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# Assessment on immunization status of infants in selected barangay in Tuguegarao City: Basis for enhancement of intervention program plan

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**Abstract**

**Aim:** This study examined the relationship between mothers' perceptions of local infant immunization interventions and the actual immunization status of their infants in three barangays of Tuguegarao City, and used the findings to propose enhancement strategies for local intervention planning.

**Methodology:** A descriptive-correlational design was employed. Using Cochran's formula and stratified sampling, 175 mothers (aged 20–35) of infants aged 0–12 months completed a structured questionnaire assessing sociodemographic characteristics, perceived effectiveness of five intervention domains (educational promotion; telephone calls/reminders; mass media; identification of target children; evaluation of immunization status), and infants' vaccine uptake. Reliability testing (Cronbach's α = 0.74), descriptive statistics, and Pearson correlation (α = 0.05) were used for analysis.

**Results:** Coverage was high for early doses (BCG and Hepatitis B birth dose = 100%), moderate for several vaccines (pentavalent 90.3%; OPV 90.9%; PCV 91.4%; IPV 90.9%), and low for MMR (fully immunized = 15.4%). Correlation analyses showed no statistically significant relationship between mothers' assessments of intervention programs and infants' immunization status (all $p > 0.05$), indicating that perceived program effectiveness alone did not predict complete vaccination. Contextual factors such as service availability, follow-up systems, and access barriers likely contributed to incomplete coverage.

**Conclusion:** Strengthening community outreach, improving access (including mobile clinics and tracking systems), and providing ongoing competency-based training for Barangay Health Workers (BHWs) are recommended to improve full immunization coverage in the targeted barangays.

***Keywords:*** *infant immunization status; immunization intervention; vaccination coverage; barangay health workers; Tuguegarao City*

## INTRODUCTION

Childhood immunization remains one of the most powerful and cost-effective achievements in public health, providing long-term protection against diseases that can cause disability and death (World Health Organization, 2025). Despite significant global and national efforts, immunization gaps persist, particularly in Geographically Isolated and Disadvantaged Areas (GIDAs), which continue to threaten progress toward the Alma-Ata Declaration and the Sustainable Development Goals, especially SDG 3 (Good Health and Well-Being) and SDG 8 (Decent Work and Economic Growth).

Globally, routine immunization coverage declined during the COVID-19 pandemic due to disruptions in health systems and delays in vaccine delivery. The third dose of the diphtheria-tetanus-pertussis vaccine (DTP3) reached 86% in 2019 but fell to 81% in 2021 (WHO, 2023; UNICEF, 2024), leaving an estimated 67 million children partially or entirely unvaccinated. Sato et al. (2023) reported that in Cambodia, one infant out of 35 born to HBsAg-positive mothers became infected despite completing the full vaccination and prophylaxis schedule. The study found that maternal viral load and HBeAg seropositivity were the main risk factors, and that vaccination coverage could not be a sufficient measure to provide holistic protection. In turn, the availability and reach of immunization programs as well as the attitudes, confidence, and sensitivity of caregivers to immunization programs in relation to low-coverage

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communities, in particular, are all key elements in need of assessment since the variables of behavior can mediate the effectiveness of programs.

The Expanded Program on Immunization (EPI) endeavors to provide continuous and free vaccinations against childhood diseases in the Philippines; however, current coverage is below the ideal target of 95% of the national population (UNICEF, 2024). Zhang et al. (2025) reported that a proportion of 75% Filipino kids had been vaccinated against the Bacillus Calmette Guerin (BCG) and hepatitis B birth dose, only around two-thirds of them had been vaccinated against the DTP, oral polio and pneumococcal conjugate vaccine (PCV), and just an extent of half had the measles mumps rubella (MMR) vaccine.

The recent statistics show that there is a worrying trend in the regional coverage. According to the Department of Health (DOH, 2022), the coverage of Region 2 in 2021 was only 73.44%, which decreased to 57.2% in 2022. This also worsened to 49.7% in Tuguegarao City, and other neighboring provinces, Cagayan, Isabela, and Nueva Vizcaya recorded huge losses. Such decreasing tendencies have been attributed to logistical barriers, increased prices of new vaccines, inefficiency within the systems, human resource limitations, the introduction of immunization in teens and adults into the immunization schedules and widespread vaccine misinformation.

Socio-cultural and behavioral factors also define the uptake of vaccines. The attitude of caregivers, their religious beliefs, misinformation, and conflicting priorities of the household determine the decision to vaccinate as well as the timeliness of immunization (Maturan, E. et al., 2022; Dalisay et al., 2025). The qualitative studies carried out in low-coverage Philippine settings emphasize the fact that community trust, risk-benefit perception, and access are still crucial factors that determine the vaccination behavior (Dalisay et al., 2025). However, immunization remains a cost-effective measure; Ahmed et al. (2025) have determined that pneumococcal vaccination has significant health and economic returns compared to the situation in non-vaccination.

Although there is a series of national initiatives and previous studies on childhood immunization, limited research has been done to examine vaccine uptake, literacy, and determinants of behavior in low-coverage urban regions such as Region 2 as seen in Tuguegarao City. Not many studies have been able to bring together socio-cultural and systemic factors in order to provide policy-makers and community leaders with a set of recommendations that can be put into practice. Thus, this study aims at addressing this gap by assessing the knowledge, attitudes, and practices of caregivers regarding childhood immunization at the Tuguegarao City. The focus on behavioral and systemic determinants in a geographically and culturally localized setting provides the study with new insights that can be utilized to implement specific interventions in order to improve vaccine coverage and literacy.

**Review of Related Literature and Studies**

Immunization can be defined as the introduction of vaccines to enhance the immune system to produce antibodies that inhibit infections (Jayaraj et al., 2023). In addition to offering personal protection, immunization also has a contribution to herd immunity, diminishing the spread of diseases in the community. According to Siddiqui (2022), vaccination is one of the most affordable public health interventions, especially in developing states where communicable diseases stand out as one of the primary causes of morbidity and mortality.

The recent studies emphasize medical and social aspects of vaccination. According to Fortmann et al. (2022), vaccines are best implemented at appropriate intervals and thus boost the immune response. Nevertheless, the maternal immunization can have an effect on infant immunity; Abu-Raya et al. (2021) revealed that babies born to mothers who received Tdap immunization showed lower IgG concentrations against pertussis, diphtheria, and specific serotypes of SPN immunization after their own immunizations than infants whose mothers had not received any immunization. The COVID-19 pandemic also contributed to the disruption of the vaccination campaigns, causing the global DTP3 coverage to decrease to 81% in 2021, compared to 86% in 2019 and leaving an estimated 67 million children with either partial or no vaccination (WHO, 2023; UNICEF, 2024).

Nevertheless, the direct relationship between the perception of immunization intervention programs by mothers and the actual vaccination status of their infants, especially in low-coverage barangays is not well investigated (Dalisay et al., 2025). This gap arises due to the fact that most of the available studies in the Philippines are based on program implementation considering the viewpoint of health workers or system-level barriers, and provide little focus on maternal perception as a behavioral determinant. Moreover, the barangay level analysis of how mothers perceive, believe, and react to certain forms of interventions like reminders, education campaigns, and child-tracking systems also are limited (Bacacao et al., 2024).

Childhood immunization in developing nations is still hindered by socio-economic and systems constraints. Mahachi et al. (2022) cited poverty, inadequate health infrastructure and personnel, and cultural or religious resistance as the barriers. Equally, Fazal et al. (2023) revealed that parental education, socio-economic status, and place of

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delivery played a significant role in the immunization uptake in India and therefore emphasized the role of social determinants. The factors related to access are also important; GebreEyesus et al. (2021) found that incomplete vaccination was closely linked to rural dwelling, the long distance to health centers, and low service rates. These challenges can be addressed, however, through community-based interventions. Wightman (2022) proved that personal contact and involvement of community health workers in Arizona positively affected vaccination rates and the importance of trust and outreach to overcome logistical and attitudinal hurdles.

Similar patterns have been observed in the context of the Philippines. According to Dalisay et al. (2025), community trust, perceived risk-benefit, and such access to services are powerful determinants of vaccination behavior in low-coverage areas. Quintos et al. (2022) have observed that national vaccine schedule is not known by many Filipino parents and affordability and accessibility are the major factors that influence whether a child is fully immunized or not. The usefulness of community engagement, culturally-sensitive education, and systematic follow-up in enhancing vaccination is also supported by local studies (Pitaloka and Handayani, 2021; Fazal et al., 2023).

**Theoretical Framework**

This study is anchored on the PRECEDE–PROCEED Model, developed by Lawrence Green and Marshall Kreuter (2014), which provides a systematic approach to planning, implementing, and evaluating health programs. The model is widely used in public health to analyze behavioral, environmental, and policy-related factors that influence health outcomes. PRECEDE focuses on diagnostic assessments, identifying predisposing, enabling, and reinforcing factors that shape health behaviors, while PROCEED emphasizes implementation and evaluation of interventions to achieve desired outcomes.

In the context of childhood immunization, predisposing factors include caregivers' knowledge, attitudes, and beliefs about vaccines; enabling factors comprise access to immunization services, availability of vaccines, and supportive health policies; and reinforcing factors involve community norms, healthcare worker support, and follow-up reminders. Studies such as Vadrevu et al. (2024) have demonstrated the model's relevance, showing that behavioral and social drivers strongly influence routine childhood immunization in low- and middle-income countries.

Guided by this framework, the present study evaluates caregivers' knowledge, attitudes, and practices, as well as barangay-level immunization programs in Tuguegarao City. By identifying the predisposing, enabling, and reinforcing factors affecting vaccine uptake, the study aims to develop evidence-based, context-sensitive strategies that strengthen local immunization efforts and improve overall community health outcomes.

**Conceptual Framework**

The conceptual framework outlines the hypothesized association between the immunization intervention programs and immunization status of the infants in the selected barangays of Tuguegarao City. The independent variable (IV) will constitute educational promotion, immunization calls and reminders, identification of the targeted children, and assessment of the immunization status, and the dependent variable (DV) is the receipt of age-appropriate vaccines in line with the national schedule. The efficacy of these intervention elements is supported by the recent evidence. Reminder-recall systems such as SMS reminders are always effective in increasing vaccine attendance and timeliness in various settings (Louw et al., 2024).

Similarly, community-based and caregiver-centered interventions, including health education, sensitization, and community engagement, have been shown to significantly increase routine immunization coverage of childhood diseases in low and middle-income countries (Jain et al., 2024; Parsekar et al., 2024). The literature addressing social and structural determinants also emphasizes that maternal education, the use of ante-natal care, and the socioeconomic status of households also affect the completion of vaccines, which is why it is necessary to identify under-immunized children and actively follow them (Williams et al., 2024).

The model assumes that the effectively established interventions related to immunizations can lead to the improvement of knowledge, attitudes, and practices of caregivers and contribute to the increased chances of timely and full vaccination. This premise is supported by empirical evidence that shows that reminders, specific health education, and follow-ups on programs result in increased rates of following the vaccine schedule (Louw et al., 2024; Jain et al., 2024).

The study was based on this framework in designing the survey instrument and analysis. Objects were developed to reflect every element of the IV, including the exposure to education activities, reminders, and follow-up activities, and the measurement of the DV was based on the proven infant vaccination records. The framework facilitates the relationship between the IV and DV by directly connecting the two to determine the true impact of

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intervention programs on immunization coverage which would facilitate actionable information on enhancing local immunization efforts.

**Independent Variable (IV):** Immunization Intervention Program (educational promotion, calls, reminders, identification of targeted children, immunization evaluation)

⬇

**Dependent Variable (DV):** Immunization Status of Infants (completion of age-appropriate vaccines)

**Statement of the Problem**

Childhood immunization remains a critical public health concern, particularly in communities where persistent gaps in vaccine uptake expose infants to preventable diseases. Recent reports have shown declining immunization coverage in several barangays in Tuguegarao City despite the presence of established intervention programs. These interventions—such as educational promotion, telephone reminders, mass media campaigns, identification of target children, and monitoring of immunization status—are designed to support full vaccine completion, yet the coverage rates remain below national targets. This situation raises concerns regarding the effectiveness of current intervention activities as perceived by mothers of infants and how these perceptions correspond to the actual immunization status of their children. Addressing this issue is essential for identifying gaps in program implementation and for developing strengthened, evidence-based enhancement plans that can support increased vaccine uptake in the selected barangays.

**Research Objectives**

**General Objective:**

To assess the immunization status of infants in selected barangays in Tuguegarao City as a basis for enhancing the implementation of infant immunization intervention programs.

**Specific Objectives:**

1. To determine the immunization status of infants based on required childhood vaccines.
2. To assess the effectiveness of infant immunization intervention programs in terms of:
   2.1 Educational promotion
   2.2 Telephone calls and messages
   2.3 Mass media
   2.4 Identification of target children
   2.5 Evaluation of infant immunization status
3. To examine the relationship between immunization intervention programs and the immunization status of infants.
4. To propose an enhancement program plan to strengthen the implementation of infant immunization programs in the selected barangays.

**Research Questions**

1. What is the immunization status of infants in the selected barangays based on required childhood vaccines?
2. How do respondents assess the effectiveness of the infant immunization intervention programs in terms of:
   a. educational promotion,
   b. telephone calls and messages,
   c. mass media,
   d. identification of target children, and
   e. evaluation of infant immunization status?
3. What enhancement strategies may be developed to improve immunization intervention programs and increase immunization coverage in the selected barangays?
4. Is there a significant relationship between the immunization intervention programs and the immunization status of infants?

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**Hypothesis**

- **$H_0$:** There is no significant relationship between immunization intervention programs and the immunization status of infants.
- **$H_a$:** There is a significant relationship between immunization intervention programs and the immunization status of infants.

## METHODS

### Research Design

This study employed a descriptive-correlational design to examine the relationship between immunization intervention programs and the immunization status of infants in selected barangays of Tuguegarao City. This design was appropriate because it allows the collection of quantitative data on existing conditions without manipulating variables, enabling the assessment of naturally occurring relationships. The independent variable, immunization intervention programs, includes educational promotion, calls and messages, mass media campaigns, identification of target children, and monitoring of immunization status, while the dependent variable, infant immunization status, is measured by the completion of age-appropriate vaccines. Mothers or primary caregivers were surveyed regarding program effectiveness, and infants' vaccination records were verified. Data were analyzed using descriptive statistics to summarize program implementation and coverage, and correlation analysis to examine the relationship between the variables. This design provides insight into how the effectiveness of intervention programs, as perceived by caregivers, relates to actual immunization coverage, offering evidence to guide local program improvements.

### Population and Sampling

The study was conducted in three purposively selected barangays in Tuguegarao City—Ugac Sur, San Gabriel, and Caggay—identified for their low immunization coverage and ongoing health interventions. The target population consisted of mothers aged 20–35 with infants aged 0–12 months, as this age group represents the peak childbearing years and is most actively involved in decisions regarding infant health and vaccination. Using Cochran's formula at a 95% confidence level, a total sample of 175 respondents was calculated and proportionally distributed across the barangays. Stratified sampling was then utilized to select mothers who met the inclusion criteria and had direct engagement with barangay immunization services, ensuring that the data obtained were accurate, context-specific, and representative of low-coverage communities.

### Instruments

The study utilized a researcher-made structured survey questionnaire as the primary data collection tool. The instrument underwent content validation by three experts in public health, research methodology, and maternal–child health to ensure clarity, relevance, and alignment with the study variables. The three experts utilized the survey instrument validation rating scale developed by Oducado (2020) to evaluate the accuracy and clarity of the instrument. Following expert evaluation, revisions were made based on their comments, and a pilot test was conducted among mothers from a non-participating barangay to assess the instrument's functionality and comprehensibility. Moreover, the validated researcher-made survey questionnaires were then translated into local language, Filipino (Tagalog) for easier to understand and readability by the participants.

Reliability testing using Cronbach's Alpha yielded a coefficient of 0.74, indicating good internal consistency based on the criteria of Rak and Wrzesniowski (2023). The finalized questionnaire consisted of three sections: (1) socio-demographic profile of respondents, (2) immunization status of infants, and (3) a five-point Likert scale (5 = Strongly Agree to 1 = Strongly Disagree) measuring mothers' perceptions of program effectiveness across five domains—Educational Promotion, Telephone Calls and Messages, Mass Media, Identification of Target Children, and Evaluation of Infant Immunization Status.

### Data Collection

Data were collected from mothers with infants aged 0–12 months in the three selected barangays—Ugac Sur, San Gabriel, and Caggay—between academic year of 2022 and 2023. The researcher distributed researcher-made structured survey questionnaires directly to the respondents at their homes or designated barangay health centers.

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Each questionnaire was accompanied by clear instructions on how to complete it, and the researcher provided assistance when clarification was needed. Respondents were given 5 minutes to answer all items, after which the completed questionnaires were collected on the same day or within a pre-arranged follow-up schedule.

To ensure completeness and accuracy, the researcher reviewed all returned questionnaires immediately after collection for missing responses or inconsistencies. Data from incomplete questionnaires were followed up directly with the respondent when feasible. The entire process was conducted in collaboration with local health personnel, including Barangay Health Workers and Nutrition Scholars, to facilitate efficient distribution and retrieval of questionnaires.

**Data Analysis**

Data were analyzed using SPSS Version 16.0. Descriptive statistics, including frequency counts and percentages, were used to summarize the socio-demographic profiles of respondents (age, civil status, educational attainment, and income), their sources of information on immunization, and the immunization status of infants for each vaccine (BCG, HBV, Pentavalent, OPV, PCV, IPV, and MMR). Weighted means were computed to determine respondents' evaluation of the effectiveness of the current immunization intervention programs across the five domains: Educational Promotion, Telephone Calls and Messages, Mass Media, Identification of Target Children, and Evaluation of Infant Immunization Status.

**Scoring Guide for Intervention Programs on Infant Immunization**

| Scale | Weighted Mean | Descriptive Equivalent | Descriptive Interpretation |
|---|---|---|---|
| 5 | 4.21-5.00 | Strongly Agree | Very Effective |
| 4 | 3.41-4.20 | Agree | Effective |
| 3 | 2.61-3.40 | Neutral | Somewhat Effective |
| 2 | 1.81-2.60 | Disagree | Ineffective |
| 1 | 1.00-1.80 | Strongly Disagree | Very Ineffective |

Inferential statistics were applied to examine relationships between variables. Specifically, Pearson's correlation coefficient (r) at a 0.05 level of significance was used to assess the relationship between mothers' evaluations of the intervention programs and the immunization status of their infants. This analytical approach aligned with the study objectives by providing both descriptive insights and correlation-based evidence on the effectiveness of the intervention programs.

**Ethical Considerations**

The study was conducted in accordance with ethical standards to ensure the protection and rights of all participants. Participation in the study was entirely voluntary, and respondents were informed of the study's purpose, objectives, and procedures before completing the questionnaire. Confidentiality and anonymity were strictly maintained, and all information was stored securely in compliance with the Data Privacy Act of 2012 (Republic Act No. 10173). To maintain confidentiality, all survey responses were coded with unique identifiers rather than names. Paper-based responses were kept in locked cabinets and were securely disposed of after the analysis phase was completed in accordance with data management protocols.

No participant was subjected to physical, psychological, or emotional harm during the conduct of the study. Coordination with barangay officials and health personnel was limited to facilitating access to respondents and did not influence participation, ensuring ethical integrity throughout the data collection process.

**RESULTS and DISCUSSION**

**Table 1. Immunization Status of the Respondents' Infants.**

| Vaccine | Immunization Status | Frequency (f) | Percentage (%) |
|---|---|---|---|
| 1. Bacillus Calmette–Guérin (BCG) | Fully Immunized | 175 | 100.0 |
| **Total** | | **175** | **100.0** |
| 2. Hepatitis B Vaccine (HBV) | Fully Immunized | 175 | 100.0 |
| **Total** | | **175** | **100.0** |

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| | | | |
|---|---|---|---|
| 3. Pentavalent Vaccine (DPT, Hepatitis B, Hib) | Fully Immunized | 158 | 90.3 |
| | Partially Immunized | 17 | 9.7 |
| **Total** | | **175** | **100.0** |
| 4. Oral Polio Vaccine (OPV) | Fully Immunized | 159 | 90.9 |
| | Partially Immunized | 16 | 9.1 |
| **Total** | | **175** | **100.0** |
| 5. Pneumococcal Conjugate Vaccine (PCV) | Fully Immunized | 160 | 91.4 |
| | Partially Immunized | 15 | 8.6 |
| **Total** | | **175** | **100.0** |
| 6. Inactivated Polio Vaccine (IPV) | Fully Immunized | 159 | 90.9 |
| | Partially Immunized | 5 | 2.9 |
| | Unimmunized | 11 | 6.3 |
| **Total** | | **175** | **100.0** |
| 7. Measles, Mumps, and Rubella (MMR) | Fully Immunized | 27 | 15.4 |
| | Partially Immunized | 41 | 23.4 |
| | Unimmunized | 107 | 61.1 |
| **Total** | | **175** | **100.0** |

The analysis revealed that Bacillus Calmette-Guerin (BCG) and Hepatitis B vaccines were administered to all infants (100%). A slightly lower coverage was observed for Pentavalent (90.3%), Oral Polio (90.9%), Pneumococcal Conjugate (91.4%), and Inactivated Polio vaccines (90.9%). The lowest coverage was recorded for Measles, Mumps, and Rubella (MMR), with only 15.4% of infants fully vaccinated.

These results indicate a decline in vaccine uptake for later doses, consistent with findings from Mahachi et al. (2022) and Quintos et al. (2022), who reported that logistical challenges, insufficient follow-up, and misinformation contribute to incomplete immunization cycles. In the local context, this highlights persistent gaps in sustaining complete vaccine coverage, particularly for vaccines administered beyond the neonatal period.

Furthermore, the low MMR coverage suggests a need for targeted interventions, such as enhanced follow-up systems and community-based education, to ensure timely completion of the full immunization schedule (Vadrevu et al., 2024).

**Table 2. Descriptive Statistics on Intervention Programs on Infant Immunization**

| Intervention Program | Overall Mean | Description | Interpretation |
|---|---|---|---|
| **Teaching Strategies** | 3.95 | Agree | Effective |
| **Telephone Calls and Reminders** | 3.85 | Agree | Effective |
| **Mass Media** | 3.93 | Agree | Effective |
| **Identification of Target Child** | 3.91 | Agree | Effective |
| **Evaluation on Infant Immunization Status** | 3.88 | Agree | Effective |

The overall assessment of intervention programs indicated that all strategies were perceived as effective, with mean scores ranging from 3.85 to 3.95. Teaching Strategies scored highest (M=3.95), highlighting the importance of educational efforts in raising awareness and encouraging vaccine adherence (Siddiqui et al., 2022).

Mass Media (M=3.93) and Identification of Target Children (M=3.91) also demonstrated effectiveness in promoting vaccination and monitoring eligible infants (Dhaliwal et al., 2021; Hansen et al., 2023). Telephone Calls and Reminders had the lowest mean (M=3.85) but remained effective in improving communication with caregivers (Quintos et al., 2022). Evaluation on Infant Immunization Status (M=3.88) emphasizes that monitoring and follow-up are crucial components for sustaining vaccine coverage (Zhao et al., 2024).

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These findings suggest that mothers recognize the relevance of multi-component interventions. However, perceived program effectiveness alone does not guarantee improved immunization outcomes, emphasizing that structural and logistical factors also play a crucial role in ensuring complete vaccination coverage (Zhao et al., 2024).

**Table 3. Correlation between Assessment of Intervention Programs with Infant Immunization Status**

| VARIABLES | | | INFANT IMMUNIZATION STATUS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Bacillus Calmette -Guerin (BCG) | Hepatitis B Vaccine (HBV) | Pentavalent Vaccines (Dpt, Hepb, Hib) | Oral-Polio Vaccine (OPV) | PCV For Pneumonia And Meningitis | Inactivated Polio Vaccine (IPV) | Measles, Mumps, And Rubella (MMR) |
| ASSESSMENT OF INTERVENTION PROGRAMS | Educational promotion | r-value | - | - | .032 | -.011 | -.024 | -.043 | -.096 |
| | | p-value | - | - | .673 | .883 | .750 | .570 | .207 |
| | Immunization calls and reminders as to telephone call and message | r-value | - | - | -.069 | -.086 | -.075 | -.087 | -.077 |
| | | p-value | - | - | .363 | .260 | .324 | .252 | .309 |
| | Immunization calls and reminders as to mass media | r-value | - | - | .092 | .077 | .072 | .068 | -.016 |
| | | p-value | - | - | .224 | .309 | .347 | .369 | .830 |
| | Identification of target child | r-value | - | - | -.093 | -.099 | -.117 | -.118 | -.013 |
| | | p-value | - | - | .223 | .192 | .123 | .121 | .862 |
| | Evaluation on infant immunization status | r-value | - | - | -.031 | .038 | .058 | .078 | .032 |
| | | p-value | - | - | .688 | .620 | .443 | .303 | .678 |

Correlation analysis revealed that r-values ranged from -0.118 to 0.092, with p-values > 0.05 across all vaccine types. This indicates no statistically significant relationship between mothers' assessment of program effectiveness and the actual immunization status of their infants. These results align with Mahachi et al. (2022), demonstrating that positive perception of programs does not automatically translate into complete immunization. Factors such as logistical barriers, accessibility of vaccination sites, and caregiver engagement are more decisive in determining vaccination outcomes. The small effect sizes observed further suggest that while intervention programs are perceived positively, additional measures are required to enhance vaccine coverage in low-coverage communities.

Furthermore, Policymakers and health practitioners should focus on addressing systemic challenges—such as vaccine supply, follow-up mechanisms, and accessibility—to complement educational and promotional strategies. Community trust, consistent reminders, and culturally tailored messaging may also improve uptake (Dalisay et al., 2025; Quintos et al., 2022).

## Conclusions

The study found that Bacillus Calmette-Guerin (BCG) and Hepatitis B vaccines achieved full coverage (100%), while later-dose vaccines such as Pentavalent (90.3%), Oral Polio (90.9%), Pneumococcal (91.4%), Inactivated Polio (90.9%), and Measles, Mumps, and Rubella (MMR) (15.4%) showed declining coverage. Mothers generally perceived the immunization intervention programs as effective, with mean scores ranging from 3.85 to 3.95 across educational promotion, mass media, telephone reminders, identification of target children, and program evaluation. However, correlation analysis indicated no significant relationship between mothers' perceptions of program effectiveness and the actual immunization status of their infants ($p > 0.05$).

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These findings highlight that positive perception of programs alone does not guarantee complete vaccination. Structural and systemic factors, including follow-up mechanisms, access to services, and logistical support, play a more decisive role in ensuring full immunization coverage. Strengthening these areas is essential to improve infant vaccination outcomes in low-coverage barangays.

**Recommendations**

Based on the findings of this study, the following recommendations are proposed to enhance infant immunization coverage in low-coverage barangays of Tuguegarao City:

**Table 4. Proposed Enhancement Program Plans for Infant Immunization Implementation**

| Proposed Program Component | Proposed Activities and Strategies | Stake Holders Involved | Duration of the Activity | Expected Results | Basis of the Enhancement |
|---|---|---|---|---|---|
| 1. Strengthening the Community-Based Health Promotion and Education | Conduct regular community education campaigns on the importance of infant immunization via house-to-house visits, barangay meetings, and online campaigns. | Department of Health (DOH), City Health Office, Barangay Health Workers, and Mothers | *Continous Process (Monthly sessions)* | May increase parental awareness and participation in infant immunization programs | Findings show limited awareness and persistent misinformation; similar programs improved vaccine coverage (Siddiqui et al., 2022) |
| 2. Quality and Evidenced-Based Trainings for Barangay Health Workers | Implement competency-based training on immunization protocols, vaccine handling, communication skills, and vaccine hesitancy counseling. | Department of Health (DOH), City Health Office, and Barangay Health Workers, | Every 6 months | May enhance BHWs' capacity to implement immunization activities effectively | Continuous BHW training has been shown to improve service delivery and trust (Zhao et al., 2024) |
| 3. Modernization of Reminders and Tracking operating systems | Develop an SMS-based reminder system and vaccination tracking dashboard; utilize social media for immunization announcements; assign BHWs to monitor defaulters. | Department of Health (DOH), City Health Office, Barangay Health Workers, and Mothers | Continous Process (Monthly updates and tracking) | May improve monitoring of vaccination schedules and reduce missed doses | Digital reminders significantly enhance timely vaccination and reduce defaulting (Bacacao et al., 2024) |
| 4. Implementation of Windshield Surveillance Method | Conduct systematic windshield surveys within identified communities (GIDAs).<br><br>Use a standardized observation checklist | Municipal/City Health Office<br><br>Barangay Health Workers (BHWs) | Estimated 1–2 weeks per barangay or area surveyed, depending on size and accessibility. | May improved understanding of community health conditions through firsthand observation. | Windshield surveys are essential in community health assessment as they provide firsthand |

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|---|---|---|---|---|---|
| | to document environmental conditions, community structures, population patterns, and visible health-related indicators. . | Rural Health Midwives<br><br>LGU Planning and Development Office<br><br>Community Volunteers<br><br>Community Health Nurses | | May provide more accurate identification of priority health needs in GIDAs. | observation of environmental conditions, population traits, and available resources. (Nies, McEwan, & Sumile, 2025). |
| 5. Monitoring and Evaluation Enhancement using Community Organizing Participatory Action Research (COPAR) | Conduct regular assessment of intervention effectiveness using COPAR (Community Participatory Action Research) framework | DOH, City Health Office, BHWs, Barangay Health Committees | Community-led evaluation sessions, feedback collection, and participatory review meetings every quarter of year | May provide evidence-based insights for program improvement and ensure sustainability | Findings emphasize that systematic evaluation strengthens immunization program outcomes (Pitaloka & Handayani, 2021) |

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