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India's Journey Towards Immunization Agenda 2030: Overcoming Challenges and Achieving Milestones - A Comprehensive Review

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Abstract

Immunization, in its literal meaning, the process of 'exempting' individuals from disease, is a comprehensive continuum of events. Since the inception of the Universal Immunization Program (UIP), India's immunization ecosystem has undergone remarkable expansion, including expanding the vaccine basket, strengthening supply chains, enhancing vaccine quality assurance, and modernizing data systems. Over the past decade, UIP has undergone a huge transformation, marked by innovations, challenges, and achievements. The introduction of the rotavirus and pneumococcal conjugate vaccines, and the transition from the Tetanus Toxoid vaccine to TD-10 and TD-16 for adolescents, reflect a balancing approach between child immunization and a shift toward a life-course approach to vaccination. Large-scale catch-up campaigns played a pivotal role in reaching populations that had been missed. Simultaneously, rapid urbanization and shifting human settlements posed new complexities in service delivery. Strengthened data driven decision-making, supported by improved digital systems and accountability, enabled real-time monitoring, accelerating the identification of zero-dose and dropout children. Increased budgetary provisions for immunization under the National Health Mission further reinforced service delivery, allowing states to expand outreach, improve quality, and sustain program momentum. Together, these advancements have positioned India at the forefront of progress toward Immunization Agenda-2030. With declining zero-dose, improved coverage & equity, and strong political commitment, the country is now on the cusp of ensuring that every child is fully vaccinated. India's experience demonstrates that strategic investments, innovation, and system-wide coordination can transform immunization outcomes in the most complex and dynamic settings.

Keywords

Agenda 2030, Data driven decision, Immunization Coverage, Innovation, Intensified Mission Indradhanush, Zero Dose.

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Introduction

The Expanded Program on Immunization (EPI) has been a long-standing intervention, not only crucial for combating vaccine-preventable diseases (VPD) in countries but also for reinforcing and strengthening public health systems. In 2024, the World Health Organization (WHO) celebrated the 50th anniversary of EPI, marking its inception in 1974, and making it one of the longest-running programs. It has been estimated to have averted 154 million deaths worldwide (Mirza et al., 2025; Shattock et al., 2024). Sustaining high coverage of routine childhood vaccinations remains crucial to achieving the EPI's goals and advancing global health.

India's Universal Immunization Program (UIP), one of the most extensive public health programs in the world, provides vaccination against twelve VPDs at no cost to more than 26 million eligible children and 29 million pregnant women (MoHFW, 2025b). Over the recent decade, the UIP in India expanded, going beyond traditional vaccines, such as Polio, Diphtheria-Tetanus-Pertussis (DTP), BCG, and Measles-Rubella (MR), to include Rotavirus, Japanese Encephalitis (JE), Pneumococcal Conjugate Vaccine (PCV), and Inactivated Poliovirus Vaccine (IPV). The objective was to expand the breadth of protection (BOP), which represents the mean coverage for antigens recommended by the WHO, and reduce mortality and morbidity associated with VPD (WHO, 2024a). Under the National Health Mission (NHM), along with its rural and urban counterparts, the National Rural Health Mission (NRHM) and the National Urban Health Mission (NUHM), the country has made significant strides in strengthening its health systems (MoHFW, 2024). The country's goals broadened from Full Immunization Coverage (FIC) to FIC plus, to improve the efficiency and monitoring of the UIP. A child is considered fully immunized if they have received BCG, three doses of OPV, three doses of Pentavalent, and one dose of MR by the first year of age. The FIC plus indicator collects data on children who have received all recommended vaccines by one year of age. It excludes the JE vaccine, which is administered only in specific sub-national areas. The newer antigens, such as IPV, PCV, and Rotavirus vaccines (RVV), were added to the monitoring mechanism in 2024, aligning with programmatic needs (MoHFW, 2024).

The measure and reach of UIP have been revised from FIC to FIC plus, with an aim of leaving no child behind (WHO, 2020). Given the time-sensitive nature of childhood vaccines, even a slight reduction in vaccination coverage among millions of children threatens the progress made over decades (Evans et al., 2023). Between 2020 and 2022, routine child immunization in India faced severe setbacks due to the COVID-19 pandemic, which necessitated complete lockdowns and overwhelmed public health infrastructure. The number of children not receiving the first dose of essential childhood vaccines increased in 2020 compared to 2019, rising by 3.5 million for the first dose of diphtheria, tetanus, and pertussis vaccine (DPT-1) and by 3 million for the first dose of measles vaccine (P. Kumar et al., 2023). As a response, the country has successfully reached out to these unvaccinated and zero-dose cohorts through targeted immunization strategies, restoring and surpassing the pre-pandemic coverage levels to 96% in 2024 (WHO & UNICEF, 2024).

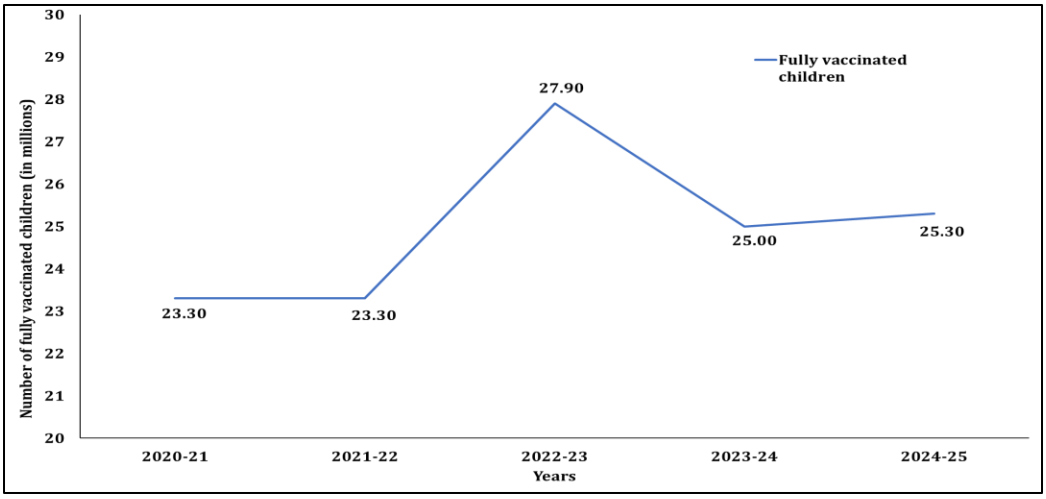

Figure 1 Number of children fully vaccinated in millions (2020-2025).

Data Source: Health Management Information System (HMIS). The number of fully vaccinated children has consistently increased over the past five years, exceeding pre-pandemic levels.

Figure 1 shows the number of children who were fully vaccinated over the last five years, derived from the Health Management Information System (HMIS) (MoHFW, 2025). During the pandemic (2020-21), 23.30 million children were vaccinated. In 2022-23, numerous rounds of large-scale catch-up campaigns were conducted (Intensified Mission Indradhanush, IMI), and 27.90 million children were vaccinated, one of the highest numbers, covering a substantial backlog of zero-dose, leftout, and dropout children. In 2024-25, 25.30 million children were vaccinated, approximately 2 million more than during the pandemic (2020-21).

India is tackling the world's largest birth cohort

India, home to nearly 1.44 billion people, approximately 17.8% of the world's population, also accounts for nearly one-fifth of all global childbirths (Bureau, 2024). Given its massive population and a continuously expanding cohort of pregnant women and children, the country carries a significant responsibility in safeguarding maternal and child health. Guided by its commitment to achieving Universal Health Coverage (UHC) by 2030, the Government of India has introduced far-reaching reforms to ensure that every citizen has access to affordable, high-quality healthcare. India has steadily innovated and strengthened its health system to address evolving demographic and epidemiological needs. To improve quality, efficiency, and equity, system-level efforts must address the fragmentation of healthcare financing and service provision by promoting convergence, aggregation, and standardization.

Despite the complexities it faces, India's health system takes justified pride in its achievements over the past decade. The country has successfully eradicated polio, guinea worm disease, yaws, and maternal and neonatal tetanus, milestones that reflect sustained political commitment and strong public health action.

India experienced a decisive demographic transition with the Total Fertility Rate (TFR) dropping from 3.4 in 1992-93 to 2.2 in 2020-21. This progress is reflected in child health indicators. The Infant Mortality Rate (IMR) fell from 39 per 1,000 live births in 2014 to 25 by 2023 (Office of the Registrar General & Census Commissioner, India, 2025). Additionally, the Neonatal Mortality Rate (NMR) declined from 26 to 20 per 1,000 live births, and the Under-5 Mortality Rate (U5MR) decreased from 45 to 32 during the same period (MoHFW, 2025).

Progress has not been uniform. Deep inter- and intra-state disparities persist, with socio-economically disadvantaged communities consistently facing greater barriers to both access and quality of care. These inequities are further complicated by a rising wave of non-communicable diseases alongside the continued presence of communicable diseases. The health system's capacity is strained by this dual challenge, which also increases the complexity of both policy design and implementation (Chauhan et al., 2023). India's health landscape also reflects multiple layers of fragmentation: a fragmented network of payers and risk pools, a highly heterogeneous mix of public and private healthcare providers, and an uneven digital infrastructure that powers the health system. Even with these challenges, India continues to push forward with structural improvements, technological advancements, and financial reforms that collectively strengthen its march toward UHC.

Mitigating all odds: Seasonal variation, climate change, and environmental disaster

Over the past decade, climate change has emerged as a significant factor impacting both service delivery and vaccine demand under the UIP. The increasing number of floods, heavy rain, and extreme temperatures affects the delivery of the public health program. These changes have affected all countries, including India. Extreme heatwaves (April-June) and rainfall (June-August) in India commonly disrupt the UIP service delivery (Mishra et al., 2022). Due to the extreme events, the number of outreach and fixed sessions is affected, and the impact is most pronounced in areas where outreach sessions are the primary means of vaccination. At the macro level, the total number of sessions held under UIP has increased annually. Despite facing various challenges, including climate-related obstacles, the trend line over the past five years, as illustrated in Figure 2, indicates a significant increase in the number of sessions held. Specifically, 14.1 million sessions were conducted in 2024-25, an increase of 2.6 million from 2020-21.

Our health system has rallied to overcome these odds, giving the utmost priority to immunization. In India, on average, approximately 1.9 million children are vaccinated under the UIP each month, which exceeds the yearly vaccination numbers of many countries. Prolonged high temperatures in the northern and southern parts of India significantly impact the uptake of immunization services. Despite this, India's UIP coverage has exceeded that of many other countries. Heat waves disrupt routine childhood immunization, with outreach services more adversely affected than fixed-site facilities. Projections suggest that global warming and rising regional temperatures will intensify in the coming years (IVAC, 2024). Without combating climate change at a

meaningful scale, today's challenges will only worsen tomorrow (Gupta et al., 2021). However, these disruptions will not affect all regions equally. Countries with high geographic exposure, dense population, and socioeconomic challenges are disproportionately more vulnerable. In the context of increasing global temperatures, it is essential to plan and implement climate-resilient immunization strategies.

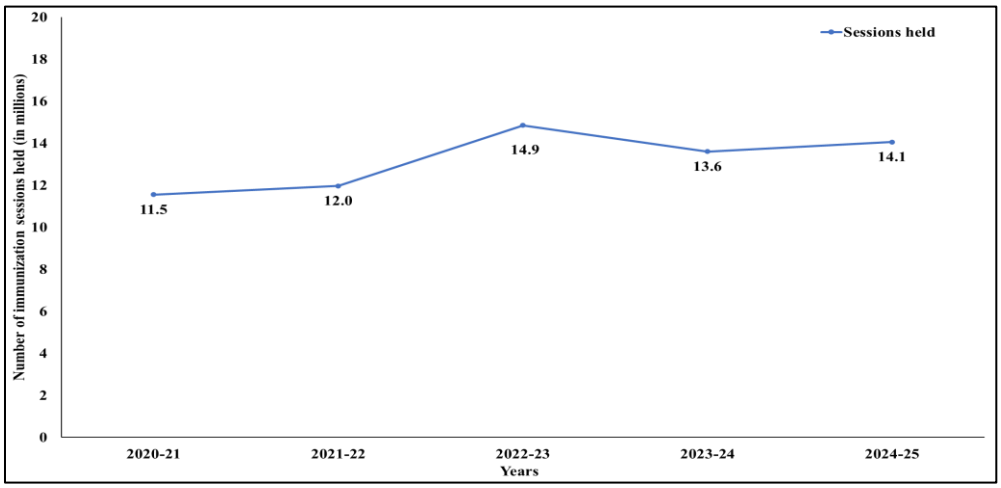

Figure 2 India's immunization sessions trends; number in millions (2020-2025)

Data Source: Health Management Information System (HMIS). The sessions held include both in-facility and outreach sessions, and have consistently increased over the years

Increasing urban & peri-urban populations: Role of intersectoral coordination & strengthening services

India's immunization landscape, long anchored in rural outreach, is undergoing a significant shift with the rapid pace of urbanization. Historically, the country's health planning, beginning from the Bhore Committee Report (1946) to the National Rural Health Mission (NRHM, 2005), prioritized rural populations, leaving urban health services fragmented and uncoordinated. The establishment of the National Urban Health Mission (NUHM) in 2013 marked a pivotal moment, recognizing urban health, including immunization, as a priority and bringing coherence to the system (Goel, 2008). India's urban population is projected to reach nearly 603 million by 2031, implying that around 40% of Indians will live in urban and peri-urban areas (IIMAD, 2025). This demographic shift brings immense opportunities but also complex challenges for the UIP, which must cater to a highly mobile, diverse, and transient urban population.

The expansion of informal settlements, the absence of clearly defined catchment areas, and overlapping jurisdictions among health facilities often result in missed populations and duplication of efforts, leading to inequities. Urban poor communities' migrants, street children, construction workers, and slum dwellers remain disproportionately unvaccinated, partly because they fall outside formal population registries or live in unlisted settlements

(Devasenapathy et al., 2016; Singh et al., 2019). These systemic challenges are multiplied by unplanned urban expansion and the absence of granular, disaggregated data for planning immunization sessions. The peri-urban belts, which often lie beyond the jurisdiction of both municipal corporations and rural health departments, suffer from service delivery gaps. The consequence is an uneven immunization landscape.

The 74th Constitutional Amendment (1992) assigned 18 public health functions to urban local bodies (ULBs), including water supply, sanitation, solid waste management, and health service delivery, each of which directly or indirectly impacts immunization outcomes (India Code Legislative Department, 1992). Later, the National Health Policy (2017) called for a focused approach toward the urban poor, migrants, and informal workers, highlighting the importance of convergence across sectors, including Integrated Child Development Services (ICDS), education, housing, and labor welfare, to address the social determinants of immunization. Recognizing these challenges, policy frameworks (National Health Policy, 2017) emphasized intersectoral coordination as the backbone of urban health (MoHFW, 2017).

Considering this evolving urban context, the UIP has adapted through innovative service delivery mechanisms such as Urban Primary Health Centres (UPHCs) and Health and Wellness Centres (HWCs), which act as nodal points for planning, implementing, and monitoring immunization activities (Lahariya, 2020). These centres not only serve as fixed sites for routine vaccination but also anchor outreach and mobile sessions in slums and peri-urban areas. Supported by GIS-based microplanning, these centres regularly identify underserved pockets, optimize session scheduling, and track beneficiaries using digital platforms such as the U-WIN (UNDP, 2024).

The role of intersectoral coordination is pivotal. Collaboration between the ICDS, Urban Local Bodies, Health Departments, and community-based organizations ensures that information on migrant settlements, construction sites, and slum clusters is continuously updated. In several cities, this approach has demonstrated success through effective joint planning between health and ICDS staff, the engagement of frontline workers, and coordinated support from local authorities for space allocation, waste management, and outreach mobilization. Such convergence has enabled flexible session timings, 'vaccination on demand' approaches, and integration with other urban health services, improving immunization coverage (MoHFW, 2013).

The COVID-19 pandemic further reinforced the importance of this coordination. Urban immunization centres have become critical points for routine vaccination, demonstrating the importance of an integrated service delivery model. These experiences underline that effective immunization in urban and peri-urban areas cannot be achieved in isolation; it requires sustained cross-sectoral engagement, real-time data sharing, and governance mechanisms that connect health with housing, sanitation, and urban planning. The way forward lies in institutionalizing Model Immunization Centres (MICs), rooted in quality, flexibility, and convenience, ensuring

no eligible population in urban or peri-urban areas is left unprotected.

Immunization coverage and Zero-dose children: Global and India

In August 2020, during the World Health Assembly, the global health community reaffirmed its commitment to "leave no one behind" by prioritizing the identification and vaccination of zero-dose children, those who have not received even a single dose of any vaccine (O'Brien et al., 2022). These children often live in communities marked by deep-rooted socio-economic, geographic, and systemic inequities. Reaching them is essential not only for achieving Universal Health Coverage but also for advancing the SDGs, particularly SDG-3, which aims to "ensure healthy lives and promote well-being for all at all ages." Immunization also contributes, directly or indirectly, to 13 SDGs by reducing poverty, improving education outcomes, and promoting gender equality through healthier families and communities (Decouttere et al., 2021).

Globally, an estimated 14.5 million children remained completely unvaccinated in 2023. The highest burden was observed in Nigeria, with 2.1 million zero-dose children, followed by India with 1.6 million and Ethiopia with approximately 917,000 children (Jones, 2024). Zero-dose children often represent communities left behind due to a combination of factors such as poverty, gender inequity, migration, conflict, misinformation, and limited access to health services. Linking these families to early childhood immunization provides health, social, and economic benefits that span generations. However, a proportion of these zero-dose children belong to vaccine-hesitant or vaccine-resistant households, where misinformation, social beliefs, and peer influence lead to refusal or delay in vaccination, even when services are available (Nashwan & Abuhammad, 2025).

India's immunization landscape reflects a dynamic mix of challenges and achievements. According to the WHO-UNICEF Estimates of National Immunization Coverage (WUENIC), the number of zero-dose children in India increased sharply during the COVID-19 pandemic, rising from 1.4 million in 2019 to 2.9 million in 2020, representing nearly 19% of the global burden. This surge mirrored the severe disruptions caused by lockdowns, diversion of health resources to pandemic control, and temporary suspension of immunization sessions. Routine immunization coverage indicators also declined during this period. DTP1 coverage dropped from 94% in 2019 to 87% in 2020, DTP3 from 91% to 85%, and the first dose of measles-containing vaccine (MCV1) from 95% to 89%. Globally, a similar pattern was observed, with the number of zero-dose children peaking at 18.1 million in 2021. However, the subsequent recovery in immunization coverage both in India and globally demonstrates the resilience of national immunization programs (P. Kumar et al., 2023).

India's focused and sustained efforts have led to remarkable progress. By 2024, the number of zero-dose children had dropped to approximately 0.9 million, a 43% reduction compared to the previous year. The coverage of DTP1 increased from 93% in 2023 to 96% in 2024, outpacing the global average, which has stagnated at 89% since 2021. Among 194 countries, only 93, including India, have

achieved DTP1 coverage of 96% or above (MoHFW, 2025a). This achievement reflects not just recovery but acceleration toward universal immunization. The magnitude of India's progress is particularly striking, given its enormous scale, as the country vaccinates approximately 130 million children, including 26 million infants and 29 million pregnant women, every year.

To address the persisting inequities and reach the last mile, India launched a "Guidance Document on Strategic Approach for Reaching Zero-Dose Children". This national framework defines a Zero-Dose Implementation Plan (ZIP) anchored in a health system strengthening approach. The Government of India prioritized 143 districts across 11 high-burden states, which together account for around 60% of zero-dose children, to receive targeted attention. ZIP integrates 11 key interventions to identify, track, and immunize every child, leveraging innovations such as U-WIN for electronic vaccine tracking and the Mission Indradhanush (MI) platform for accelerated coverage (MoHFW, 2024). The U-WIN system has recorded over 277.7 million vaccine doses administered to 74.3 million beneficiaries through more than 12.6 million vaccination sessions as of November 2024, marking a major stride in digital monitoring and accountability (MoHFW & PIB, 2024).

Despite notable progress, India has encountered several challenges. The slight resurgence of zero-dose children in 2023 was linked to localized disruptions, including work strikes by community health workers, extreme weather events, and service delivery interruptions. These challenges, however, have also driven innovation through intensified microplanning, urban immunization strategies, and intersectoral coordination involving health, ICDS, urban local bodies, and civil society partners.

India's journey reflects an evolving immunization ecosystem that integrates technology, governance, and community engagement. Mission Indradhanush, its successive intensifications, and the integration of U-WIN have enhanced vaccine delivery, particularly in urban and migratory settings. The strategic use of data, accountability frameworks, and partnerships with NGOs and the private sector have been instrumental in identifying missed communities and sustaining gains (Dhawan et al., 2023). The recent WUENIC 2024 estimates confirm that India's antigen-wise coverage DTP1 at 96%, MCV1 at 97%, and BCG at 91% consistently surpasses global averages. The trendline in Figure 3 shows that the number of BCG doses administered has increased consistently over the last five years, indicating greater focus on birth dose administration.

India's experience demonstrates that, with political will, digital innovation, and community-centered planning, even large and complex systems can achieve equity in immunization. The reduction of zero-dose children from 2.9 million in 2020 to 0.9 million in 2024 is not merely a numerical success; it signifies the strengthening of health systems, restoration of public trust, and reaffirmation of the principle of leaving no one behind. As the world moves toward the IA2030 targets, India's example offers valuable lessons in resilience, adaptability, and the power of sectoral convergence to close remaining immunization gaps.

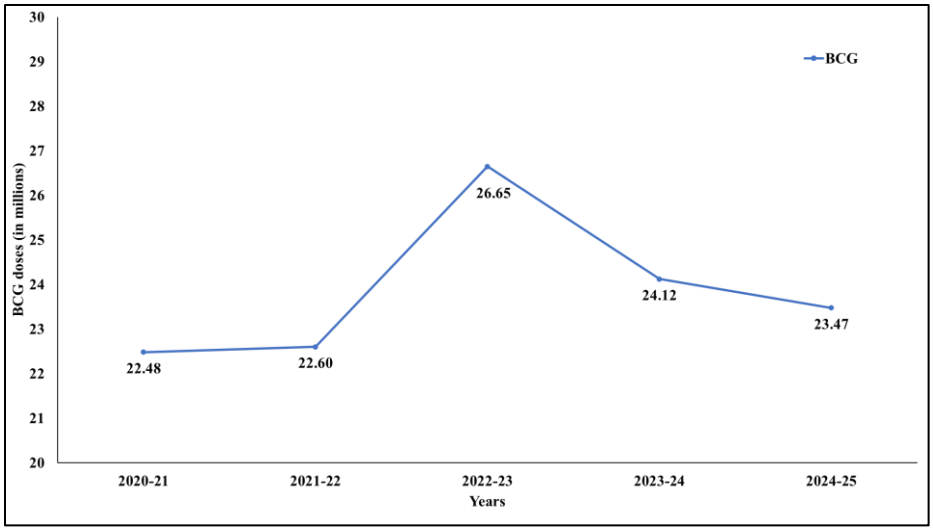

Figure 3 Number of BCG doses in millions (2020-2025)

Data Source: Health Management Information System (HMIS). The BCG doses have consistently increased over the past five years, surpassing levels recorded before the pandemic.

Special vaccination drives: Intensified Mission Indradhanush and Measles-Rubella elimination efforts

As the COVID-19 pandemic disrupted essential health services, millions of children missed their scheduled vaccinations, posing a serious risk of resurgence of VPDs. Recognizing the urgency to address this gap, India introduced the Intensified Mission Indradhanush (IMI) 3.0 in early 2021, a rapid, targeted effort to bridge the immunization backlog and reach unvaccinated and partially vaccinated children. IMI 3.0 prioritized districts where routine immunization coverage had been most severely affected, particularly urban slums, tribal areas, and hard-to-reach regions. The drive was implemented with a special focus on migrants, underserved groups, and children whose routine immunization access was disrupted by the pandemic.

In 2022, the momentum continued with IMI 4.0, nearly 6 million children and 1.5 million pregnant women were vaccinated, reflecting the scale and operational depth of India's immunization network. These campaigns, supported by the meticulous use of microplans, interdepartmental convergence with ICDS and urban local bodies, and engagement of community influencers, successfully revitalized public confidence in immunization.

By 2023, the launch of IMI 5.0 marked a new era in India's immunization mission. Beyond catching up on missed doses, the strategy of IMI 5.0 was visionary in its objective, aligning with the country's Measles and Rubella (MR) Elimination Goal, and reinforcing the nation's long-term public health mission. India's elimination goal, set for 2026, requires more than 95% vaccination coverage with two doses of the MR vaccine across all districts for three consecutive years, accompanied by a high-quality surveillance system. As of 2024-25, India has recorded 93.7% coverage for the first

dose of MCV and 92.2% for the second dose, alongside a 73% decline in measles cases and a 17% reduction in rubella cases compared to the previous year.

Figure 4 highlights the country's progress in administering MCV doses and efforts toward disease elimination. These efforts are supported by a robust framework that emphasizes immunization coverage, case-based surveillance, outbreak preparedness, and demand generation. The country's commitment was globally recognized when India received the "Measles and Rubella Champion Award" from the Measles and Rubella Partnership in March 2025, an acknowledgment of India's sustained leadership and innovation in immunization (MoHFW & PIB, 2024). The introduction of U-WIN, launched by the Hon'ble Prime Minister, has digitized the immunization management system and decision-making. U-WIN enables appointment booking, real-time data capture, certificate generation, and follow-up reminders to ensure complete vaccination, improving measles-rubella coverage in the first and second years of life (Karol & Thakare, 2024).

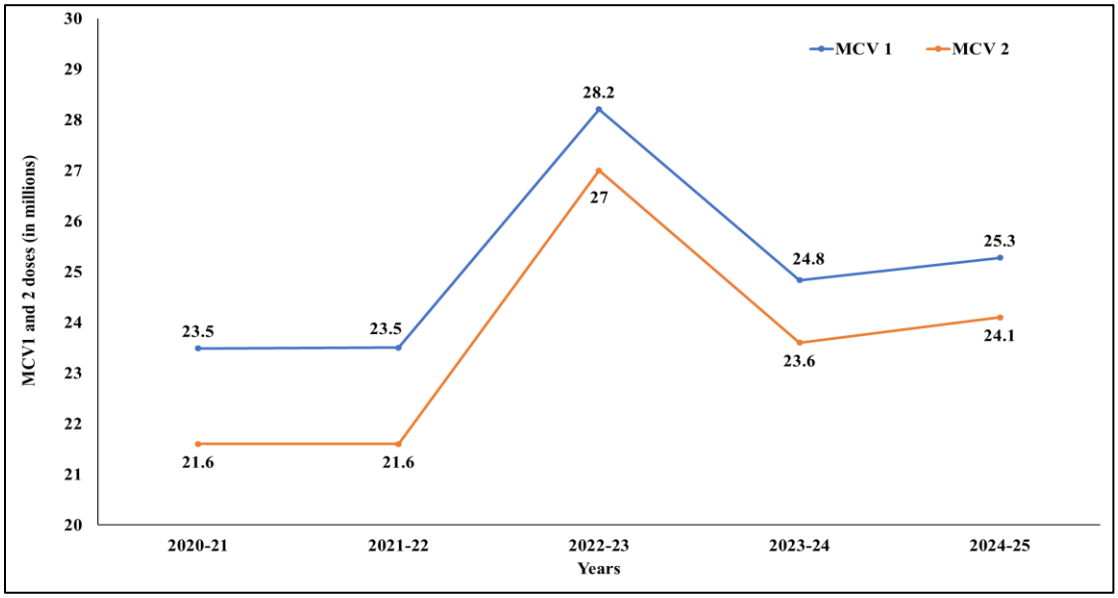

Figure 4 Number of measles-containing vaccine (MCV) doses in millions (2020-2025).

Data Source: Health Management Information System (HMIS). Over the last five years, the number of doses has steadily increased, further improving the coverage

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India's approach reflects not just a public health commitment but a robust investment in human capital. The return on investment (ROI) from the childhood vaccination program with WHO-recommended antigens is 44 times the program cost. The highest returns were observed for measles, 58 times the cost through two routine doses, and 2.02 times for rubella (Bahl et al., 2023). The Immunization Agenda 2030 (IA2030) identifies measles vaccination coverage as a tracer indicator of immunization equity and progress toward the Sustainable Development Goals (SDGs), underscoring the

interconnectedness of vaccination, health systems, and social development (O'Brien et al., 2024). The South-East Asia Region's collective commitment to measles and rubella elimination has further strengthened India's resolve. With the National Verification Committee (NVC) working alongside the Regional Verification Commission (SEA-RVC) and the National Technical Advisory Groups, India's elimination strategy aligns with global standards for surveillance, monitoring, and verification (Organization, n.d.). The updated Measles, Rubella, and Congenital Rubella Syndrome Surveillance Guide (2022) supports state-level systems in maintaining timely and sensitive surveillance, ensuring every suspected case is investigated, and every outbreak is contained (Bahl et al., 2023).

. The continuum from the first IMI round to IMI 5.0 exemplifies not only the nation's determination to close immunity gaps but also its capacity to adapt, innovate, and lead disease elimination (Gurnani et al., 2018).

Evolving mechanism of data driven decision-making in immunization

Data driven decision-making has increasingly emerged as the backbone of India's UIP, transforming the way policies are framed, interventions are prioritized, and progress is monitored at every level (John & Kompithra, 2025). The success of any long-term public health program relies not only on coverage and outreach but also on the consistency and reliability of the data that informs these efforts. In the context of immunization, where a child's journey from birth to full protection involves five critical data points from BCG at birth to MCV2, the continuous flow of high-quality, timely data becomes indispensable for shaping responsive and evidence-based strategies. Over the last five years, India has made remarkable strides in institutionalizing data use for immunization program management. Multiple studies have emphasized that data quality comprehension significantly determines the likelihood of its use in decision-making. When data are viewed as accurate, complete, and timely, they gain credibility and influence decisions at both the policy and operational levels. This transition toward data driven governance in immunization has been reinforced by the government's investments in digital systems, capacity enhancement, and fostering a culture of evidence-based decision-making (Adamu et al., 2025).

Strong analytical competency has consistently been shown to positively influence data utilization. Recognition and rewards for data driven performance have been shown to enhance motivation and accountability, fostering a culture where data is viewed not as an administrative burden but as a tool for improvement. Furthermore, the district and block health officials are responsible for multiple national health programs under the Reproductive and Child Health (RCH) Program, which demands a high level of coordination and efficiency. In such multitasking environments, timely access to reliable data enables quick, informed decisions that optimize resource allocation and enhance program delivery (DMEO & NITI Aayog, 2021).

Recognizing the importance of capacity building, initiatives such as the Rapid Immunization Skill Enhancement (RISE) program have been instrumental in

strengthening local capacities. RISE has improved technical aptitude and built practical skills among frontline health workers. This continuous cycle of 'training–tracking–timing' has improved program quality, enhanced efficiency, and ultimately contributed to the reduction in zero-dose prevalence. The capacity-building approach has enabled grassroots health workers and data collectors to utilize data and translate it into actionable insights (Chase et al., 2024).

Parallelly, the digital transformation, through the introduction of platforms such as eVIN (Electronic Vaccine Intelligence Network) and U-WIN, has revolutionized the monitoring and tracking of immunization services. eVIN has digitized vaccine stock management across the cold chain, ensuring real-time visibility of supply and reducing stock-outs. U-WIN ensures beneficiary tracking, recording vaccination events, scheduling sessions, and generating certificates (Karol & Thakare, 2024). Together, these systems have enabled the government to accurately track children who have missed vaccinations, dropped out, or migrated, ensuring that no child is left behind. Data from U-WIN and eVIN are now routinely reviewed in District Task Force for Immunization (DTFI) meetings, making them core instruments for program planning, monitoring, and corrective action. The result has been a significant reduction in the number of zero-dose children, improved equity in vaccine coverage, and accelerated progress toward national and global immunization goals.

In essence, from the local health sub-center to the national program management level, data have evolved from being passive records to strategic instruments of change. This paradigm shift has not only optimized program efficiency but also strengthened trust and transparency guided by evidence.

Increased budgeting effort through the National Health Mission (NHM)

Reducing the zero-dose burden and "leaving no one behind" requires more than operational ingenuity. It requires predictable, proportionate funding that translates policy intent into action at scale. Over the last five years, India has significantly increased its fiscal priority for health, and the NHM remains the primary vehicle through which these resources are allocated to immunization and related child health priorities. Central allocations to NHM rose to Indian Rupee (INR) 360 billion in the financial year (FY) 2024-25 (Budget Estimates), from 334 billion in 2020-21. NHM continues to account for a substantial share of allocations from the Ministry of Health & Family Welfare, as its overall envelope expands (Sitharaman, 2025; WHO, 2024b). Total expenditure on vaccines for routine immunization has more than doubled, rising from INR 15.09 billion to INR 33.72 billion. The total expenditure on UIP increased from INR 22.59 billion (2020) to INR 43.88 billion (2024). The current figure is approximately 12.19% of the total NHM budget, a notable increase from the 6.7% recorded in 2020. The budget allocation for 2023 reached an unprecedented INR 57.51 billion, in line with the ambitious big catch-up campaign, IMI 5.0 (WHO, 2024b). To address the immunization backlog owing to COVID-19 disruptions, the target age cohort for IMI 5.0 was broadened to children up to five years of age. Unlike previous IMI campaigns in select

districts, this was the first nationwide IMI campaign.

Two features of the recent budgetary situation are particularly important for the UIP. First, immunization is financed within the broader Reproductive & Child Health (RCH) flexipool and via dedicated "immunization kind grants" under NHM. The RCH flexipool is the second-largest NHM component, and the immunization kind grants, while smaller in share, ensure that states receive earmarked resources for routine immunization, supplementary activities, and pulse polio needs (Schueller et al., 2022). Across FY 2023-24 and 2024-25, the NHM Records of Proceedings (ROP) show activity-level budgeting with explicit line items for immunization, reflecting a shift toward programmatic clarity in financing. Second, while approved budgets have generally kept pace with state demands (over 90% of proposed NHM budgets were approved in recent years), a persistent and worrying gap remains between allocated funds and actual expenditures. In FY 2023-24, about 62% of allocated NHM funds were actually spent. In FY 2024-25 (until November 2025), expenditure was even lower (≈38% of allocated funds). In other words, additional allocations matter only if they are converted into on-the-ground action, such as staffing, cold chain management, outreach sessions, vaccines, and community mobilization, which together determine whether the zero-dose child actually receives their first dose.

How have these budgetary choices translated into programmatic gains? There are three concrete ways the improved fiscal envelope and its deployment have strengthened immunization performance over the last five years. First, funding was allocated for intensified campaigns and catch-up drives. The NHM design, facilitated through RCH and immunization grants, enabled the program to finance successive rounds of Mission Indradhanush and the Intensified Mission Indradhanush (IMI) phases, supporting microplanning, additional outreach sessions, and temporary surge capacity (including contractual staff, incentives, and supplies) in high-priority districts. Making these funds available and visible in the ROPs helped states plan and implement time-bound campaigns that directly addressed missed and zero-dose children (Schueller et al., 2022).

Second is investments in health system strengthening (HSS) that sustain long-term gains. The largest share of NHM budgets continues to be allocated to HSS infrastructure, maintenance, and human resources, which underpin routine immunization. While HSS dominates the NHM spending profile, its proper utilization enables consistent service delivery, cold-chain reliability, and supervision that ensures vaccine quality is not compromised. The NHM analyses indicate that HSS has accounted for the majority of proposed and approved budgets in recent years, demonstrating an intent to build durable capacity rather than only financing one-off campaigns (Spasenoska et al., 2025).

The third facet is fund allocation for digital tracking and accountability. Budget support and program emphasis enabled the rapid rollout and scale-up of digital platforms that translate expenditures into measurable actions. eVIN enhances vaccine resourcing

and distribution efficiency by providing real-time visibility into vaccine stock levels. U-WIN, a beneficiary-tracking and session-management platform, has recorded millions of beneficiaries, sessions, and doses to date, becoming a central tool in district task force reviews and microplanning for migrant and dropout populations. This digital backbone enables program managers to convert budgeted inputs into measurable outputs, including the number of sessions held, children tracked, certificates issued, and gaps closed.

Despite these positives, the budget narrative contains clear caveats that must shape any realistic assessment and future recommendations. First, state-level heterogeneity in utilization is substantial: several high-burden states have spent well below their allocated amounts in FY 2023-24 and FY 2024-25 (to date), which limits the national impact. Second, some NHM components (notably HSS and RCH) dominate spending, a prioritization that is justifiable from an operational perspective. Still, the relatively small share for "immunization kind grants" (single-digit percent shares in NHM components) means that targeted activities (outreach incentives, urban micro-plans, migrant tracking) still compete within constrained sub-pools and require strong prioritization in the state Program Implementation Plan (PIP). Third, the persistent gap between approved budgets and actual expenditures signals bottlenecks in absorptive capacity, financial management, or programmatic readiness that must be addressed for additional allocations to be effective.

From an economic and policy vantage, the case for sustained or increased immunization financing is compelling: immunization is highly cost-effective, protects human capital at birth, and prevents catastrophic health spending downstream. However, the fiscal argument alone is insufficient; the budget must be accompanied by systems that convert money into measurable coverage. This requires strict monitoring of fund release and utilization, demands capacity building for state financial management, explicit allocation pathways. The NHM institutional architecture enables many of these levers (Single Nodal Agency releases, two-year ROPs, supplementary ROPs), but these must be executed with rigorous operational discipline. The last five years have shown that budget increases, programmatic clarity, and digital tracking are driven by effective execution. Improved financing under NHM, targeted program investments like IMI, and real-time data systems have significantly reduced the number of zero-dose children nationwide. However, sustaining progress and achieving the last mile requires continued adequate and predictable financing. This must also be coupled with stronger expenditure absorption and a higher prioritization of the immunization agenda at the sub-national levels.

Discussion

The UIP has consistently served as one of India's most enduring and transformative public health programs, shaping the foundations of the country's health system over four decades. What began with a handful of traditional vaccines has, over time, expanded into a comprehensive schedule that

now includes multiple life-saving vaccines, such as RVV and PCV. This expansion has strengthened India's strategy to reduce the prevalence of VPDs and established a robust delivery system capable of reaching millions of children and pregnant women each year. Achieving complete immunization coverage, however, is a continuous process and should follow scientific timelines and recommendations. Every child's journey through the immunization schedule from the first contact at birth to the second dose of measles-containing vaccine (MCV2) requires multiple visits, uninterrupted access to services, a steady supply chain, and trust in the healthcare system. Even a minor disruption at any point can slow the pace of coverage, service delivery, and widen immunity gaps. The COVID-19 pandemic demonstrated this vulnerability with unprecedented clarity.

During the initial lockdown phase of the COVID-19 pandemic, routine immunization became one of the most severely disrupted essential health services, and the fear of infection exacerbated the situation (WHO, 2024). Supply chains were strained, health workers were redeployed to handle the crisis, and mobility restrictions halted outreach sessions. For a country with the world's largest birth cohort, even a small percentage decline in coverage translated into hundreds of thousands of additional zero-dose or under-immunized children. While many countries immunize their annual birth cohort over a year, India vaccinates a comparable number in a month, making even temporary disruptions magnified in scale. Despite challenges, India successfully managed a complex public health emergency by simultaneously conducting the world's largest COVID-19 vaccination drive, while also gradually resuming routine immunization services (V. M. Kumar et al., 2021). This balanced approach adopted by the government rapidly scaled up COVID-19 vaccination and steadily restored routine immunization. India has been implementing large-scale catch-up campaigns since 2014. In 2021, 2022, and 2023, these campaigns were strategically planned to counteract the decline in immunization coverage. These efforts contributed to consistent improvement in coverage. According to administrative data (HMIS), the FIC has steadily increased over the past few years, reflecting annual gains that demonstrate renewed momentum in service delivery (Tawde et al., 2024). However, the HMIS data has certain limitations. Trend analyses in this paper rely on HMIS data, which may be subject to reporting biases and uncertainties in population figures. These factors could influence the precision of coverage estimates; therefore, the findings should be regarded as indicative of broad trends rather than precise metrics. Nonetheless, HMIS remains an essential tool for monitoring program performance and informing strategic decisions.

Health financing played a catalytic role in sustaining these efforts. In recent years, the budget allocated for UIP under the NHM increased by nearly 100%, from 2020 to 2025, supporting both routine activities and intensified campaigns (Pandey et al., 2025). Sustained health financing and commitment have been key drivers of uninterrupted services and improved immunization coverage. Studies worldwide consistently show that investing in immunization systems yields significant returns, with each extra dollar spent correlated with measurable

improvements in DPT coverage and enhanced child survival rates (Sim et al., 2020). NHM-strengthened budgeting enabled states to effectively plan and expand outreach sessions, engage medical colleges for improved immunization in urban areas, build capacities, strengthen microplanning, and enhance cold-chain infrastructure, all crucial for restoring pre-pandemic performance and accelerating progress.

One of the lesser-discussed yet critical challenges during the pandemic was large-scale migration. There was a sudden population movement from urban to rural areas, followed by reverse migration, and then migration towards urban areas as economic activity resumed, disrupting the continuity of care. Families relocating for livelihood often give less priority to preventive health services, including immunization. This made it difficult for frontline workers to track migratory populations, thereby increasing the risk that children would miss their scheduled doses. Recognizing this, states intensified urban outreach, established partnerships with medical colleges, and expanded hours for facility-based immunization. Additionally, Model Immunization Centres (MICs) were established in several states to meet the needs of caregivers through flexible session timings and improved quality of care (UNICEF, 2025). The introduction of digital tools further strengthened India's capacity to track migratory and dropout cases effectively. U-WIN, built on the successful foundation of the CoWIN platform, now enables real-time registration, tracking, and follow-up of beneficiaries across multiple locations. Its utility in tracing migratory children, ensuring scheduled dose completion, and improving communication with caregivers has significantly enhanced program responsiveness. U-WIN, combined with eVIN's real-time visibility into vaccine stocks and cold-chain performance, has made India's immunization system more data driven. The integration of these platforms into the District Task Force for Immunization (DTFI) review has institutionalized data use at the local level, allowing district officials to identify gaps early and adapt targeted solutions.

These advancements collectively position India on the cusp of achieving several major global health milestones. The SDGs and IA2030 aim for equitable access to vaccination, strengthened primary health systems, the elimination of VPDs, and a reduction in infant and under-five mortality. India's intensified efforts in the last five years have brought it close to eliminating measles and rubella. The integration of surveillance, outbreak preparedness, high-quality data, sustained budgeting, model immunization centers in urban areas, and digital beneficiary tracking forms the backbone of this progress. Immunization is not merely a vertical program; instead, it continues to evolve and requires horizontal strengthening. India's ability to recover from pandemic disruptions and accelerate progress toward universal coverage reflects the confluence of key enablers, including intensive campaigns, scaleup of new vaccine, digital tools enabling data driven decision-making, financial commitments, and demand generation. As India continues its pursuit of leaving no child behind, the lessons from this period reaffirm that strong systems, timely data, and adequate financing remain the most potent tools in

safeguarding every child's right to life-saving vaccines.

Data availability statement

The datasets used and analyzed in this study are not publicly available and can be provided upon request.

Declaration of Interests

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript.

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