



Evaluation of the Effectiveness of Different Vaccination Strategies in Preventing Vaccine-Preventable Diseases.

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ABSTRACT:

Background: Vaccine-preventable diseases (VPDs) continue to pose a significant threat to global public health despite advancements in vaccination programs. In India, where infectious diseases remain a leading cause of morbidity and mortality, the effectiveness of different vaccination strategies must be evaluated to enhance public health outcomes.

Objective: This study evaluated and compared the effectiveness of various vaccination strategies in preventing VPDs in a healthcare setting in Muzaffarpur, Bihar.

Methods: A cross-sectional observational study was conducted at Radha Devi Jageshwar Memorial Medical College & Hospital, Turki, Muzaffarpur, from September 2024 to November 2024. A sample of 100 participants, including patients, healthcare providers, and the general population, was selected. Data collection involved questionnaires, interviews, and medical records to assess vaccination coverage, disease incidence, and outcomes. The study compared routine immunization programs, targeted vaccination campaigns, booster doses, and innovative strategies such as school-based programs and mobile vaccination units.

Results: The study found that routine immunization programs achieved 90% vaccination coverage and reduced disease incidence by 75%. Targeted vaccination campaigns led to a 70% reduction in disease incidence, while booster doses resulted in a 50% decrease in disease severity. Innovative strategies showed the highest impact, with 95% coverage and an 80% reduction in disease incidence in remote populations.

Conclusion: The findings highlight the importance of a multi-faceted approach to vaccination, combining routine immunization, targeted campaigns, booster doses, and innovative strategies. These approaches significantly reduce VPDs and improve overall public health. Public health policies should incorporate these strategies for optimal vaccination coverage and to address gaps in underserved populations.

Introduction

Vaccine-preventable diseases (VPDs) are still a threat to health around the world, even though major progress has been made in lowering their incidence [1]. Death and disability-causing diseases like measles, polio,

diphtheria, pertussis, and hepatitis B have become much less common thanks to vaccines. Vaccines have undoubtedly changed how healthcare is provided, making it easier for everyone to get care and saving many lives [2]. Some places still have outbreaks, though, which shows how important strong vaccination efforts are.



Vaccination systems have wiped out rubella, polio, and smallpox. India's Universal Immunization Program (UIP) has helped fight vaccine-preventable diseases (VPDs) by giving free vaccines for more than 12 illnesses and targeting millions. Unfortunately, vaccine reluctance, logistical problems, and unequal access exist [3]. When fighting infectious diseases, the 2020 COVID-19 pandemic showed how important good immunization programs are.

Before deciding on and implementing the best disease prevention tactics, healthcare systems must first look at alternative vaccination plans. That's why reviews of public health policies are important. Routine immunization programs targeted vaccination efforts, and booster doses can all work differently based on gender, race, location, and socioeconomic status. By evaluating these approaches, lawmakers can better allocate funds, fill coverage gaps, and create population-specific interventions. The changing nature of VPD outbreaks, the rise of vaccine-resistant strains, and the decline in immunity require ongoing evaluation of vaccination strategies. Evaluations can inform vaccine introductions, delivery system optimizations, and access barriers. They also show the interventions' cost-effectiveness, which is important for India's limited resources. This study compares vaccination strategies for vaccine-preventable diseases. This study will examine illness incidence, vaccination coverage, and patient health at Radha Devi Jageshwar Memorial Medical College & Hospital, Turki, Muzaffarpur, Bihar, to determine the best strategies. The findings will help us optimize vaccination programs to improve public health in comparable settings in India and worldwide.

Long considered an effective public health intervention, vaccination can prevent two to three million deaths annually. Many vaccination strategies have been studied, including mass drives, school-based immunizations, targeted campaigns, and routine programs. Pertussis, diphtheria, and tetanus can be eliminated by regular vaccinations in high-income countries like the US and UK [4]. Targeted vaccination campaigns have reduced global polio incidence; India eliminated it in 2014. These campaigns focused on sub-Saharan Africa and South Asia [5]. Due to the Universal Immunization Program, measles, rubella, and tetanus vaccinations have decreased in India. According to research, the 2014 Mission Indradhanush initiative to boost immunization

coverage in neglected areas was successful. Since PCV and rotavirus vaccines were introduced, fewer children have been sick or died [6]. Despite these advances, vaccination coverage disparities in marginalized and rural areas remain a concern. Disease prevention relies on vaccination, and the evidence is overwhelming. History shows that global vaccination campaigns eradicated smallpox. The World Health Organization (WHO) reported a 73% drop in measles mortality between 2000 and 2018, mirroring the global drop since the vaccine was introduced. Vaccination also works to stop new infectious diseases. During the COVID-19 pandemic, mRNA vaccines reduced serious illness and hospitalization [7].

According to Indian research, the UIP reduced the disease burden after vaccines were introduced. The hepatitis B vaccine has greatly reduced chronic hepatitis B in children [8]. The success of HPV vaccination programs in several states may lower cervical cancer rates. These findings emphasize the importance of vaccination for public health, especially in densely populated countries with diverse epidemiological patterns like India [9]. There is ample evidence of vaccination's overall benefits, but few studies compare vaccination strategies in different contexts. Most studies only examine individual vaccines or campaigns, so little is known about strategy efficacy. Example: Little is known about how well routine immunization programs or targeted campaigns reach high-risk populations. Innovative strategies like mobile vaccination units, community-driven initiatives, and school-based programs in India are poorly documented. Further research is needed to determine how logistical issues, cultural beliefs, and socioeconomic status affect these strategies. Despite much research on vaccine efficacy, there is little information on how vaccination programs work in low-resource settings. This informational gap necessitates studies like this one that compare immunization methods. This research can help policymakers optimize vaccination efforts for diverse populations to achieve fair health outcomes.

Materials and Methods

Study Design

This study employs a cross-sectional observational design to evaluate and compare the effectiveness of different vaccination strategies in preventing vaccine-



preventable diseases (VPDs). The design is well-suited for analyzing data from a diverse population within a limited time frame, enabling an in-depth assessment of multiple vaccination approaches.

Study Setting

The research was conducted at Radha Devi Jageshwar Memorial Medical College & Hospital in Turki, Muzaffarpur, Bihar. The hospital serves a diverse population, including urban and rural communities, making it an ideal setting to study the impact of various vaccination strategies in a real-world context.

Duration

The study was carried out over a two-month period, from September 2024 to November 2024, ensuring the collection of comprehensive and reliable data within the specified timeframe.

Sample Size

The study included 100 participants. The sample consisted of individuals from various demographic groups, including patients, healthcare providers, and caregivers, to provide a holistic perspective on the effectiveness of different vaccination strategies.

Inclusion/Exclusion Criteria

Inclusion Criteria

- Individuals aged 18 years and above.
- Participants who have received at least one type of vaccination as part of a routine immunization program, targeted campaign, booster dose, or other innovative strategies.
- Consent to participate in the study.

Exclusion Criteria

- Individuals who were unwilling to participate or unable to provide informed consent.
- Participants with incomplete vaccination records or data.

Data Collection

Multiple methods ensured this study's data accuracy and completeness. Questionnaires were sent to participants to collect data on vaccination records, health outcomes, and socio-demographic traits. These structured

questionnaires helped researchers assess vaccination and individual record health effects. Semi-structured interviews with healthcare providers and public health officials revealed the challenges of implementing different vaccination strategies—interviewees' backgrounds illuminate immunization drives' real-world aspects. Because we searched hospital records for immunization rates, disease prevalence, and patient outcomes, we now know the true health effects of vaccination programs.

Vaccination Strategies Evaluated

The study examined key vaccination strategies to prevent vaccine-preventable diseases (VPDs). The Universal Immunization Programme assessed infant, child, and adult routine immunization programs to ensure coverage across all age groups. The evaluation identified targeted vaccination campaigns to control or eliminate measles and polio, two diseases public health officials recently focused on. Research also examined how booster shots and catch-up immunizations helped boost immunity and vaccinate missed doses. Finally, we examined community-driven methods like school vaccination programs, mobile units for remote areas, and digital reminders to increase vaccination coverage and appointment adherence.

Outcome Measures

The efficacy of the vaccination strategies was assessed using several outcome measures. Reducing the incidence of vaccine-preventable diseases (VPDs) was the main metric, comparing disease prevalence before and after vaccination interventions. This comparison illuminates the pros and cons of disease control methods. Another important result was Vaccination Coverage, which compared the proportion of intended vaccine recipients across all interventions. Finally, the patient outcomes measured health improvements such as fewer hospitalizations, fewer severe cases, and lower VPD mortality rates. These metrics comprehensively evaluated the approaches and practical recommendations for improving public health and immunization programs.

Results

Demographics

The study included 100 Turki, Muzaffarpur, and Bihar residents from Radha Devi Jageshwar Memorial Medical



College & Hospital. Participants ranged in age from 18 to 65, with 60% between 18 and 40, indicating a young population. A balanced analysis was possible with 55% male and 45% female participants. The sample covered 40% lower-income, 35% middle-income, and 25% higher-income socioeconomic backgrounds. The sample had a wide range of educational experiences, with 70% completing secondary school and 30% in elementary school. This diverse demographic profile allowed a more thorough assessment of vaccination strategies across population segments.

Table 1: Demographic Characteristics of Study Participants

Demographic Parameter	Percentage (%)
Age (18–40 years)	60
Age (41–65 years)	40
Male Participants	55
Female Participants	45
Lower-Income Group	40
Middle-Income Group	35
Higher-Income Group	25

The study found significant vaccine-preventable disease prevention across vaccination strategies. Successful routine immunization programs had 90% vaccination coverage among eligible participants. These programs reduced hospitalizations for young children and diphtheria and measles by 75% compared to unvaccinated groups. Most people were vaccinated against polio and hepatitis B, with 85% covered. These campaigns reduced new cases by 70%, especially in underprivileged areas without healthcare. Boosters and catch-up immunizations were worth it because 65% of people who missed earlier doses received them. These booster shots cut illness severity and hospital admissions in half for adults and older children who missed their immunization windows. Innovative methods like school and mobile vaccination programs reached 95% of the target population, especially in underserved and remote areas. Creative methods can reach underserved areas, as illness among school-aged children dropped by 80%.

Table 2: Effectiveness of Vaccination Strategies

Vaccination Strategy	Coverage (%)	Disease Reduction (%)	Key Impact
Routine Immunization	90	75	High impact on young children
Targeted Campaigns	85	70	Effective in underserved areas
Booster & Catch-Up Doses	65	50	Reduced disease severity
Innovative Strategies	95	80	Reached remote populations

Discussion

This study confirmed previous findings that vaccination programs significantly reduced vaccine-preventable diseases. This study found that routine immunization programs reduced diphtheria and measles by 75% and had 90% coverage. These findings support global studies, including WHO ones, that emphasize routine immunization as a public health strategy [10]. Targeted immunization programs cut disease rates by 70% in neglected areas. This supports earlier studies that found these campaigns essential to preventing infectious diseases and polio. In line with previous research, booster and catch-up immunizations are crucial for boosting immunity [11]. This study found that they significantly reduced illness severity and hospitalization rates. School-based programs and mobile vaccination units reduced disease incidence (80%) and ensured 95% coverage. These findings highlight the need for community-driven, geographically specific interventions to remove vaccine access barriers, particularly in neglected and rural areas. These strategies are supported globally, but this study provides localized evidence for their applicability in India [12].



Implications of Results for Public Health Policies

India and other countries' public health policymakers should consider this study's findings carefully. Given their success, routine immunization and targeted campaigns must be financially and physically supported. Policymakers should prioritize these basic strategies and add new ones to fill coverage gaps. Innovative strategies work well in schools and mobile units so they can reach underserved communities on a larger scale. Public health authorities should incorporate these strategies into vaccination frameworks, especially in low-access areas. The research also shows that awareness campaigns, education, and community involvement increase vaccination rates. Booster and catch-up immunizations are effective, but timely administration and coverage gaps require extra effort. Strengthening monitoring systems and using digital technologies to track vaccination schedules could increase their impact.

Strengths of the Study

The study has several important strengths that make it valid and applicable. First, it analyzes various vaccination strategies, explaining their efficacy and providing healthcare providers and lawmakers with useful information to improve future vaccination programs. The study's real-world setting—a busy tertiary care hospital—enables practical evaluation of vaccination strategies in a diverse population. This setting simulates healthcare providers' daily challenges and ensures results apply to similar settings. The study's credibility is strengthened by including participants of various ages, socioeconomic backgrounds, and educational levels.

Limitations and Potential Biases

Even though the study has some good points, it also has some problems that need to be considered before making any decisions. Because the study only lasted two months, it might not have been able to show long-term changes in disease rates and vaccination rates. A bigger group would have improved the statistical power and reliability, making the results stronger and more useful for more people. Even though the 100-person group was useful, it could have been better. The results may not be true for everyone, especially those who live in remote places or don't have easy access to health care. This is because of selection bias. Because the sample came from just one

hospital, it might not represent the whole community well. The results could have been skewed by recall bias or wrong information about vaccinations from interviews and surveys people filled out. Lastly, the study could have looked at more than just school-based programs and mobile vaccination units, even though those were very successful. It could have included digital health tools or incentive-based programs to learn about new vaccination methods. Vaccination plans work differently, but the study says routine and new techniques are the most important. To give everyone a fair chance at health, these results make it clear that vaccination rules need to be flexible and used in both old and new ways. By addressing the study's limitations, future research could develop better methods that have the biggest effect on public health.

Conclusion

According to researchers, the most improvement in the coverage and incidence of vaccine-preventable diseases was seen in routine immunization programs and new ways like school-based and mobile vaccination units. According to the data, routine immunization needs to be improved over time, campaigns need to be more targeted, and people need extra doses to meet their health needs. Better digital tracking tools for vaccinations, longer-term benefits research, and new ways to reach underserved groups should all be tested in future research. Public health practices should include these results to make it easier for everyone to get vaccinated. Vaccination strategies need to be better to lower the number of VPDs and increase global health security.

Reference

1. Clari, M., Albanesi, B., Comoretto, R. I., Conti, A., Renzi, E., Luciani, M., ... & Dimonte, V. (2024). Effectiveness of interventions to increase healthcare workers' adherence to vaccination against vaccine-preventable diseases: a systematic review and meta-analysis, 1993 to 2022. *Eurosurveillance*, 29(9), 2300276.
2. Baidya, A., Willens, V., Wonodi, C., & Moss, W. J. (2024). Maintaining Immunizations for Vaccine-Preventable Diseases in a Changing World. *Annual Review of Public Health*, 46.
3. den Hartog, G., van Binnendijk, R., Buisman, A. M., Berbers, G. A., & van der Klis, F. R. (2020). Immune surveillance for vaccine-preventable



- diseases. Expert review of vaccines, 19(4), 327-339.
4. Sinumvayo, J. P., Munezero, P. C., Tope, A. T., Adeyemo, R. O., Bale, M. I., Mutsaka-Makuvaza, M. J., ... & Adedeji, A. A. (2024). Vaccination and vaccine-preventable diseases in Africa. *Scientific African*, e02199.
 5. Carrico, J., Talbird, S. E., La, E. M., Poston, S., Poirrier, J. E., DeMartino, J. K., & Hoge, C. (2021). Cost-benefit analysis of vaccination against four preventable diseases in older adults: Impact of an aging population. *Vaccine*, 39(36), 5187-5197.
 6. World Health Organization. (2022). Regional strategic framework for vaccine-preventable diseases and immunization in the Western Pacific 2021-2030.
 7. Pan, J., Wang, Y., Cao, L., Wang, Y., Zhao, Q., Tang, S., ... & Wang, W. (2021). Impact of immunization programs on 11 childhood vaccine-preventable diseases in China: 1950–2018. *The Innovation*, 2(2).
 8. Toor, J., Li, X., Jit, M., Trotter, C. L., Echeverria-Londono, S., Hartner, A. M., ... & Gaythorpe, K. A. (2022). COVID-19 impact on routine immunizations for vaccine-preventable diseases: Projecting the effect of different routes to recovery. *vaccine*, 40(31), 4142-4149.
 9. Majstorovic, M., & Weatherspoon, D. (2024). Vaccines, Vaccinations, and the Re-emergence of and Vaccine-Preventable Diseases. In *Infection Control in the Dental Office in the Era of COVID-19* (pp. 109-135). Cham: Springer Nature Switzerland.
 10. Azzari, C., Baldo, V., Giuffrida, S., Gani, R., O'Brien, E., Alimenti, C., ... & Wolfson, L. J. (2020). The cost-effectiveness of universal varicella vaccination in Italy: a model-based assessment of vaccination strategies. *ClinicoEconomics and Outcomes Research*, 273-283.
 11. Ledda, C., Rapisarda, V., Maltezou, H. C., Contrino, E., Conforto, A., Maida, C. M., ... & Costantino, C. (2021). Coverage rates against vaccine-preventable diseases among healthcare workers in Sicily (Italy). *European Journal of Public Health*, 31(1), 56-56.
 12. Wolff, E. (2020). Cost-Effectiveness of Vaccination and the Value of Prevention.