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REVIEW ARTICLE

75 Years of Vaccination in India and Way Ahead

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Abstract

Prevention of diseases through vaccination has been a key component of Preventive Medicine. The history of vaccination in India begins from pre-Independence where Small pox vaccine was introduced for the first time and administered through tikadars(vaccinators) till post-Independence where the political will and the medical experts helped us eliminate Poliomyelitis- a dreaded disease. Post-Independence, India has come a long way from starting the manufacturing of vaccines, introducing Expanded Polio Immunization (1978) and Universal Immunization Programme (1985) to a path breaking performance in Covid-19 vaccination. The Covid-19 vaccination has brought India under the limelight globally and are ready to take up further challenges. The Covid-19 vaccination is a model in itself for the world and has been analysed in detail from planning to its execution. This paper attempts to review the history of vaccination from pre-Independence era in brief to a greater focus on how it paved a way for further developments in the domain of Vaccination post-Independence in the country.

Keywords: vaccination, covid-19 vaccination, India, expanded programme on immunization, universal immunization programme

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Introduction

The description of infectious diseases like Tuberculosis, leprosy, etc. in our ancient literatures tells us that they have been present in our society since times immemorial. Alongside human evolution and development, man has tried to treat these diseases, moreover, eliminate these diseases from the Society. Man has been curious to study about these diseases and has been working continuously to remove them since health has always been considered a human right. While treating a disease has been an integral part of this system, so has been the idea of prevention. Prevention has been considered the ultimate goal of our system where everybody can lead a healthy life. As Public Health Specialists, our main area of concern is prevention of diseases. To implement this, vaccination has been considered a major pathway towards achieving this goal. The history of usage of vaccines dates back to 1000 AD in China in preventing smallpox disease [1]. The concept of vaccination reached India in early 1800s after the arrival of smallpox vaccine as the disease was well prevalent in India, such that it was also called Indian plague [1]. Starting from having paid vaccinators to the Compulsory Vaccination Act which came into practice in 1938 and moved towards our goal of maximum immunization coverage but still a lot was lacking at the policy level. Not only through transportation but in late 1800s, we also developed the Cholera vaccine, but the immunization failed as there were many deaths reported post cholera vaccination [1].

Although, in the later years, the cause of death was found and reported to be due to programmatic errors only [1]. Even when being ruled by the British, various vaccination laboratories were being set up in India. While on one side, we were keen on being self-capable in manufacturing of vaccines locally and making India a self-reliant nation, our concern also shifted towards the resistance among the citizens towards vaccinations. After a lot of research, it was found that one of the major causes of this resistance was the side effects after vaccination, which otherwise is a usual phenomenon but kept the concept of Immunization in bad light as it was not being dealt appropriately. To rectify this, the concept of reporting of Adverse Events Following Immunization (AEFI) came up and was perceived as one of the strengthening tools towards immunization coverage [2,3,4]. This way the seeds of Immunization were sown in the country. Previous literature has described the fight against various diseases through vaccination under disease headings both pre- and post- Independence. Through this review, we present a comprehensive overview on the vaccination history from pre-Independence to post Independence and how the country's journey vaccination programme during the COVID-19 pandemic has brought India under the global limelight for the first time.

Literature Review

1. Fight against Polio

Nearing India's Independence, Polio had created an aftermath in the country. After various scientists failed at their discoveries, it was Jonas Salk who developed the trivalent vaccine in 1955. Further, Sabin developed an oral polio vaccine (OPV) and trials were done by 1960. Concurrently, Vaccine associated paralytic poliomyelitis (VAPP) was found to be associated more with OPV than the Sabin variant in 1962. But OPV outnumbered IPV through various research and proved more beneficial and efficient for mass use in 1964 and it was implemented in every country by WHO through Expanded Program on Immunization (EPI) in 1974. It was only in 1970 that the indigenous OPV production started in India. In 1988 when the Global Polio Eradication Initiative (GPEI) was being launched, the OPV was chosen for use in all these countries and the program received the due attention because of World Health Assembly's target to eradicate polio by 2000 [5].Table 1 shows the timeline progress in achieving the polio free status of India [6,7,8].

Table 1. Timeline of polio eradication

S.No	Year	Milestone achieved
1.	1988	World Health Assembly set a target of polio eradication by 2000.
2.	1995-96	First two National Immunization Days for polio vaccination conducted.
3.	1996	Vaccine Vial Monitor used on polio vaccine vials.
4.	1999	Polio drive moved from booth activity to house-to-house coverage.
5.	2005	Monovalent oral polio vaccine was used.
6.	2010	Bivalent oral polio vaccine used for polio campaigns in India.
		Last reported wild polio virus in sewage sample from Mumbai, India.
		Last case of wild polio virus type 3 reported from Pakur, Jharkhand.
7.	2011	Last case of any type of wild polio virus reported from Howrah, West Bengal.
8.	2012	WHO removes India from the list of polio endemic countries.

During the next six years, extensive efforts were made particularly in states of Tamil Nadu, Kerala and Delhi following which two National Immunization Days (NIDs) were conducted. By 1996, Vaccine vial monitors also came into use in our country to further enhance the efficacy of the vaccine and its monitoring. The programme conceived its full form in 1997 when WHO and India began the National Polio Surveillance Project. As a result, within only two years of inception, the last case of Polio (WPV-2) was reported in 1999. Gaining further momentum, the strategy of booth vaccination was further expanded to door-to-door coverage of the whole target population. In 2005, monovalent OPV had come into use but in 2010, bivalent OPV was used in these campaigns. We could successfully report the last sample of polio virus in 2010 in sewage sample in Mumbai. The last case of any type of WPV was reported in Howrah, West Bengal on 13th of January 2011. Following that, India received a Polio free status from WHO. The success of this program has been acknowledged by WHO and our country has been appreciated by them quoting "*The strategies for polio eradication work when they are fully implemented. This is clearly demonstrated by India's success in stopping polio in January 2011, in arguably the most technically challenging place, and polio-free certification of the entire WHO Southeast Asia Region in March 2014*" [7,8].

2. Fight against Tuberculosis and Small pox

After the Independence in 1947, focus was brought onto Preventive health and so to the Vaccination program of the country. The logistical concerns were addressed, and various manufacturing units were set up in the country. BCG vaccine laboratory was set up in 1948 and by 1951; liquid BCG vaccine was made available for mass campaigns. The BCG vaccination gave an immediate boost to the vaccination program of the country where it was inculcated in National Tuberculosis Control Programme started in 1962. This happened as Tuberculosis was taking a shape of an epidemic in the country. After various deliberations in relation to the efficacy of the BCG vaccine, it was realized to be given at an early age i.e., within first year of birth and was included in the UIP. All these amendments were possible only because of the research trials done by our indigenous Institutes and the importance of self-reliance was understood [9].

Not only this, World Health Assembly's resolution to eradicate smallpox in 1958 was also taken up leading to genesis of National Smallpox Eradication programme in 1962 with an objective of vaccinating the entire population in the following three years. By 1965, live attenuated freeze-dried smallpox vaccine was also made available for larger population [9].

Two years later, freeze dried BCG and OPV became available in India as well. But

the results were disappointing because the disease outbreak could still not be reduced due to lack of access to the target population. In 1967-1968, the smallpox eradication strategy was reformulated in terms of surveillance along with epidemiological investigation of outbreaks and rapid containment drives. Even the vaccination technique from using a rotary lancet was changed to bifurcated needle technique in 1969. The old liquid vaccine was replaced by more potent, heat-stable and freeze-dried vaccine in 1971.By mid-1973, the vaccination helped to contain the disease in select States of India. An intensified approach was undertaken, and a phase wise implementation of the program was done where firstly the disease was searched and attempts were made for containment. In the second phase, UP, Bihar, Madhya Pradesh and West Bengal were targeted where each village and every house was screened to detect any suspected case within a one-week period. Case investigations and containment operations were done in the next three weeks. Still, the count remained at 188,000 cases and 31,000 deaths. The Government intensified the search, containment process and the vaccination efforts. With continued surveillance, the last reported case came in 1975 and India received the Smallpox free status in 1977. The journey of India becoming "Smallpox free" is a great learning tool in the history of India as to how a socio-political approach with strong determination can help reach great heights [9,11,12].

3. Fight against Vitamin A deficiency & Expanded Programme on Immunization (EPI)

The National Prophylaxis Programme against Nutritional Blindness due to Vitamin A Deficiency (NPPNB due to VAD) was developed in 1970 for preventing nutritional blindness due to keratomalacia. Being a completely centrally sponsored programme, it was launched in a phasic manner as an urgent remedy to combat xerophthalmic blindness. This Programme was initiated in 11 States of the country. After achieving positive results during Evaluation conducted by the National Institute of Nutrition (NIN), Hyderabad in 1976 in two States, the Programme was extended to all States in the country. In view of operational feasibility, the administration of first dose of Vitamin A was linked to measles immunization. Presently, Vitamin A Supplementation (VAS) is being implemented through the existing network of Primary Health Centres and Sub-Centres. The services of Integrated Child Development Services [ICDS] functionaries are being utilized for the implementation of the Programme [13,14].

In 1974, Expanded Programme on Immunization was developed and was launched in 1977 globally with the aim to immunize every child against diphtheria, pertussis, tetanus, poliomyelitis, typhoid and tuberculosis by 1990.In 1974, below 5% children were receiving a 3rd dose of DPT and poliomyelitis vaccines within their 1st year of life. These coverage levels have now exceeded beyond 50% and millions of cases of the target disease have been successfully prevented. The next decade came to be a boon for the Vaccination program of the country where various milestones were achieved from indigenous measles vaccine production, manufacturing of IPV in 1984 by setting up various public- private joint venture companies like Indian Immunological Limited, Panacea Biotech, Indian Vaccine Company Limited (IVCOL), Bharat Immunological and Biological Limited (BIBCOL) [9].

The world looked at India at a fast-moving pace in becoming self-dependent, adopting excellent approaches for Vaccine Preventable Diseases (VPDs). In 1985, EPI was renamed to Universal Immunization Programme (UIP) where typhoid vaccination was replaced by measles vaccine and more focus was made to those less than one year in the programme. The focus was now extended to six basic vaccines to infants and tetanus vaccine to pregnant women. During this period, India started manufacturing of many new vaccines which became licensed and

available in the market. There have been additional national efforts to improve coverage, which include launch of Immunization Strengthening Project, Urban Measles Campaign and Border Districts Cluster Strategy, etc. After another revision of AEFI guidelines in 2005-2006 improved the reporting system and is further being revised continuously [15].

India released its first National Vaccine Policy in 2011 which envisages the guiding principles for functioning of immunization programme in the country. Following this, 2012-13 was declared as "Year of intensification of Routine Immunization". Focus was now paid to 239 poor performing districts of India with the intent to prioritize conduction of immunization weeks along with improving cold chain status and for better coverage [16].

4. India's journey on becoming self-reliant

Another boost to the manufacturing of vaccines in the country happened in 2009 when three manufacturers developed pandemic flu vaccine in a short period of time. Following this, a new bivalent oral cholera vaccine, a meningitis-A vaccine and an indigenous Japanese Encephalitis vaccine were developed by Indian manufacturers in collaboration with international partner and are now licensed in India. An indigenous Rota virus vaccine ROTAVAC was also announced in 2013 and its successful trial was considered an important milestone and a perfect example of successful public-private partnership [17].

5. Immunization coverage

Figure 1 shows the percentage of children who received all basic vaccinations [BCG, MCV/ Measles/ MR/ MMR, and three doses each of DPT/Penta and polio vaccine] increased from 62.0% in NFHS-IV (2015-16) to 76.7% in NFHS-V (2019-20) report. As per NFHS-5 report, over four-fifths of children received complete three doses of hepatitis B vaccine. 95% children received BCG vaccine, highest amongst all [18].

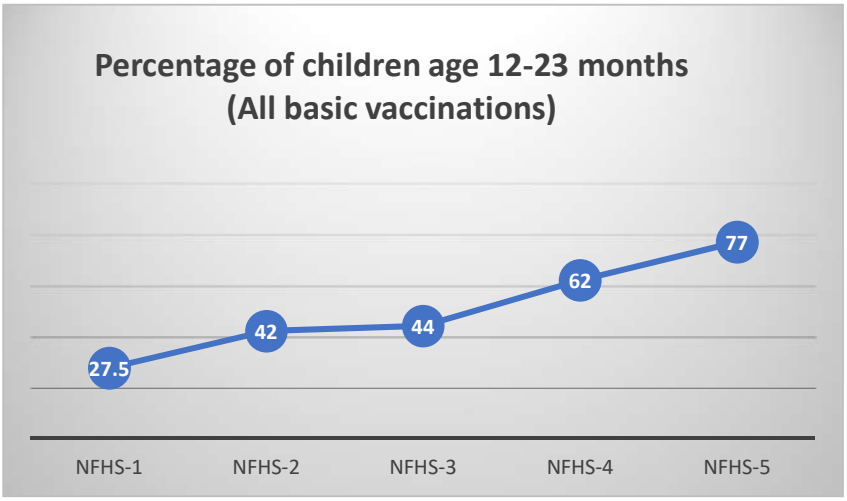

Figure 1. Percentage of children age 12-23 months (all basic vaccinations)

During the "Year of intensification of routine immunization" various strategic actions were initiated towards increased funding for supportive supervision and mobilization of beneficiaries. A web-based mother and child tracking system (MCTS) with the objective of preventing left out and drop-outs was also introduced. Towards strengthening of Adverse Event Following Immunization (AEF)] surveillance, activities including establishing a national AEFI Secretariat, collaboration with medical

colleges for research assistance, revision of the guidelines and capacity building across the country were taken up. The National cold chain management information system (NCCMIS) was also further established to ensure vaccine safety and effective cold chain management. In 2014, Mission Indradhanush was launched as a strategic endeavour by the Ministry of Health & Family Welfare (MoHFW), Government of India to expand the immunization coverage to at least 90% over the next five years. The country was categorized into high, medium and low focus districts, thereby Phase I of Mission Indradhanush targeted 201 high-focus districts of the country. Phase II targeted 352 districts between October 2015 and January 2016. During these two phases of Mission Indradhanush more than 3.7 million children were fully immunized [19].

The basic strategy included ensuring availability of sufficient vaccinators through revision of micro plans in all areas including slums, construction sites, and other hard to reach areas, achieving better community participation by intensive communication, special focus on capacity building through intensive training of the workers and ensuring engagement and accountability of administrative machinery for better implementation.

In spite of all positive changes, we still face several challenges in the form of incomplete coverage because of population resistance at certain levels, weak AEFI surveillance and reporting system along with problems at the funding level for conducting operational research, trials and self-sufficiency at manufacturing level. But today, beyond the aftermath of COVID-19 and the brilliant work done by the country in discovery, manufacturing and administration of COVID-19 vaccine has brought India at the top of the globe where we stand as an example of how a strong determination and a good cooperation of the socio-political leaders with the medical fraternity can work wonders for the masses.

6. Vaccination during COVID-19 pandemic

After the COVID-19 pandemic hit us, the urgent need of vaccine was realized at international level. India is amongst the first few countries to have developed and manufactured the COVID-19 vaccines: Covi-shield, the recombinant ChAdOx1 nCoV- 19 Corona Virus Vaccine, COVAXIN and SPUTNIK-V. With the belief in Vasudhaiva Kutumbakam (World as one family), Government of India supplied 66.37 million doses of COVID-19 vaccines to 95 countries. Recently, the National Regulator also granted permission for restricted use in emergency like situations to ZyCoV-D, the World's first DNA based COVID-19 vaccine [20]. Alongside, the following vaccines are also in advanced stages of clinical trials: sub-unit vaccine (Corbevax), mRNA vaccine (HGCO19) and Intra-nasal vaccine.

Not only the manufacturing part, but the inculcation of the technology through Co-Win portal helped the programme managers in registration and tracking of each beneficiary of COVID-19 vaccination and every vaccination event along with real time information of vaccine stocks, vaccination process, digital certification, etc. This is also serving as a platform for registration and scheduling of vaccination appointments making the system all the more effective thereby promoting easy visualization, hassle free registration and maintaining transparency in the system.

A Co-WIN Global Conclave was jointly organized in July 2021 by MoHFW, Ministry of External Affairs (MEA) and National Health Authority (NHA) with the objective to extend the platform as a digital public good to the world where more than hundred countries have shown interest for uptake and operationalization of Co-WIN. A comprehensive strategy based on six key principles was evolved including adoption of a Universal Programme approach along with provision of "free of cost" vaccines, "Aatma-nirbharta"(self-reliance) for which the Government provided support to develop indigenous vaccines, adoption of "layered

approach" included vaccinating Frontline Workers, followed by vulnerable population and ultimately for all over 18 years of age, development of Co-Win portal to facilitate the process of mass vaccination, "One Earth, One Health" approach with proactive sharing of our experiences, expertise and resources with the global community and engagement of all key stakeholders.

The National COVID-19 vaccination drive of India is world's largest vaccination drive and has been unprecedented in both scale and reach. India's well visioned vaccine production and administration effort as recommended by National Expert Group on Vaccine Administration for COVID-19 (NEGVAC) is based on four key points including strong IT framework through Co-Win portal, facilitating indigenous research along with development and production, mobilizing supplies from all sources and adherence to COVID-19 appropriate behaviour.

Vaccination drive has been monitored at various stages by the National, State and District Task Force, as per the monitoring mechanism defined in operational guidelines of COVID-19 vaccination drive. The main emphasis is over vaccination coverage status; AEFI reported and vaccine wastage, availability and utilization, supply chain issues, policy decisions regarding COVID vaccination drive etc. The AEFI surveillance system under UIP has been strengthened for COVID-19 AEFI management and reporting by inclusion of Super-specialists as well, revision in contents of Anaphylaxis kits, training of vaccinators on usage of Anaphylaxis kit, etc. To enhance the reporting, minor, severe and serious AEFIs which occur after COVID-19 vaccinations can be reported by vaccinators and district immunization officers directly on the Co-WIN app. In addition to entering of the AEFI related data, relevant investigation forms and hospital records, etc. can also be uploaded on the application [20].

Conclusion

The whole process of strengthening of vaccination in our country is far more elaborate than discussed in this small segment where every event has a detailed background with merits and a history of failures. But we need to review the history from time to time as a part of learning on what to do and what not to do. And today, as we celebrate "Azadi ka Amrit Mahotsav"(75 years of Independence) it is for sure that India has proved its mettle and stood out on a global platform.

Statements and Declarations

Competing interests: Not Applicable

Conflict of interest: Not Applicable

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