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Evaluation of the Measles/MR Supplemental Immunization Program for Children Under Two Years in the Palu City Health Office Working Area

Muhammad Jusman Rau[1]*, Stefiani Bengan Laba[1], Dilla Srikandi Syahadat[1], Marselina[1], Nur Hikmah Buchair[1], Nur Fadhilah Sari[1], Nur Azizah Azzahra[1]

[1] Department of Epidemiology, Faculty of Public Health, Tadulako University, Indonesia

Corresponding Author Email: Jusmanepid06@gmail.com

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ABSTRACT

Measles and rubella (MR) remain significant public health concerns in Indonesia, with outbreaks linked to low immunization coverage. A notable measles outbreak in October 2023 underscored the urgency of achieving herd immunity through high vaccination rates. The Ministry of Health targets 100% coverage for supplemental MR immunization; however, in 2022 Central Sulawesi reached only 30.4%, and in 2024 Palu City recorded 57.8%, both far below the target. This study aimed to evaluate the implementation of the measles/MR supplemental immunization program in 14 CHCs under the Palu City Health Office. A descriptive, quantitative, evaluative approach was employed to identify the program's strengths and weaknesses, which were assessed across input, process, and output dimensions using questionnaires. Regarding input, 100% of the CHCs had immunization officers with relevant educational qualifications, and 93% had received immunization-specific training. The process showed high compliance with SOP documentation: 100% of CHCs recorded vaccine temperature, inflow/outflow, and calculated remaining stock at every issuance, while 93% maintained individual stock cards, documented VVM status, and recorded equipment such as needles, syringes, and cold chain devices by type and quantity. However, only 86% recorded immunization logistics in general logbooks. The output showed that 86% of CHCs failed to meet the 100% immunization coverage target. Overall, these findings highlight gaps in training, service delivery, and community awareness that must be addressed to improve coverage and prevent future outbreaks. The MR supplemental immunization program in Palu City should be strengthened by ensuring annual training for immunization officers, enforcing complete SOP documentation, including vaccine stock and logistics recording, and implementing targeted outreach to improve coverage in CHCs that failed to meet the 100% target.

Key Messages:

- The low coverage of the measles/MR supplemental immunization program in Palu City highlights critical gaps in training, service delivery, and community awareness that must be addressed to achieve national targets and prevent future outbreaks.
- Misinformation, limited maternal knowledge, and the perception that immunization is sufficient only until nine months remain major barriers, underscoring the importance of strengthened health education and community engagement.

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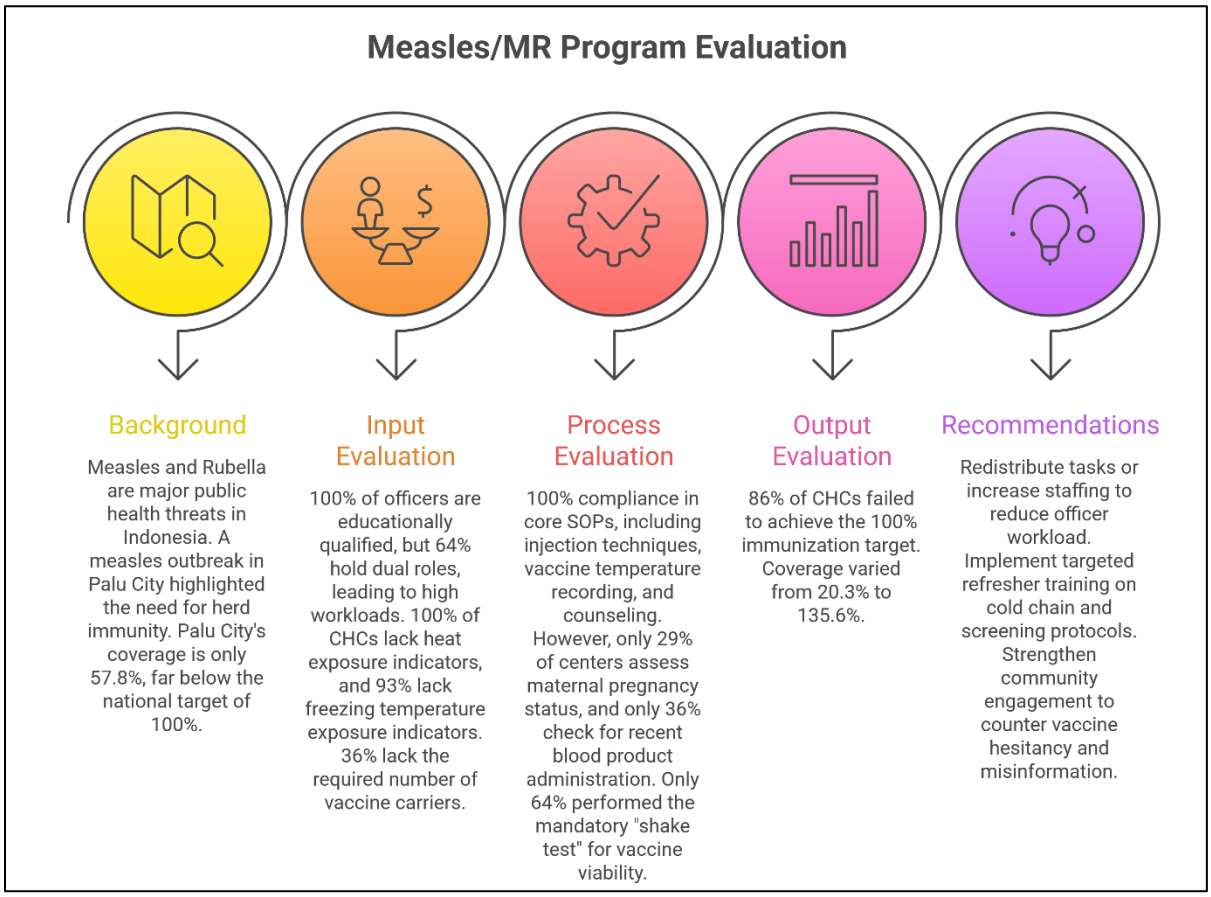
GRAPHICAL ABSTRACT



INTRODUCTION

Measles and rubella (MR) are among the most significant vaccine-preventable diseases (VPDs) globally and nationally, posing a serious public health challenge due to their high transmissibility and potential complications. Despite the availability of effective vaccines, outbreaks continue to occur when immunization coverage is inadequate. Approximately 10.3 million people were globally infected with measles in 2023. In Indonesia, a measles outbreak in October 2023 underscored the urgency of achieving herd immunity, which affected multiple regions, including Central Sulawesi. This event highlights the need for strong immunization programs and consistent coverage to prevent future outbreaks (1–3).

Immunization is an essential public health effort to induce or enhance individual immunity against vaccine-preventable diseases (4), making it one of the most cost-effective health interventions and a fundamental component of services provided in CHCs (5). Immunization coverage is closely linked to herd immunity; when immunization rates among infants and children are low, herd immunity declines, thereby increasing the risk of outbreaks (6). According to WHO data, in 2021 there were 51 million children worldwide did not receive complete immunization in 2021, an increase of 5.9 million compared to 2019 (7). In the Philippines and Malaysia, recurring measles have been linked to suboptimal immunization coverage (8,9). Similar to the pattern in Indonesia, 1,455,276 children did not receive complete immunization between 2018 and 2022 (7).

The Ministry of Health has set a target of 100% coverage nationwide for complete basic immunization by 2023. However, only six provinces succeeded in meeting the 2023 strategic plan target for 2023, a decrease from nine provinces in 2022 (10). In Central Sulawesi Province, 89.3% of the population was fully immunized. Nevertheless, the coverage of the measles/MR supplemental immunization program remained relatively low, at only 30.4% of the targeted 100% (11). In Palu City, coverage for the measles/MR supplemental immunization program increased from 28.9% in 2023 to 57.8% in 2024, but still fell short of the strategic target.

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Low immunization coverage is strongly associated with the occurrence of disease outbreaks. Notably, a measles outbreak occurred in Palu City in 2023, as well as in many other districts and cities across Indonesia and in other Southeast Asian countries. However, no evaluation of the measles/MR supplemental immunization program has been conducted in Palu City. This study aimed to fill this gap by assessing the program's implementation across CHCs under the Palu City Health Office, focusing on input, process, and output dimensions to identify specific barriers and facilitators and provide evidence-based recommendations.

METHODS

The data sources consisted of secondary and primary data. Secondary data were obtained from the Palu City Health Office Profile and the 14 CHCs' immunization records (for output assessment). Primary data were collected through observation and structured interviews using a closed-ended questionnaire adapted from Regulation of the Minister of Health of the Republic of Indonesia Number 12 of 2017 concerning the Implementation of Immunization (input, process), Anggraini et al. (2016) (input), and Majid et al. (2025) (process). The questionnaire covered two dimensions: input and process, covering 14 subtopics. The input dimension included 8 subtopics such as age (1 closed-ended question), gender (1 closed-ended question), educational background (1 closed-ended question), length of service (1 closed-ended question), immunization training history (1 closed-ended question, using a nominal scale, with Yes = 1 and No = 0, and 1 open-ended question), role (2 items), funding (1 closed-ended question, using a nominal scale, with Yes = 1 and No = 0, and 1 open-ended question), vaccine logistic (1 closed-ended question, using a nominal scale, with Yes = 1 and No = 0), cold chain (1 closed-ended questions, using a nominal scale, with Yes = 1 and No = 0, and 6 closed-ended questions using ratio scale), and Immunization Service Documents (4 closed-ended questions, using a nominal scale, with Yes = 1 and No = 0). The process dimension consisted 6 subtopics, including promotion related to immunization (1 item), target assessment and screening (target assessment (4 closed-ended questions, using a nominal scale, with Yes = 1 and No = 0] and screening (7 closed-ended questions, using a nominal scale, with Yes = 1 and No = 0]), counseling (3 closed-ended questions, using a nominal scale, with Yes = 1 and No = 0], preparation of diluent and shake test (2 open-ended questions], injection (2 open-ended questions], and recording and reporting (7 closed-ended questions, using a nominal scale, with Yes = 1 and No = 0]].

The majority of responses were measured using a nominal scale, with Yes = 1 and No = 0 , and interpreted simply as "implemented" or "not implemented" without further categorization. The output dimension was assessed using the immunization coverage rates obtained from the official records of the Palu City Health Office and CHCs. Indicators for all dimensions were based 100% on compliance with the Regulation of the Minister of Health of the Republic of Indonesia Number 12 of 2017 and Palu City Health Office standards. The content validity was ensured through an expert review by public health professionals.

Data analysis was performed using descriptive statistics, including frequency and percentage distributions for each indicator using Excel, and presented in the form of tables. Compliance levels across input, process, and output dimensions were compared using cross-tabulations. Mean scoring was not applied because all variables were measured on a nominal scale.

RESULTS

Input

Table 1. Evaluation of Input in Implementing the Advanced Immunization Program

Category	n	%
Human Resources		
Age Group		
30-34 Years	3	21
35-39 Years	1	7
40-44 Years	4	29
45-49 Years	3	21
50-54 Years	2	14
55-58 Years	1	7

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Gender		
Male	1	7
Female	13	93
Last Education		
Diploma III in Midwifery	5	36
Diploma III in Nursing	4	29
Diploma IV in Nursing	1	7
Bachelor of Science in Nursing	1	7
The Professional Nurse Program	3	21
Immunization Training		
Ever	13	93
Never	1	7
Duration of the assignment		
1-5 Years	3	21
6-10 Years	3	21
>10 Years	8	57
Multiple Roles		
Multiple	9	64
Single	5	36
Funding		
Funding availability	14	100
Facilities and infrastructure		
Vaccine logistics		
Vaccine stock	14	100
Cold chain		
Refrigerator	14	100
Vaccine Carrier		
a. 2	1	7
b. 3	4	29
c. 4	4	29
d. 5	2	14
e. >5	3	21
Cool pack		
>=20	14	100
Thermometer		
a. 1	4	29
b. 2	9	64
c. 3	1	7
Freezing temperature exposure indicator		
a. 1	7	50
b. 2	6	43
c. 4	1	7
Heat exposure indicator		
a. 0	5	36
b. 1	3	21
c. 2	6	43
Generator		
Generator Availability	12	86
Immunization Service Documents		
Immunization Record Book (Infant Cohort)	13	93
Maternal and Child Health Book	12	86
Vaccination Reporting Format	12	86
Auto-Disabled Syringe Reporting Format	8	57

Table 1 shows that one immunization officer (7%) had never attended immunization training, and 64% of officers were assigned dual responsibilities. According to the Ministry of Health Regulation No. 12/2017, the minimum cold chain requirements include one refrigerator, three vaccine carriers, 20 cool packs, one thermometer, four freezing indicators, and four heat exposure indicators. Several components did not meet these minimum standards: 36% of CHCs lacked the required number of vaccine carriers; 93% had insufficient indicators of freezing temperature exposure; all CHCs (100%) lacked the required heat exposure indicators; and 14% lacked a generator to maintain temperature stability. Although most immunization service documents were available, compliance with the ADS reporting format remained low, with only 57% of CHCs meeting this requirement (Table 1).

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Process

Table 2. Evaluation Process of the Measles/MR Booster Immunization Program for Children Under Two Years of Age

Type of Assessment	n	%
Health Promotion		
Implementation of health promotion	14	100
Target assessment and screening		
a. Target Assessment		
Identifying the infant's age	14	100
Identifying vaccines previously received by infants	14	100
Determining the type of vaccine to be administered	14	100
Consulting a pediatrician for sick infants or those with a history of seizure	14	100
b. Screening Assessment		100
Asking about mothers' and children's condition today	14	100
Asking if the child is allergic to food or medication	13	93
Questions about problems after previous immunization	14	100
Questioning about a history of malignancy or long-term steroid use	8	57
Asking if anyone at home has immune system problems	7	50
Asking if the child has received blood products in the past year	5	36
Asking if the mother is pregnant or planning to become pregnant	4	29
Counseling		
Explaining the benefits of the vaccine	14	100
Explaining the immunization schedule and the importance of the MCH book	14	100
Explaining mild side effects and managing them	14	100
Preparation of the diluent and the shake test		
Storing the diluent in the refrigerator for 12 h before use	11	78
Performing the shake test	9	64
Injection		
Administering the injection according to the SOP (left arm for MR/measles)	14	100
Disposing of used syringes in the safety box	14	100
Recording and reporting		
Temperature Recording	14	100
Vaccine inflow and outflow must be recorded in detail according to type, quantity, and batch number.	14	100
Remaining or stock vaccines and diluents must always be calculated with every receipt or issuance of vaccines and diluents.	14	100
Each vaccine type must have its own stock card	13	93
The VVM condition at the time of receiving and issuing vaccines must be recorded in the SBBK.	13	93
Immunization logistics inflow and outflow (ADS, safety **boxes, and cold** chain equipment), including vaccines and diluents, **must** be recorded in the general logbook.	12	86
Record equipment such as needles, syringes, and cold chain devices by type and quantity.	13	93

The process evaluation revealed several critical gaps in the implementation of immunization services across CHCs, particularly in the screening, diluent preparation, shake test, and recording and reporting components, as shown in Table 2. While basic screening questions were consistently asked, compliance for essential risk-related assessments declined sharply, with only 93% of CHCs asking about allergies, 57% asking about a history of malignancy or long-term steroid use, 50% identifying household immune system problems, and even fewer assessing blood transfusion history (36%) or maternal pregnancy status (29%). Similar weaknesses were observed in diluent preparation and shake test procedures: only 78% of CHCs stored diluents in the refrigerator for the recommended 12 h before use, and only 64% performed the shake test. Documentation practices also showed notable deficiencies: only 93% of CHCs maintained individual stock cards and recorded VVM status, while only 86% recorded the inflow and outflow of immunization logistics—such as AutoDisable syringes and cold chain equipment—in general logbooks. Moreover, only 93% of CHCs recorded equipment such as needles, syringes, and cold chain devices by type and quantity (Table 2).

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Output

Table 3. Evaluation Output of the Measles/MR Booster Immunization Program for Children Under 2 Years of Age

Community Health Center (CHC)	Target achievement in 2024 (%)
Mabelopura	41,4
Singgani	50,6
Birobuli	44,2
Talise	44,9
Sangurara	20,3
Lere	51,9
Nosarara	21,5
Tipo	40,6
Bulili	45,5
Kamonji	49,6
Mamboro	41,4
Kawatuna	105,4
Pantoloan	135,6
Tawaeli	46,8

The results from Table 3 indicate that 12 CHCs, representing 86%, have not yet achieved the targeted 100% coverage for measles/MR booster immunization among children under 2 years old. These CHCs include Mabelopura (41.4%), Singgani (50.6%), Birobuli (44.2%), Talise (44.9%), Sangurara (20.3%), Lere (51.9%), Nosarara (21.5%), Tipo (40.6%), Bulili (45.5%), Kamonji (49.6%), Mamboro (41.4%), and Tawaeli (46.8%) (Table 3).

DISCUSSION

These findings are important for the immunization program in Palu City because immunization coverage is still low among 14 CHCs, and most CHCs failed to reach the target of 100% MR immunization coverage for children under 2 years old. Low coverage increases the risk of measles/rubella outbreaks, as observed during the October 2023 measles outbreak. The issues involve a combination of resource gaps and process weaknesses. Several CHCs did not meet cold chain standards, including insufficient vaccine carriers and inadequate heat/freezing exposure indicators. In addition, many immunization officers were assigned multiple roles, creating workload constraints that may affect service quality. The process here is non-compliance with SOPs in detailed screening, shake test, and logistics documentation, and the output, such as low coverage, is mainly caused by misinformation, lack of maternal knowledge, and misconceptions about immunization schedules.

The results obtained were possible because many CHC staff hold dual roles, which may reduce service quality and timeliness. This indicates that good practices exist and can be replicated. These findings emphasize that strategies to improve coverage should focus on task redistribution or additional staffing, targeted retraining (screening, cold chain management), strengthening community education to counter misinformation, and strict SOP documentation supervision.

The evaluation highlights that low MR immunization coverage in Palu City occurs alongside resource gaps and process weaknesses. Although vaccine stocks were generally available and most officers had received training, shortcomings in cold chain equipment and workload constraints, combined with inconsistent screening practices, shake tests, and documentation, reduce service quality. These gaps increase the risk of missed contraindications and compromise vaccine safety.

Human resource constraints further intensify these issues. Our findings show that the majority of immunization officers held dual roles, which likely reduces the time required for thorough screening and accurate record-keeping. This aligns with Anggraini (2016), who reported similar challenges in measles surveillance due to multiple responsibilities. Task overload may explain why SOP compliance is high for core activities (injection, counseling) but inconsistent for detailed procedures (12).

Interestingly, several CHCs exceeded 100% coverage, indicating the presence of positive deviance. Investigating their strategies, such as community engagement or proactive outreach, could provide replicable models for other CHCs. Overall, the causal link between input, process, and output is clear:

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inadequate resources, process weaknesses (screening, documentation), and behavioral barriers translate into suboptimal output (coverage below 100% in majority of CHCs).

Input

Human Resource

Health workers are one of the human resource input components responsible for implementing SIU. Many staff members held multiple roles or positions. The number of programs they manage is one factor influencing the performance of health workers. The greater the number of programs assigned to health workers, the higher their workload, which can reduce productivity and work quality and result in untimely or suboptimal execution of tasks. This is consistent with the study by Dian Anggraini et al. (2016), which reported that measles surveillance officers at both district and CHC levels all (100%) held additional roles besides their surveillance duties, making it difficult for them to conduct surveillance activities, particularly in terms of time allocation(12).

The findings show that most immunization staff had attended immunization training. The training covered cold chain maintenance, AEFI, case studies, vaccine management policies, safe injection techniques, vaccine side effects, data entry, and vaccine logistics management. However, one immunization officer at a CHC had not yet received training as they had only worked as an immunization officer for one year. This may affect service quality because health workers' competencies are not updated according to the latest technical guidelines. Training improves skills and efficiency, ensuring that health workers deliver safe and standard-compliant immunization services. In line with the study by Marlen Tiblola et al. (2025), strengthening the capacity of health workers through continuous training is a primary strategy for reinforcing primary healthcare systems, particularly in addressing the evolving burden of communicable diseases(13).

Financing

Financing is a critical subsystem in the delivery of healthcare services. Each CHC within the working area of the Palu City Health Office has received a budget for immunization implementation. The budget is allocated according to the needs of the fiscal year's planned program. Several important factors influence financing in healthcare service delivery, including the amount (quantity) of health funding provided by the government or through private sector contributions, as well as the effectiveness and efficiency of the utilization (functionalization) of the available budget.

To ensure the availability of healthcare funding, management mechanisms must be agreed upon and consistently implemented by all stakeholders, including government, private sector, and the community, so that resources are effectively and efficiently used. This is essential to support health development and to improve the health of the population to the highest possible standard. Kareba (2020) reported that 78.9% of midwives at Marawola CHC stated that the MCH program budget was sufficient and disbursed on time, which contributed to the provision of quality health services. Such delays become obstacles to optimizing service delivery and reducing the effectiveness of interventions in the field(14).

Facilities and infrastructure

Healthcare facilities and infrastructure refer to the effective and efficient utilization of all health resources. The adequacy of facilities and infrastructure is crucial for ensuring client satisfaction. The facilities and infrastructure considered in this evaluation include pharmaceutical supplies, medical equipment, and supporting instruments such as vaccines, cold chain equipment, and vaccination recording documents. The details of each variable are as follows: The availability of vaccines, including measles vaccination, is a critical component of immunization programs. The evaluation of vaccine availability encompasses aspects such as quantity, type, timeliness of distribution, storage (cold chain), and accurate recording systems. Without sufficient and quality-assured vaccines, immunization services cannot function optimally. The evaluation results indicated that all CHCs in Palu City maintained adequate vaccine stocks for the implementation of supplemental immunization for children aged 2 years. Vaccine procurement follows established SOPs, whereby staff provide detailed vaccine requirements to the CHC pharmacy

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manager, who then collects the vaccines from the health office. The procurement, distribution, and management systems for vaccines must be regularly evaluated to ensure the sustainability of immunization programs. Such evaluation is also essential for achieving optimal, effective, and responsive healthcare services. Consistent with the study by Majid et al. (2025) at CHC Tegal Selatan and CHC Tegal Timur, the availability of basic immunization program facilities, including vaccines, syringes, safety boxes, and standardized cold chain equipment, was generally complete and in good condition. However, some vaccines experienced occasional stock shortages at certain CHCs (15).

All CHCs within the Palu City Health Office area are equipped with top-opening refrigerators. Each CHC also contains vaccine carriers and cool packs. Although some CHCs have an insufficient number of vaccine carriers relative to their service areas, the carriers are stored at the CHCs, and each area conducting posyandu (integrated health posts) is required to collect and return the carriers to the CHCs. Regarding temperature monitoring, several CHCs have adequate equipment, such as a one-thermometer unit, vaccine carrier, heat exposure indicator, and generator. Freeze indicators are essential components of the vaccine cold chain system at each CHC, as the absence of such indicators increases the risk of using compromised vaccines, directly affecting public health, immunization program effectiveness, and vaccine budget efficiency. According to Ministry of Health Regulation No. 12 of 2017, cold chain equipment and supporting tools are mandatory for immunization services. As immunization service units, CHCs must have adequate temperature monitoring equipment to maintain vaccine quality and effectiveness. Generators play a critical role in maintaining vaccine effectiveness, particularly in the cold chain system, by providing backup power during outages to keep storage temperatures stable. All CHCs should have reliable generators or alternative power sources, such as solar panels, with proper routine maintenance. According to the 2017 Ministry of Health Regulation No. 12 of 2017, immunization service facilities must have cold chain equipment and supporting tools, including standby generators, as power outages can cause temperature fluctuations that damage vaccines(16).

Documents Recording by the Immunization Service

The immunization recording documents include the immunization result book (infant cohort), vaccine temperature monitoring cards, vaccine and logistics stock books, and the local area monitoring (PWS) reporting format. The child's parents hold each immunization result book (infant cohort) to facilitate the immunization process. Immunization service recording documents are essential components of immunization program implementation, supporting decision-making in planning, implementing, and evaluating immunization activities. The Ministry of Health Regulation No. 12 of 2017 on the Implementation of Immunization mandates the maintenance of immunization recording and reporting documents, including infant cohort books, vaccine temperature monitoring cards, vaccine and logistics stock books, and reporting formats such as PWS (Local Area Monitoring)(16).

Process

Implementation

Each CHC conducted temperature recording in the morning and evening before staff left, along with documenting vaccine inflow and outflow according to type, quantity, and batch number. In addition, remaining or stock vaccines and diluents were always accounted for during receipt or distribution. Vaccines that were not fully used during off-site services were returned, stored, and prioritized for use in the next service session.

CHC staff carried out effective vaccination promotion activities within the Palu City Health Office working area. Promotion was conducted during CHC service hours and at posyandu activities, following various stages in accordance with the SOPs. This study aimed to enhance parents' or caregivers' knowledge of the immunizations provided to children under two. Fata et al. (2025) reported similar findings, emphasizing that education should include not only information on vaccine types but also counseling on potential side effects and how to manage them. A two-way communication approach through counseling was found to be effective, allowing caregivers or parents to ask questions and receive adequate explanations to address their concerns(17).

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Almost all health workers conducted pre-immunization activities, including inquiries about medical history and physical checks of vaccines. Kumar et al. (2023) reported similar results, finding that 60% of staff checked VVM, batch numbers, and expiry dates, whereas 80% of non-compliant staff did not strictly follow established procedures(18).

Output

The target for measles/MR booster immunization coverage for children under two (baduta) in the Palu City Health Office is 100%. However, the majority of CHCs did not achieve the established target , primarily due to multifactorial barriers. Perceived barriers included limited parental awareness, misconceptions that immunization is complete at nine months, misinformation about vaccine side effects, and caregiver absenteeism based on health worker perceptions obtained during structured interviews. These perceptions do not represent data collected from parents or community members.

Previous studies supported this result. Misinformation shared on social media, doubts about halal compliance, lack of knowledge among health personnel, unfavorable family attitudes and customs, past negative experiences, and false information about vaccine reactions contributed to the decrease in vaccination demand in Indonesia (19). In addition, the COVID-19 pandemic reduced routine immunization coverage (20). The constraints related child immunization faced by low- and middle-income countries, such as weak health systems, limited staff and vaccine supply, practical challenges for caregivers, including cost, distance, and waiting time, social norms and fear, poor service quality, and administrative constraints (21). Factors related to vaccination at the appropriate age included mothers' education, health services engagement, birth order, and limited access (22). Additionally, transient populations living in rented or temporary housing face challenges in accessing routine immunization services, consistent with evidence that high mobility and migration status contribute to coverage gaps in urban and peri-urban areas (23,24). Addressing these obstacles is essential for improving the coverage of immunization for children under two.

This study has several limitations. It only provides a descriptive overview of the program and does not analyze the relationship between cause and effect. The data were summarized using simple percentages without advanced statistical tests; therefore, interpretation was limited. Additionally, the information was based on self-reports from health workers, which could lead to bias. However, the findings can still serve as useful information for improving the immunization program in Palu City.

CONCLUSION

Human resource inputs—such as educational qualifications and training—generally met the required standards. In contrast, the equipment and workload inputs did not. Specifically, 64% of immunization officers held dual roles, and several CHCs lacked the minimum number of vaccine carriers and temperature exposure indicators required for cold chain compliance. The process followed the SOPs for injection and counseling, but the implementation of detailed screening and shake test was inconsistent. The output showed that most CHCs failed to achieve the target coverage.

Procedural non-compliance and behavioral barriers not resource limitations primarily cause the low MR immunization coverage in Palu City. Although funding and vaccine availability are sufficient, screening, shake test, and documentation weaknesses undermine service quality. Additionally, 64% of officers holding dual roles reported workload issues that affected SOP adherence. To address these challenges, context-specific recommendations are required: redistribute tasks or add staff to reduce workload, implement targeted refresher training on screening and cold chain management, strengthen documentation compliance supervision, and enhance community engagement to counter misinformation. Integrating these measures into local health policies will not only improve service quality and coverage but also contribute to achieving national immunization targets and preventing future outbreaks.

Although human resource inputs—such as officer qualifications and training—generally met the required standards, significant gaps were identified in equipment availability and workload distribution. Cold chain equipment did not fully comply with the Ministry of Health standards, and 64% of officers held dual roles, which may compromise service quality and timeliness. These findings indicate that resource adequacy alone is insufficient; addressing equipment shortages and reducing staff workload are critical for

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improving program effectiveness.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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