

Review Article

Newer Vaccines Applicable to Public Health Problems in India: A Comprehensive Review

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ABSTRACT

Vaccines are biological tools that enhance the immune system's ability to combat infectious diseases, saving millions of lives globally each year. India's Universal Immunization Programme, one of the largest in the world, targets 12 preventable diseases, including polio, measles, and tetanus, while continually adding new vaccines such as those for Rotavirus and Pneumococcal infections. Launched in 2014, Mission Indradhanush aims to achieve 90% immunization coverage by focusing on under-vaccinated and zero-dose children in high-risk areas. Recent advancements like the Electronic Vaccine Intelligence Network have modernized vaccine logistics, ensuring efficient distribution and real-time monitoring. India's commitment to eliminating measles and rubella by 2023 exemplifies its sustained efforts to strengthen immunization infrastructure, improve coverage, and address emerging public health challenges.

Keywords: Vaccine, International Health, Emergency

INTRODUCTION

Vaccination has emerged as a cornerstone of public health, protecting individuals and communities from life-threatening diseases. Vaccines, derived from live attenuated or inactivated organisms, toxoids, or anti-genic fragments, stimulate the body's immune response, preventing infections such as diphtheria, polio, and measles. Globally, vaccines save an estimated 2–3 million lives annually. In India, the Universal Immunization Programme (UIP) provides free vaccines to approximately 2.67 crore newborns and 2.9 crore pregnant women every year. Landmark achievements under this program include the elimination of polio in 2014 and maternal and neonatal tetanus in 2015. Recent expansions to the UIP include vaccines for rotavirus, pneumococcal pneumonia, and human papillomavirus (HPV), reflecting an adaptive approach to emerging health challenges.

Mission Indradhanush, introduced in 2014, targets full immunization coverage, prioritizing children in underserved areas. Complementing these efforts, the electronic vaccine intelligence network (eVIN) has digitized vaccine stock management and cold chain logistics, improving efficiency and transparency. With the goal of eliminating measles and rubella by 2023, India has also integrated technology-driven solutions and focused campaigns to strengthen immunization programs.¹⁻³

New vaccines are needed for several diseases that continue to pose global health threats. These include diseases caused by emerging infectious agents such as the *Zika virus*, chikungunya, and Ebola, for which vaccines are either in development or need improvement. Malaria and tuberculosis

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still lack highly effective vaccines, making them priorities for vaccine research. In addition, newer variants of respiratory viruses, such as influenza and coronavirus disease-19, necessitate ongoing vaccine development to address emerging strains. Vaccines for anti-biotic-resistant bacterial infections and diseases such as dengue, human immunodeficiency virus, and cancer are also urgently needed to improve public health outcomes globally.⁴

VACCINES: AN OVERVIEW

Vaccines are immune-biological substances designed to offer protection against specific diseases by eliciting protective antibodies and other immune responses. They are prepared using live-modified organisms, killed pathogens, cellular extracts, toxoids, or a combination of these. By preventing serious infections, vaccines save millions of lives every year and form a critical component of public health strategies worldwide.

GLOBAL VACCINE COVERAGE

The number of unvaccinated or zero-dose children has declined significantly, with global figures dropping from 18.1 million in 2021 to 14.3 million in 2022. While this is an improvement, the coverage has yet to reach pre-pandemic levels. For example, the coverage of Diphtheria, Pertusis and Tetanus (DPT3) vaccines improved from 81% in 2021 to 84% in 2022 but remains below the 2019 level of 86%. Similarly, measles vaccine coverage increased to 83% in 2022 but is still short of the 2019 benchmark. The first-dose HPV vaccine coverage for girls rose from 16% to 21%, signaling a positive trend but highlighting the need for accelerated efforts.⁵

IMMUNIZATION IN INDIA

India's Expanded Program on Immunization began in 1978 and was rebranded as the UIP in 1985, expanding beyond urban areas. It became part of the Child Survival and Safe Motherhood Program in 1992 and later the National Reproductive and Child Health Programme in 1997. The UIP provides vaccines free of cost against 12 diseases, including hepatitis B, Haemophilus influenza type B, and Japanese encephalitis (in endemic regions).

Landmark achievements include polio elimination in 2014 and maternal and neonatal tetanus elimination in 2015. The introduction of newer vaccines, such as rotavirus and pneumococcal conjugate vaccines (PCVs), has significantly expanded the program's scope.^{6,7}

NEW VACCINE INTRODUCTIONS

1. Inactivated polio vaccine (IPV): Introduced as part of the Global Polio Endgame Strategy, IPV was launched in 2015 and expanded nationwide by 2016.

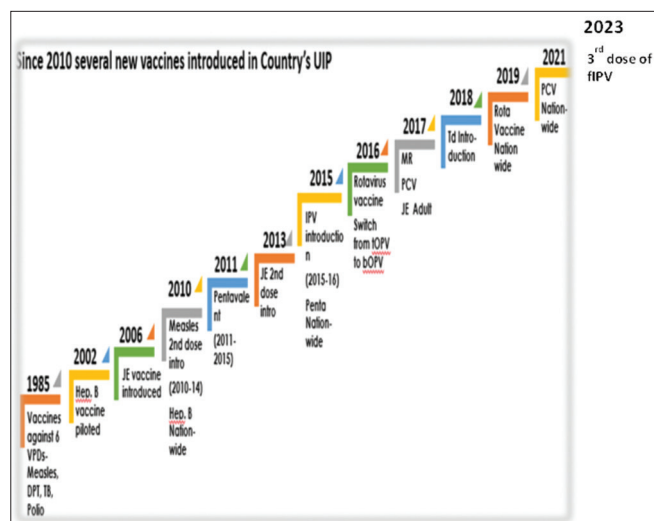


Figure 1: New vaccines introduced in the country's Universal Immunization Program.

2. Rotavirus vaccine: Rolled out in 2016 to combat diarrheal diseases, this vaccine has since been scaled up nationwide.
3. Measles-rubella vaccine: Introduced through a phased campaign starting in 2017, this vaccine targets children aged 9 months–15 years, supporting India's commitment to measles and rubella elimination.
4. PCV: Launched in 2017, PCV aims to reduce infant mortality from pneumonia.
5. HPV vaccine: Recommended in 2022 for inclusion in the UIP, it targets cervical cancer prevention in girls aged 9–14 years [Figure 1].

TECHNOLOGICAL ADVANCEMENTS IN VACCINE LOGISTICS

Innovations like eVIN have revolutionized vaccine logistics by digitizing stock management and cold chain monitoring, ensuring real-time visibility of vaccine inventories. The National Cold Chain Training Center and other training facilities have also strengthened India's capacity for cold chain equipment maintenance and vaccine delivery.

MISSION INDRADHANUSH AND THE FOCUS ON ZERO-DOSE CHILDREN

Mission Indradhanush has significantly improved immunization rates, targeting hard-to-reach and high-risk populations. Its intensified phases have led to substantial increases in full immunization coverage in underserved districts.

CONCLUSION

India's immunization program exemplifies a robust public health strategy supported by technological innovation,

targeted campaigns, and international collaborations. By addressing challenges such as vaccine hesitancy, cold chain logistics, and zero-dose children, the program is steadily advancing toward its goal of universal immunization. The integration of digital tools such as eVIN ensures a sustainable and scalable model, enabling India to safeguard its population against vaccine-preventable diseases while paving the way for global public health progress.

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