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## Mini Review

# Vaccination in India: An Insight

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## Abstract

This review has documented the vaccination in India and the history of it with a view to know the directions of developing indigenous vaccines for expanding the benefit to the grass root level in this highly populated country. Expansion of smallpox vaccination, typhoid vaccine trial and setting up of vaccine institutes were witnessed in the early twentieth century in almost each state in India. A number of private vaccine manufacturers came up in the post independence period in India besides the establishment of BCG vaccine in National Institutes. Smallpox vaccination was continued till it was eradicated and the country became smallpox free in 1977. Universal Immunization Programme was launched in 1985 as a part of the expanded programme of immunization which was established in 1978. India has declared as the country of non-endemic for poliomyelitis in 2012. Therefore, the immunization efforts are guided by the experience of the past events for analyzing and developing vaccines in the present time.

## Introduction

Vaccination is one of the most cost effective interventions for the survival against several dreaded pathogens worldwide. It focuses on delivering for the benefit of the children and the pregnant women and the persons suffering from serious diseases [1]. The effectiveness of the vaccination against polio, measles, diphtheria and others in India and other countries are well documented since 1798 when it first discovered against small pox [1,2]. Survey reports suggested that only 61% of all children received the vaccine each year [3]. In India Universal immunization programme (UIP) and National Immunization programme have set to immunize of the population. The objective of the programme is to increase the immunization coverage to improve the quality of service and to achieve self sufficiency in vaccine production [4]. According to the district level household survey, total of 53.5% coverage was done during the year 2007-08 [4].

## History

The main goal of vaccination or immunization is to eradicate the infections from our society [5]. Various research tools have been developed to eliminate effectively the disease causing agents and to increase the quality of the diagnosis. Small pox was reported first in Goa, India, in 1545 AD as a

killer disease and referred as Indian plague [6]. The inoculation of mild disease in human may prevent the disease in future. Small pox affected almost all races in the human history and its eradication technique was also practiced in Eastern world [7]. In 1774, Benjamin Jesty of England inoculated the cowpox virus to his wife and children and developed the small pox vaccine. After few years, Edward Jenner, an English doctor investigated that mild cowpox virus develops mild disease but with no serious effect. However, this finding led him for the foundation of developing vaccine [7]. The credit for developing smallpox vaccine was given to Edward Jenner in 1796. It is really unfortunate that the original inventor Jesty did not publicize his findings in 1774 which was twenty two years earlier than Jenner Table 1.

## Vaccination in indian perspective

Weather condition of Indian sub continent helps to multiply the growth of the agents of infectious diseases like measles, plague, hepatitis, and others. This continent is very large and thickly populated with 130 million people approximately. A large group of sections come under middle class and poor. Therefore, the socio- economic status is also very low among large group of people. Infectious pathogens are able to manifest diseases to create an epidemic situation. So, proper immunization has become mandatory to control the diseases.

**Table 1:** National Immunization programme of India for Infants Children and Pregnant Women (2020) [8].

Vaccines	Protection area	Route	Number of doses	Catch- up Dose (can be given if the doses as per schedule are missed )
BCG (Bacillus Calmette Guerin)-Lyophilized vaccine	Tuberculosis	Intra-dermal	1	Up to 5 years
OPV(Oral Polio Vaccine)- Liquid vaccine	Poliomyelitis	Oral	5	Additional doses of OPV on all pulse polio days for children till 5 years of age
Hepatitis B –Liquid Vaccine	Hepatitis B	Intra-muscular	4	If a birth dose is missed, monovalent Hep B before 4 weeks of age
DPT (Diphtheria,Pertussis and Tetanus Toxoid) –Liquid vaccine	Diphtheria,Pertussis and Tetanus	Intra-muscular	5	Missed primary dosed can be completed till 1 year of age The 1 <sup>st</sup> booster dose can be given upto 4 years. 2 <sup>nd</sup> booster dose can be given before 7 years of age
Measles –Lyophilized vaccine	Measles	Subcutaneous	2	All school children and adolescents who did not have natural infection or received the vaccine earlier should be immunized with 2 doses at 4 weeks interval
TT (Tetanus Toxoid) Liquid vaccine	Tetanus	Intra-muscular	2	Minimum interval between dose 1 and 2 is 4 weeks. Between dose 2 to 3 4 weeks Between dose 3 and 4 is 6 months
JE vaccination (in selected high disease burden districts) Lyophilized vaccine	Japanese Encephalitis (Brain fever)	Subcutaneous	2	If <12 months of age generally 2 doses. If >12 months of age generally 2 doses of Booster dose not recommended
Hib (given as pentavalent containing Hib+DPT+Hep B) (in selected states) – Liquid vaccine	Hib Pneumonia and Hib meningitis	Intra-muscular	3	For age < 12 months; 2 doses at 4 weeks interval, with a booster at age 12-18 months. For child 12-15 months; 1 dose only followed by a booster dose after at least 4 weeks Above 15 months- single dose No catch up above 5 years of age

In the early part of British - India, there was no certain policy for giving the vaccine to the people. Some migrant vaccinators travelled to the rural parts of India and vaccinated people sporadically. However, the percentage was very low at that time. The policy of vaccination was adopted in 1892 in India but in reality it was executed lately [9].

In 20th century, the outbreak of cholera and typhoid was a huge toll in India. In India during 1944-1945 the highest numbers of smallpox cases were reported. After the world war-II, the numbers of cases were diminished. Another crucial thing was that the typhoid vaccine trials were initiated in India [9-11].

After independence, a maximum number of smallpox cases found in India. Cholera and plague epidemics were also occurring but tuberculosis was perceived as a major cause of morbidity and mortality. At that time, the Govt. of India introduces BCG to eradicate the pulmonary tuberculosis [12]. Tuberculosis Campaign helped to extend BCG vaccination all over India [12]. In 1962 the National small pox eradication programme contributed a lot for the eradication of small pox from India [13].

In 1978, India launched National Immunization programme, called as Expanded Programme on Immunization (EPI) with the introduction of BCG, OPV, DPT and typhoid-paratyphoid vaccines [14,15]. But till 2011 Hepatitis-B is a most recent antigen that has been added for vaccination with six other vaccines in India [15].

Till date, India is now able to introduce various indigenous vaccines like rota virus, human papilloma virus etc. Japanese encephalitis vaccine is also developed in 2013 in India [9].

Japanese encephalitis vaccine was imported in India till the year 2012. Thereafter, a good number of Government Institutes

like Department of Biotechnology, Department of Science and Technology (DST), Council for Scientific and Industrial Research (CSIR), Indian Council of Medical Research (ICMR), and Institutes such as National Institute of Immunology, All India Institute of Cholera and other Enteric Diseases, and All India Institute of Medical Sciences have started vaccine research and providing indigenous vaccine development [16]. A new conjugated typhoid vaccine was produced by the Indian manufacturer in 2008/2009 apart from Vi Polysaccharide vaccine [17].

ROTAVAC, rota virus vaccine based on an indigenous strain known as 116E, was manufactured and proved comparable to other rotavirus vaccines in 2014 [18]. This was the successful outcome of public-private partnership and called as 'unique social innovation model' [19]. Typbar-TCV, a typhoid conjugate fourth generation vaccine, has been launched in India in 2013 [20]. JENVAC, indigenous Japanese encephalitis (JE) vaccine, developed jointly by the National Institute of Virology, Indian Council of Medical Research and Bharat Biotech Ltd. in 2014 [21] Tables 2,3.

### Vaccination in case of infectious disease

In India, vaccination coverage of BCG since 1985 under Universal Immunization programme was very good in the various part of the country except some of the eastern states. BCG vaccination was very effective in the early disease progression for healthy children but not in the case of malnourished children. In those childrens, in spite of BCG vaccination develops serious and fatal types of tuberculosis. The tuberculin anergy is mainly responsible for the disease progression [28,29].

Smallpox is a serious viral disease and vaccination against small pox was implemented in the year 1800s to mid 1900s. It causes a serious health problem in India in the past and

**Table 2:** Introduction of new antigens in Universal Immunization Programme (UIP) in India.

UIP launched with BCG, DPT, OPV and measles	1985
Hepatitis B vaccine becomes the part of UIP	2002/2003
JE vaccine added to UIP	2006-10
Measles Vaccine (MCV2) second dose introduced in UIP	2010

Source: Refs. 22, 23, 24, 25, 26

**Table 3:** List of licensed vaccine manufacturing units in India.

BCG Vaccine Laboratories	Guindy, Tamil Naud
Institute of India Ltd	Pune, Maharashtra
Pasteur Institute of India	Coonoor, Tamil Nadu
Central Research Laboratory	Kasauli, Himachal Pradesh
Haffkine Biological Product C Ltd	Mumbai, Maharashtra
Human Biologicals and Immunologicals	Hyderabad, Telangana
King Institute of Preventive Medicine	Chennai, Tamil Nadu
Pasteur Institute,	Shillong, Meghalaya
Bio Vaccines	Hyderabad, Telangana
Dano Vaccines	Hyderabad, Telangana
Bahrat Immunological and Biologicals Company Ltd	Bulandshahar, Uttar
PradeshPanacea Biotech International (L)	Hyderabad, Telangana
Sanofi Pasteur India Pvt Ltd	Delhi
Zydus Cadilla,	Ahmedabad, Gujarat
Chiron Behring Vaccine Lab	Ankleswar, Gujarat
Chiron Behring Vaccine Lab	New Delhi

Source: Ref.27

now completely eradicated from India. In 1962 the National Smallpox Eradication Programme (NSEP) in India was launched with main objective of successful removal of small pox within few years from India. After the end of the 60s, the NSEP programme redirected towards surveillance. The staffs were assigned in different areas in the states and were divided into endemic and non-endemic areas where priority was given to endemic areas [8,12]. At the end of the 1970s, the NSEP programme completely eradicated the small pox from India [12].

Hepatitis B virus (HBV) infection was also identified as a major public health problem in India [31]. Hepatitis is 50 to 100 times more infectious than HIV infection [31]. Approximately 30% of the world's populations have serological evidence of either current or past infections with hepatitis B virus. In 1994 and 1995, approximately 110138 and 110012 cases of patients with acute jaundice were reported to the Ministry of Health and Family Welfare [32]. During the last few years, hepatitis B vaccine has become available in the private sector in urban areas of India as well. India falls under intermediate endemicity zone with the prevalence of 2–7%. That is average of 4% with a disease burden of about 50 million [32,33].

## Conclusion

Indian sub continent was the home of emergence of the various diseases in the past. The climate pattern and the socio

economic status of this country also boosted the emergence of various diseases. National immunization programme, Universal immunization programme were few of those strategies that Indian govt. implemented to diminish the spreading of the disease. These very effective programmes were lead to immunize the entire population of the country. But there are certain limitations for immunization programmes. The population of this country is very large and to immunize the entire population has become challenging for the officials and volunteers. It needs a complete plan for running the programme and making it successful for the entire country.

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