Java, Indonesia. This study aimed to identify the key barriers and facilitators that affect hospital readiness, ultimately informing strategies to enhance maternal healthcare services during emergencies. The research framework was adapted from the WHO hospital readiness checklist for COVID-19 2020 (WHO, 2020) and modified to assess hospital readiness in maternal COVID-19 referral centers in East Java.

This study focused on three main priority aspects of assessing maternal referral readiness, including health workforce availability, facility infrastructure, and administrative and health policy systems. The health workforce component evaluated the availability of essential personnel for maternal care. The infrastructure assessment focused on the availability of critical facilities, including negative-pressure delivery rooms, COVID-19 operating theaters, neonatal and postpartum isolation areas, diagnostic capabilities, and PPE supplies. The administrative and policy component reviewed the

implementation of maternal COVID-19 service protocols, referral mechanisms, infection prevention programs, staff training, and hospital coordination systems. By integrating both qualitative insights and quantitative data, this study provided a comprehensive analysis of the challenges faced by maternal referral hospitals. It offered evidence-based recommendations for improving healthcare delivery in future public health emergencies.

Samples and Sampling Methods

The total study population consisted of all 127 hospitals designated as COVID-19 maternal referral hospitals by the East Java Provincial Government, with details as follows: 99 government hospitals as stipulated in the 2020 Governor's Decree (KEPGUB/Number 188/218/KPTS/013/2020), and 28 private or non-government hospitals designated by East Java Provincial Government as additional emergency referral hospitals.

Given the study's objective of evaluating the overall readiness of these hospitals, a total population sampling method was employed, meaning all 127 hospitals were included in the quantitative survey. For the qualitative data, a purposive sampling method was used to conduct focus group discussions, with hospitals selected based on the criteria of reporting the highest number of COVID-19 cases and being designated as the primary referral hospitals in their respective areas. Focus group discussions were conducted with key hospital personnel, including one hospital manager, one obstetrician, and two midwives from each of the 28 selected hospitals. Each hospital's management selected the participating staff based on their roles and involvement in delivering maternal COVID-19 care during the pandemic. This approach ensured that the findings reflected the broader hospital system's preparedness in East Java during the pandemic.

Instruments

Data collection was conducted using both quantitative and qualitative instruments. The quantitative data were obtained through an online survey that included a modified version of the WHO hospital readiness checklist for COVID-19 2020. The survey gathered information across three key aspects: (1) availability of health workforce related to maternal services, (2) availability and readiness of critical infrastructure for maternal COVID-19 care (such as isolation rooms, diagnostic tools, and PPE supplies), and (3) implementation of administrative and health policy systems (such as referral mechanisms, infection prevention protocols, and staff training programs). Other aspects, such as hospital financing, logistics operations, public communication, and general hospital security protocols, were excluded in this study, as the three selected assessment aspects were considered the most direct factors on maternal care delivery. The survey was distributed in Bahasa Indonesia via SurveyMonkey. However, to ensure linguistic accuracy and clarity, the survey items were carefully reviewed by members of the research team who are fluent in both Bahasa Indonesia and English and who are familiar with maternal health and hospital system contexts.

To complement the survey findings, the qualitative instrument consisted of a semi-structured focus group discussion (FGD) guide developed based on the adapted WHO hospital readiness for COVID-19 framework (WHO, 2020). The guide included open-ended questions designed to explore barriers and facilitators not only within the three main aspects assessed in the quantitative survey, but also broader operational challenges, such as hospital financing and diagnostic capacity.

Data Collection

Primary data collection was conducted from October to November 2020. The online survey was distributed to hospital staff at each of the 127 designated COVID-19 maternal referral hospitals in East Java. Each hospital was requested to select one representative respondent who was directly involved in maternal COVID-19 services. In this survey, referral hospital characteristics were classified based on hospital type, level, and ownership. Participants were asked to complete a structured study based on the current conditions of their facility at the time of their response.

For qualitative data, 28 focus group discussions (FGDs) were conducted in November 2020 with hospital personnel from selected referral hospitals via Zoom Meeting. Each focus group discussion (FGD) involved four participants: one hospital manager, one obstetrician, and two midwives, resulting in a total of 112 participants across all discussions. Each FGD lasted approximately 60 minutes and was conducted by each region, referring to the hospital's administrative district, to capture local contextual differences in maternal referral readiness. The FGDs were moderated by public health researchers from Universitas Airlangga, who remained neutral and promoted equal participation. Moderators emphasized the voluntary nature of participation, confidentiality, and the importance of hearing all perspectives equally.

Secondary data were also obtained from the East Java Provincial Health Office to complement the primary data and provide contextual background on hospital readiness and maternal health services during the pandemic. These included regional statistics on maternal mortality, COVID-19 case distribution among pregnant women, and the official referral status of each hospital.

Data Analysis

Data from the online survey were analyzed using descriptive statistical methods to quantify hospital readiness to assess hospital readiness across all participating facilities. Analysis focused on predefined indicators within the three key domains adapted from the

Table 1. Characteristics of hospitals

Category	Amount	Percentages
Level of Hospital*		
Level A (Third-level)	3	2.9%
Level B (Second-level)	39	37.1%
Level C (First-level)	43	40.9%
Level D (First-level)	20	19.0%
Owned Hospital Status		
Private	49	46.7%
Government	48	45.7%
Army/Police	8	7.6%
Total	105	100%

**Level A=tertiary referral hospitals; Level B=secondary-level hospitals; Level C=first-level referral hospitals with moderate specialist services; Level D=basic-level hospitals with limited specialist services.*

WHO Hospital Readiness Checklist for COVID-19 (WHO, 2020), which include health workforce availability, facility infrastructure, and administrative and health policy systems.

The qualitative data from the focus group discussions (FGDs) were analyzed using a descriptive qualitative approach. Key findings were grouped according to the predefined three domains of the adapted WHO Hospital Readiness framework—health workforce availability, facility infrastructure, and administrative and health policy systems. Themes were identified based on recurring issues reported across hospitals, without the use of formal coding procedures. The researchers employed thematic mapping and iterative reading to organize responses into major themes. Integrating both datasets from the survey and FGDs, identified high and low readiness scores from the survey were further contextualized with qualitative explanations from the FGDs, providing a broader understanding of the readiness of COVID-19 maternal referral hospitals in East Java.

Ethical Considerations

This study received ethical approval from the Ethics Committee of the Faculty of Medicine, Airlangga University, under the ethical clearance number 18/EC/KEPK/FKUA/2021. All respondents provided informed consent before participating in the survey and interviews, ensuring compliance with ethical research standards. The confidentiality and anonymity of the participants were maintained throughout the study, and the data were used strictly for research purposes.

Table 3. Availability of Hospital Infrastructure

Category	Amount	Percentages
Negative pressure delivery room	41	39.0%
COVID-19 operating room	59	56.1%
NICU isolation*	55	52.4%
Postpartum isolation	55	52.4%
PPE supplies*	97	92.4%
PCR rapid test / swab facility*	94	89.5%
Mobile X-ray/ultrasound facility	97	92.3%

**NICU=Neonatal Intensive Care Unit; PPE=Personal Protective Equipment; PCR=Polymerase Chain Reaction.*

Table 2. Availability of Health Workers

Category	Amount	Percentages
General Practitioners	105	100.00%
Midwives	105	100.00%
Nurses	105	100.00%
Obstetricians	104	99.04%
Pediatrics	104	99.04%
Anesthetist	104	99.04%
Internist	105	100.00%
Pulmonologist	96	91.42%
Radiologist	101	96.19%
Clinical Pathologist	97	92.38%
Clinical Microbiologist	20	19.04%

Results

Characteristics of Hospitals

The final response rate of this study was 83% (105 out of 127 targeted hospitals). The majority (59.9%) of the COVID-19 referral hospitals were classified as first-level referral hospitals (Table 1). However, Level C hospitals (first-level referral hospitals with moderate service capacity) offer broader specialist services—including internal medicine, surgery, pediatrics, and obstetrics-gynecology—while Level D hospitals (basic first-level hospitals with limited specialist services) primarily provide general medical care with limited specialist support and have 50-250 beds, functioning mainly to stabilize patients before referral to higher-level facilities.

In terms of ownership, the majority of hospitals were public sector facilities, 45.7% of hospitals are government, followed by a smaller proportion of private and military-affiliated hospitals, 46.7% in the private sector, and the remaining 7.6% were army/police.

Aspects of Health Human Resources

According to the data for health workers, the focus of the collected data is on health personnel directly involved in providing COVID-19 maternal services in hospitals. Almost all hospitals reported having core clinical staff essential for maternal COVID-19 care, including general practitioners, midwives, obstetricians, pediatricians, and anesthetists. However, the availability of clinical microbiologists was limited. Details of the distribution of health workers' readiness are presented in the following table.

Aspects of Hospital Infrastructure

In terms of hospital infrastructure availability, data were collected, primarily on essential facilities needed to provide COVID-19 maternal services. While basic facilities such as PPE stocks and diagnostic tools (PCR or rapid tests) were available in most hospitals, negative-pressure delivery rooms, COVID-19 operating rooms, and isolation areas for NICU and postpartum were still insufficiently distributed. Details on the availability of infrastructure are presented in the following table.

Table 5. Thematic Summary of FGD Findings

Theme	Key Findings	Quotes
Diagnostics	Delays in obtaining PCR results were commonly reported, particularly by hospitals such as Hospital S and Hospital K (S/K), which impacted timely maternal COVID-19 case management.	*"We had to wait two to three days for PCR results, which delayed emergency procedures"* – Midwife, Hospital S *"We referred many patients while awaiting PCR confirmation"* – Manager, Hospital K
Infrastructure	Inadequate COVID-19-specific infrastructure (negative-pressure delivery rooms, isolation facilities) was highlighted by hospitals such as Hospital L, Hospital E, and midwives from Hospital NP.	*"We didn't have a negative-pressure delivery room, so we had to improvise with temporary dividers"* – Obstetrician, Hospital L *"Postpartum patients had to share isolation space due to limited rooms"* – Midwife, Hospital NP
Financing	Financial challenges related to BPJS claims for COVID-19 diagnostic services were raised by hospitals S, K, G, and an obstetrician from Hospital P.	*"It was difficult to process BPJS claims for COVID swabs and care—it took months"* – Manager, Hospital S&G *"Private hospitals struggled more because we didn't receive emergency support funds"* – Obstetrician, Hospital P
Staffing	Shortages of healthcare workers, particularly in emergency and maternity units, were cited by Emergency Room staff at Hospital SL and other participants, affecting operational efficiency.	*"Some of our staff were exposed and had to isolate, leaving only two people on night shift"* – Midwife, Hospital NP *"Emergency unit was overwhelmed, and we lacked backup staff"* – Manager, Hospital SL

Aspects of Hospital Regulation

In the regulatory and administrative aspects of the hospital, the essential data we encountered were that 68.5% of patients had been served with COVID-19, and only 77.1% of the use of the Integrated Referral System (SISRUTE). Hospital administration details are listed in the following table.

Focus Group Discussion Results

The focus group discussions revealed several key themes related to the challenges hospitals face in managing maternal COVID-19 cases (Table 5). To support the contextual interpretation of qualitative data, a list of participating hospitals and their basic characteristics is presented in Appendix A. First, delays in obtaining PCR results were frequently reported by hospitals such as Hospital S and Hospital K (S/K), significantly affecting diagnostic efficiency and timely patient management. Participants emphasized that prolonged turnaround times hindered rapid triage and treatment decisions for maternal COVID-19 cases.

Second, infrastructure limitations were underscored by facilities such as Hospital L, Hospital E, and midwives from Hospital NP, who highlighted the inadequate availability of COVID-19-specific facilities, including negative-pressure delivery rooms and postpartum isolation areas. These limitations restricted hospitals' ability to safely manage infectious maternal patients while maintaining essential services.

Third, financial challenges, particularly related to BPJS Kesehatan claims for swab testing and COVID-19 maternal services, were raised by participants from Hospitals S, K, and G, as well as an obstetrician from Hospital P. Bureaucratic hurdles and delayed reimbursements were noted as additional operational strains during the pandemic response.

Fourth, staffing shortages emerged as a significant concern, especially among emergency and maternity units. Emergency Room staff at Hospital SL and other participants reported that infections among healthcare workers, combined with increased patient loads, created substantial operational pressure and disrupted maternal service delivery.

Across all discussions, there was a strong consensus on the urgent need for enhanced government support and policy advocacy, including strengthening universal screening protocols for pregnant women, improving PCR diagnostic capacities, upgrading hospital infrastructure, and expanding staff support and protection programs.

Table 4. Administration and Health Policy in Hospitals

Category	Total	Percentages
Already serving COVID-19 patients	98	93.3%
Already serving COVID-19 maternal	72	68.5%
Have Clinical Pathways and Guideline of COVID-19	96	91.4%
Have an SOP for maternal management of COVID-19*	86	81.9%
Have a COVID-19 maternal service flow	89	84.7%
Screening for COVID-19 in maternal cases	99	94.3%
Implement the IPC program*	101	96.2%
Covid-19 service training for health staff	101	96.2%
Using SISRUTE for referrals*	81	77.1%
Have a referral system for COVID-19 patients	103	98.1%

*****SOP = Standard Operating Procedure; IPC = Infection Prevention and Control; SISRUTE = Sistem Informasi Rujukan Terintegrasi (Integrated Referral Information System).

Discussions

This study explored the readiness of referral hospitals in East Java, Indonesia, to manage maternal COVID-19 cases by combining survey results and qualitative insights gathered from hospital representatives. Out of 127 designated referral hospitals, 105 participated, resulting in an impressive response rate of 83%. The majority of the participating hospitals were classified as Level C facilities (40.9%), which are equipped with basic specialist services but have limited high-technology capacity. Although both Level C and Level D hospitals are categorized as first-level referral facilities, Level C hospitals offer broader specialist support. In contrast, Level D hospitals primarily provide basic medical care and stabilization. This finding highlights how the COVID-19 pandemic placed considerable pressure on hospitals that were not fully equipped to handle high-complexity maternal cases. Based on the Indonesian health system's structure and WHO recommendations, lower-level hospitals often struggle to manage complex infectious diseases unless additional resources are rapidly mobilized (WHO, 2020). Therefore, the heavy reliance on Level C and D hospitals during the pandemic highlights systemic vulnerabilities that need urgent attention for future health emergencies.

Meanwhile, in terms of ownership, 46.7% of the hospitals surveyed were privately owned, a proportion nearly equal to public sector hospitals. This distribution indicates that private facilities play a significant role in the delivery of pandemic maternal care. Nevertheless, FGDs revealed that private hospitals faced greater challenges in mobilizing financial resources for infrastructure upgrades and service expansion. This finding is supported by previous studies, which indicated that private health facilities often lack the buffer funding that government institutions can access during emergencies (Muchsam et al., 2022). Consequently, strategic funding mechanisms and public-private partnerships should be strengthened to ensure that both sectors can effectively contribute to the resilience of the maternal health system.

Regarding human resources, the survey results demonstrated that most hospitals had sufficient midwives, nurses, general practitioners, pediatricians, obstetricians, and anesthesiologists to maintain maternal health services. However, the availability of specialized personnel such as pulmonologists and clinical microbiologists remained limited, with only 20 hospitals reporting access to microbiologists. This aligns with known structural patterns in health systems where specialized care is concentrated in tertiary centers (Wallace et al., 2023). Although task-shifting strategies, such as substituting clinical pathologists for microbiologists, allowed services to continue, these workarounds potentially compromise quality. Strengthening specialist distribution and emergency capacity-building must therefore be a priority, especially for decentralized healthcare systems.

Another fact states that, on average, hospitals say they do not have adequate infrastructure for COVID-19 services. This includes 61% who do not have a delivery room with negative pressure, specifically for COVID-19, 43.9% who do not have a negative operating room, and 47.6% who do not have particular isolation postpartum and NICU rooms. However, 92.4% said that their PPE supplies were sufficient. A modeling study conducted by Putra et al. (2020) projects 3,308 severe cases, 681 critical cases of COVID-19, an additional two ICU admissions per 1,000 births, and 52 maternal deaths during the first peak of the COVID-19 pandemic in the United States. Hospitals should be encouraged to ensure adequate provision of personal protective equipment for obstetric care providers and prioritize their safety. Facility readiness, encompassing infrastructure, resources, and COVID-19-specific protocols, is crucial for effective patient management and referral processes (Perez et al., 2022). However, shortages of essential supplies and delays in equipment acquisition have hindered hospitals' preparedness against COVID-19 (Seif Rabiei et al., 2023). This is particularly important because, regardless of the disease's seriousness, almost all women with COVID-19 will elect to deliver in a hospital setting. Thus, obstetric care professionals would be uniquely and inevitably at risk of contracting COVID-19. Moreover, recent studies have indicated increased risks of preterm birth, pre-eclampsia, cesarean delivery, and perinatal death. This may mean that we would also see a rise in the usage of services not explicitly linked to COVID-19 or delivery alone.

In addition to infrastructure gaps, as for diagnostic facilities, 89.5% already have facilities for conducting rapid Ab tests and PCR swab tests. FGDs highlighted that PCR result delays were a common obstacle, particularly for hospitals outside major urban centers. Patients have to wait up to several days to receive treatment for their disease because they must wait for the results of the PCR swab examination, which the samples are sent to the laboratory in the capital city of Surabaya. This, of course, can lead to service delays and compromise the quality of maternal health services. 92.3% of hospitals reported having X-ray machine facilities. A chest X-ray is not the gold standard for diagnosing COVID-19. However, due to limitations in CT scans, especially in regional hospitals, chest radiographs are still used as a supporting tool to aid in the diagnosis of COVID-19. Diagnostic delays, initially caused by limited testing capacity and reagent shortages, led hospitals to heavily rely on rapid tests despite their limitations in accuracy and sensitivity (Valera et al., 2021). The shift towards real-time RT-PCR assays as the gold standard for COVID-19 diagnosis reflects ongoing efforts to improve diagnostic reliability and timeliness (Kim et al., 2024). Alternative methods, such as chest CT scans, have been explored in resource-constrained

settings, highlighting the importance of adaptive diagnostic strategies during the pandemic (Bahrami-Motlagh et al., 2020). Investing in decentralized, point-of-care molecular testing facilities would therefore significantly enhance maternal service resilience and improve clinical outcomes in health crises.

Interestingly, although 93.3% of hospitals surveyed reported providing general COVID-19 services, only 68.5% stated that they had managed maternal COVID-19 cases. This gap suggests that many hospitals, despite offering basic COVID-19 care, were not fully prepared to handle the specialized demands of managing pregnant and postpartum women infected with COVID-19. This finding is consistent with patterns observed globally, where maternal health services often face resource competition during pandemics, due to the specialized infrastructure, isolation protocols, and staff competencies required (Perez et al., 2022). The need for dedicated isolation delivery rooms, postpartum NICUs, COVID-specific operating rooms, and ICU beds placed significant financial and logistical demands on hospitals, particularly on smaller or private institutions with more limited resources. Furthermore, financial limitations faced by private hospitals, which did not receive the same government funding support as public hospitals, exacerbated service delivery gaps. These challenges contributed to increased patient referrals, relay referrals, and even temporary service closures, as hospitals became overwhelmed with caseloads and healthcare worker infections, as reported by Hud et al. (2020). Consequently, the pandemic not only exposed gaps in infrastructure and financing but also highlighted the fragility of maternal service continuity during public health emergencies, particularly in decentralized health systems.

Furthermore, the managerial aspect findings showed that almost all hospitals (96.2%) have implemented the Infection Prevention and Control program and have trained all staff to handle COVID-19 patients. Additionally, 94.3% had implemented universal screening for COVID-19. Some things that can be improved are 8.6-18.1% of hospitals can make Clinical Practice Guidelines, Clinical Pathways, and flowcharts for treatment for COVID-19 patients, so that services can be of higher quality and standardized. Several other things that were complained about during the FGD were many free referrals, especially during the pandemic. In a tertiary hospital in Surabaya, patients often come to the ER while giving birth with a suspected COVID-19 status. Some of them were diagnosed with PROM, severe preeclampsia, ectopic pregnancy, etc. The patient came alone and was not treated adequately for a referral. At the previous hospital, because the patient showed rapid test positive results, she was advised to go to the tertiary referral hospital immediately due to her positive COVID-19 status. At the beginning of the pandemic, it was challenging for referring hospitals to find special isolation rooms for COVID-19 patients because many hospitals lacked the necessary infrastructure, so they tended to make free referrals. Survey data also shows that many hospitals (32.8%) have not utilized the integrated referral system (SISRUTE) facilitated by the Ministry of Health. This makes coordination between referral hospitals difficult. They tend not to use the SISRUTE system because it is not perfect yet. Response time often took too long, and the program lacked socialization. Additionally, many regional hospitals already had their referral systems in place.

In addition to managerial aspects, financial barriers compounded the operational challenges. Hospital representatives consistently highlighted issues with BPJS Kesehatan claims, particularly regarding COVID-19 diagnostic tests and maternal care services. Delays in claim approvals, administrative burdens, and coding inconsistencies added financial strain, particularly for private hospitals, which lacked government subsidies (Muchsam et al., 2022; Heltiani et al., 2023). This economic instability, in turn, affected the hospitals' ability to sustain COVID-19-specific services, invest in infrastructure upgrades, or hire additional staff during critical periods.

Lastly, staffing shortages have exacerbated the burden on healthcare workers, impacting the quality of care provided to maternal COVID-19 cases (Brazier et al., 2023). Increased workload and burnout have further strained healthcare systems, necessitating comprehensive workforce planning and support strategies (Cordey et al., 2022; Hirshberg et al., 2023). These challenges—diagnostic inefficiencies, infrastructure shortages, financial barriers, and staffing constraints—were deeply interconnected. Addressing one aspect without considering the others would offer only partial solutions. The findings of this study align with international experiences, where hospitals at the first referral level face immense pressure without parallel strengthening of their structural and financial foundations (Perez et al., 2022; Wallace et al., 2023). It also reinforces the WHO's recommendations that hospitals offering maternal COVID-19 care must be comprehensively prepared with isolation rooms, neonatal intensive care units (NICUs), operating theaters for infectious cases, and sustainable diagnostic and workforce support systems (WHO, 2020).

Building maternal healthcare resilience during pandemics requires more than ensuring sufficient staffing. It demands investments in infrastructure readiness, operational financing, diagnostic reliability, and efficient referral coordination. The heavy reliance on Level C and D hospitals during the COVID-19 pandemic, facilities not initially designed for high-complexity pandemic management, exposes systemic vulnerabilities that must be urgently addressed. Strengthening lower-

level hospitals with adaptive capacity, flexible infrastructure, and integrated health information systems is essential for safeguarding maternal and neonatal outcomes in future public health emergencies. A key strength of this study lies in its comprehensive mixed-methods approach, combining large-scale survey data with in-depth qualitative findings across diverse hospital types and COVID-19 risk zones. This methodology allowed for a nuanced understanding of both system-wide trends and contextual operational challenges.

Nevertheless, the study has its limitations. Reliance on self-reported data introduces the risk of reporting bias, and the findings are context-specific to East Java, thereby limiting their broader generalizability. Moreover, because the pandemic was dynamic, hospital readiness levels could have evolved after the data collection period.

Conclusion

Based on the findings from the surveys and focus group discussions among COVID-19 referral hospitals in East Java, Indonesia, several critical conclusions and recommendations emerge. Hospitals faced significant challenges during the pandemic, including diagnostic delays due to limited PCR testing capacities and a reliance on rapid tests, which impacted the quality and timeliness of maternal healthcare. Facility readiness varied, with notable deficits in COVID-19-specific infrastructure, such as negative pressure rooms and isolation facilities, despite having adequate PPE supplies. Financial constraints, particularly concerning BPJS claim approvals, added strain, necessitating streamlined processes and improved communication.

To address these challenges, it is crucial to enhance diagnostic capabilities by expanding PCR testing infrastructure and reducing reliance on rapid tests. Improving facility readiness through targeted investments in COVID-19-specific infrastructure and ensuring adequate staffing is essential. Streamlining BPJS claim processes and enhancing financial support mechanisms will alleviate the financial burdens on hospitals. Finally, supporting healthcare workers through comprehensive workforce planning and resilience-building measures is imperative. Collaborative efforts among stakeholders, including healthcare providers, policymakers, and insurers, are essential to fortify maternal COVID-19 care and ensure resilient healthcare delivery in future health emergencies.

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Declaration of Interest

The authors declared that there are no competing interests.

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