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A Decade of the National Health Mission: Full Immunization Coverage and Vaccine Preventable Diseases in India

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Abstract: ***Immunization in India has been proven and one of the most cost-effective mechanisms to prevent the under-five mortality. This study is based on secondary data analysis from four rounds of National Family Health Survey (NFHS), conducted during 1992–93, 1998–99, 2005–06 and 2015-2016 and Global Burden of Disease Data (GBD) for the year 2016. A multivariate analysis was done focusing on the urban-rural, Caste and state differentials in full immunization coverage among children aged 12-23 in India during 2005-2016 along with district level analysis for poor and better performing states and analysis of mortality of Vaccine Preventable diseases in India. The vaccination coverage varied considerably from state to state. The full immunization coverage in India has increased to nearly double in a span of 25 years. In the decade 2005-2016 the Empowered Action Group (EAG) states also show an incredible growth of more than 1.5 times, while the under-five mortality has decreased to 24%. India need to achieve Sustainable Development goal of 90% national vaccination coverage by 2030. This can be possible if the government focus on the districts of eleven under five mortality contributing states like Nagaland, Arunachal Pradesh, Assam, Gujarat, Mizoram, Uttar Pradesh, Madhya Pradesh, Tripura, Rajasthan, Maharashtra and Uttarakhand. Rapid and effective implementation of supply side as well as demand side interventions to the remotest places in India can save our children.***

Keywords: Immunization, Vaccine Preventable Diseases, National Family Health Survey (NFHS), Global Burden of Disease (GBD), EAG states.

1. Introduction

Immunization is a public tool for controlling and eliminating infectious diseases. It is also one of the most cost-effective health investments with proven strategies that make it accessible to even the most hard-to-reach and vulnerable populations. Every year around 2 to 3 million deaths are avoided by immunization. According to the latest data from WHO, in the year 2016, 65% of the target population around the world received vaccination. The average coverage of vaccination acrossthe Western Pacific was 66% and Eastern Mediterranean was 59%.The European Region had 72% coverage and the Regions of America had 81%, while Africa had 56%, and the South East Asian Region had 57%.[1]

The World Health Organization (WHO) and Member States coordinate with the global laboratory networks to support surveillance for selected vaccine preventable diseases like polio, measles, rubella, yellow fever (YF), Japanese encephalitis (JE), rotavirus, influenza, tuberculosis, and invasive bacterial disease (IBD). There has been a decline of 95% in the incidence of vaccine-preventable diseases, due to the introduction and widespread use of vaccines recommended for universal usesince 1980. Declines have been observed for certain vaccines introduced more recently. During2005, vaccine preventable diseases were approximately 20% of all the epidemic assistance investigations by the centre for diseases control and prevention.[2]The Global Vaccine Action Plan (GVAP 2011–2020) sets the goal of 90% coverage at the national level and 80% in every district or equivalent administrative unit with all vaccines in national programs by 2020. India is one of the 194 Member States of the World Health Assembly which has endorsed the GVAP framework in 2012.[3]

Since the successful eradication of smallpox in mid 1970s, much attention is given to the immunization program in India. India launched the Expanded Program on Immunization (EPI) for immunizing children against diphtheria, pertussis, tetanus and typhoid in 1978 mainly for the urban areas. Oral Polio Vaccine, BCG and the measles vaccine were included in 1979-80, 1981-82 and 1985-86 respectively. The program was revised in1985 andrenamed as Universal ImmunizationProgramme (UIP) to protect all infants (0-12 months) against six diseases namely tuberculosis, diphtheria, pertussis, tetanus, poliomyelitis, and measles. The technology mission was started as an offshoot of the Seventh Plan in the fields of literacy, immunization, oilseeds, drinking water, dairy products and telecommunication. In 1986, UIP was given the status of National Technology Mission. UIP became a part of Child Survival and Safe Motherhood (CSSM) program in 1992. CSSM includes both UIP and Safe motherhood program. In 1997, the UIP was integrated with Reproductive Child Health (RCH) program and became a key area under NRHM in 20050.[3]

The Ministry of Health and Family Welfare (MOHFW) under National Health Mission, had launched Mission Indradhanush (2014) with the aim of expanding immunization coverage to all children across India by year 2020. India has one of the lowest immunization rates worldwide despite a longstanding Universal Immunization Program (UIP) that provides free childhood vaccines, out of the 27 million new births in India each year, only 44% of these receive the full immunization schedule, while on the other hand, in Bangladesh 82% of children are immunized by two years of age. In Nepal,80% of children are fully immunized by one year of age.[4]The most recent data on

vaccine-preventable mortality in India is from a 2008 study, which estimated that of the 826,000 deaths in children aged 1–5 years, almost three quarters or 604,000 deaths were due to vaccine-preventable diseases including diarrhoea, pertussis, measles, meningitis, and pneumonia. Collectively, the burden of these diseases highlights the significant human cost of the poor vaccination coverage among infants and children in India.[5] This study showcases the success of immunization coverage in India and decline of U5MR, especially due to mortality from Vaccine Preventable Diseases since the launch of National Health Mission (2005). The aim of this study is to track the immunization coverage, Vaccine Preventable Diseases and under five mortalitiesover a decade of the NHM, during 2005-2016.

2. Methods

Data Source and Study design

The study is based on secondary data analysis and desk review. We used data from four rounds of National Family Health Survey (NFHS), the Indian Version of the Demographic and Health Survey (DHS) conducted during 1992–93, 1998–99, 2005–06 and 2015-2016 and the Global Burden of Disease Data (GBD 2016) for the year 2016.

Socio-demographic Variables

The study also uses multivariate analysis, focusing on the urban-rural, caste and state differentials in full immunization coverage among children aged 12-23 in India during 2005-2016 along with district level analysis for poor and better performing states. Analysis of mortality of Vaccine Preventable deaths for India and its 36 states and union territories was done by using Global burden of disease 2005, 2016 and we compare Full Immunization coverage, Under-Five Mortality rates (U5MR) and mortality of vaccine preventable deaths in India for 2016.

Outcome Variable

The outcome variable for the study is Under-Five Mortality rate and deaths due to Vaccine preventable diseases. The predictor variable is full immunization among children aged 12–23 months. According to the guidelines developed by the WHO, children are considered "fully immunized" when they receive vaccination against tuberculosis (BCG), three doses of diphtheria, whooping cough (pertussis), and tetanus (DPT) vaccine; three doses of poliomyelitis (polio) vaccine and one dose of the measles vaccine by the age of 12 months. BCG should be given at birth or at first clinical contact, DPT and polio require three vaccinations at approximately 4, 8, and 12 weeks of age, and the measles vaccine should be given at age 12 months or soon after reaching 9 months of age. The Vaccine Preventable diseases are considered based on the categorization developed by WHO.

3. Results

Trends in Child (12-23 months) Immunization, India during 1992- 2016

It has been seen that the full immunization coverage in India has increased by nearly two folds in a span of 25 years. In the year 1992 total immunization coverage was 36% only. By the year 1998, India had a 6% increase in full coverage to reach 42%. Thereafter, was a meagre 2% up to the year 2005 with the immunization coverage steady at 44%. In a decade (2006-2015), India witnessed 18% increase achievingtotal immunization coverage of 62% in 2016.

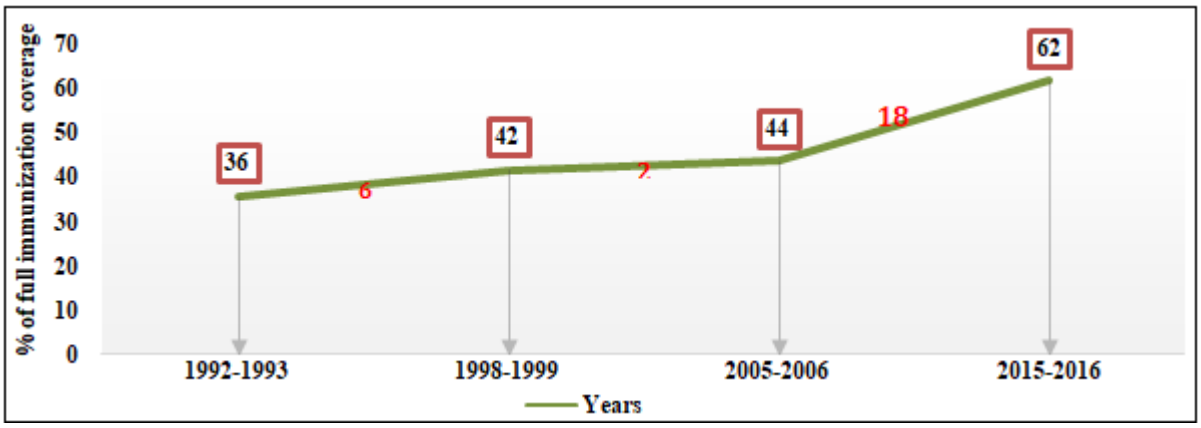

Figure 1: State wise full immunization coverage (in %) among children aged 12-23 months, India, 2005-2016

Out of a total 36 states and union territories (UT) in India, the full immunization coverage of eleven states was lower than the national average 62% for the year 2016. They were Nagaland, Arunachal Pradesh, Assam, Gujarat, Mizoram, Uttar Pradesh, Madhya Pradesh, Tripura, Rajasthan, Maharashtra, Uttarakhand and 1 UT (Dadra & Nagar Haveli). There were inter-state differences in full immunization, with 89% of eligible children in Punjab and 91% in Puducherry utilized full immunization in 2016; while less than 40% of the children fully vaccinated in Nagaland and Arunachal Pradesh.

The finding from the analysis is, state likeTamil Nadu showed a 11% reduction in full immunization coverage from 81% in 2005 to 70% in 2016 followed by Himachal Pradesh (4% decline), Uttarakhand (2% decline), Maharashtra and Haryana (3% decline) during a decade from 2005 to 2016 (indicated by red bars in Figure 2).

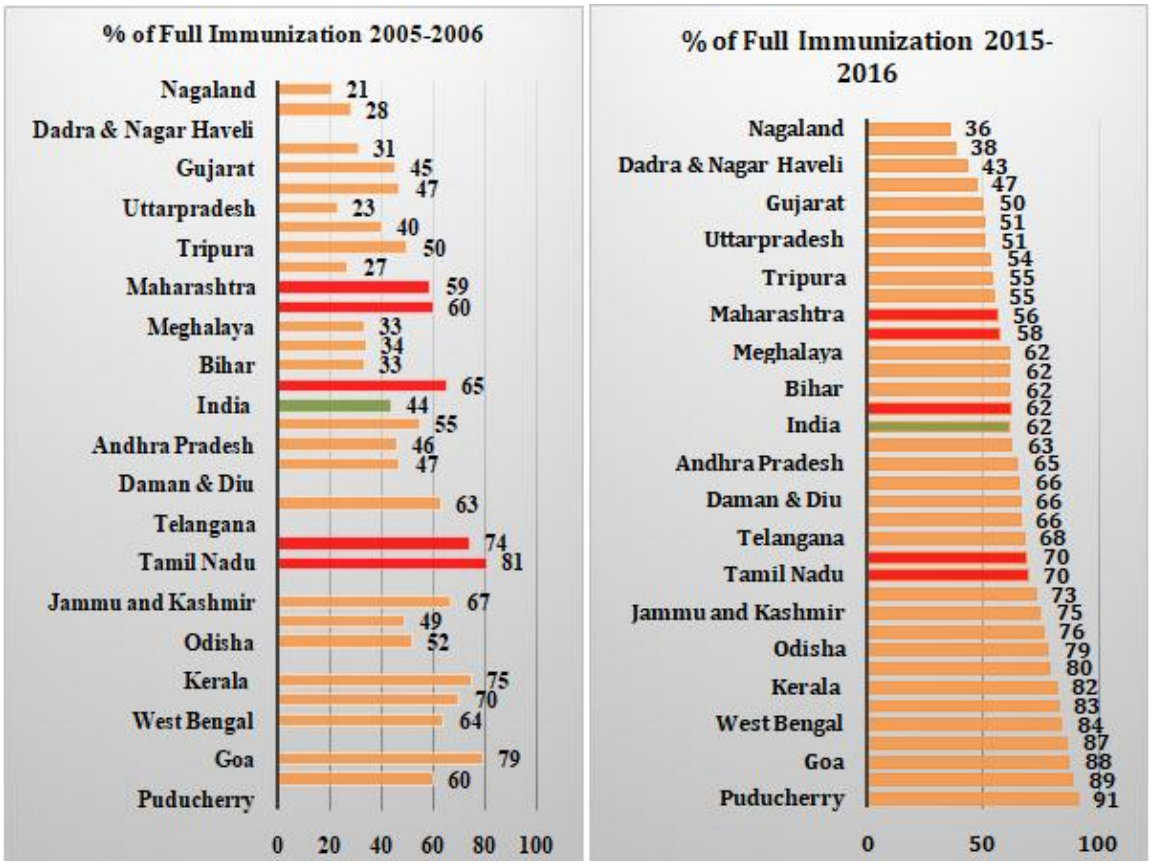

Figure 2: Trend in Full Immunization coverage among EAG states, India, 2005-2016

The Empowered Action Group (EAG) states show marked improvementin the full immunisation coverage over a decade. Jharkhand, Rajasthan and Uttar Pradesh were the states with maximum progress of 28%, followed by Odisha and Chhattisgarh with an increase in 27% of the full immunisation coverage during a decade 2005-2016. The state of Odisha had total immunisation coverage of 52% in the year 2005-2006 which increased to79% in the year 2015-2015. Similarly, in Chhattisgarh, the total immunisation coverage increased from 49% to 76%. In the same decade India witnessed an increase of18%. The EAG states had a better growth in total immunisation coverage than India, but states like Madhya Pradesh and Uttarakhand had a lower percentage increase in the decade. Uttarakhand was the only state with a declining coverage trend of the total immunisation in the decade 2005-2006 to 2015-2016.

Table 1: EAG state wise Immunization coverage, 2005-2016.

EAG State	% of Full Immunization, 2005-2006	% of Full Immunization, 2015-2016	% increase in Full Immunization coverage
Odisha	52	79	27
Chhattisgarh	49	76	27
Jharkhand	34	62	28
Uttarakhand	60	58	-2*[1]
Rajasthan	27	55	28
Madhya Pradesh	40	54	14
Uttar Pradesh	23	51	28
India	44	62	18

Full Immunization coverage by Residence and Caste differentials, India, 2005-2016

The decadal trend analysis of NFHS-3 (2005-2006) and NFHS-4 (2015-2016) data shows a difference in immunization coverage by area of residence (Urban/Rural)and by caste. The full immunization coverage of children aged 12-23 months residing in urban and rural areas is greater than 60%. The figure-3 shows, as the national average of full immunization increases by 18%, the coverage of children residing in rural areas increased by 22% against only a 6% increase in Urban areas during the decade (2006-2015).However, the full Immunization coverage of children who belonged to scheduled tribes increased by 25 % in a decade. It was followed by 23% increase in coverage among children who belong to schedule caste. The coverage of children from other backward class has increased by 21%.The population belonging to the rural areas, scheduled tribes, schedule caste and other backward class all lagged behind in 2005. They have all caught up with their urban counterparts with an average of 23% increase in coverage. In contrast, immunization coverage of urban children has not increased much with a mere 4% increase in the decade.

[1]Decline in Immunization coverage

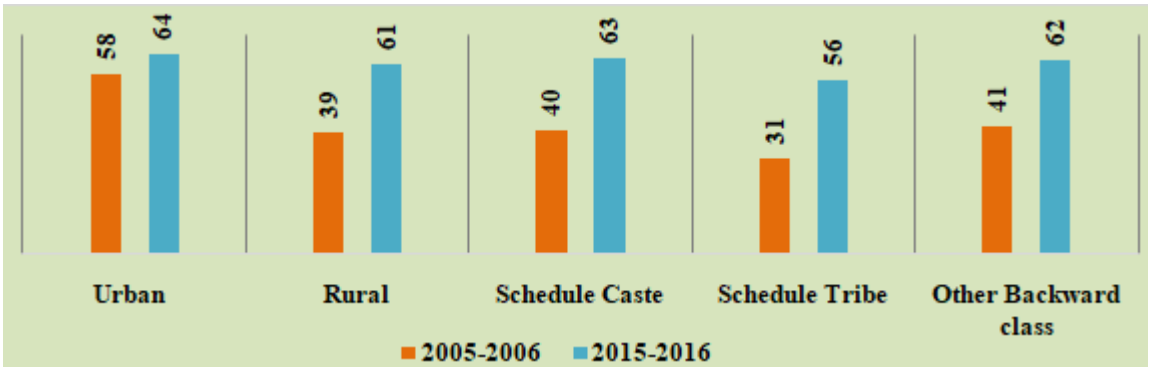

Figure 3

District level full immunization coverage for low and high performing states

Comparing the two North-eastern states of Nagaland and Arunachal Pradesh, we find that the total immunisation coverage in Nagaland was 36%. However, there exists a vast difference noted in the coverage of immunisation in the state of Nagaland across districts as shown in figure-4.

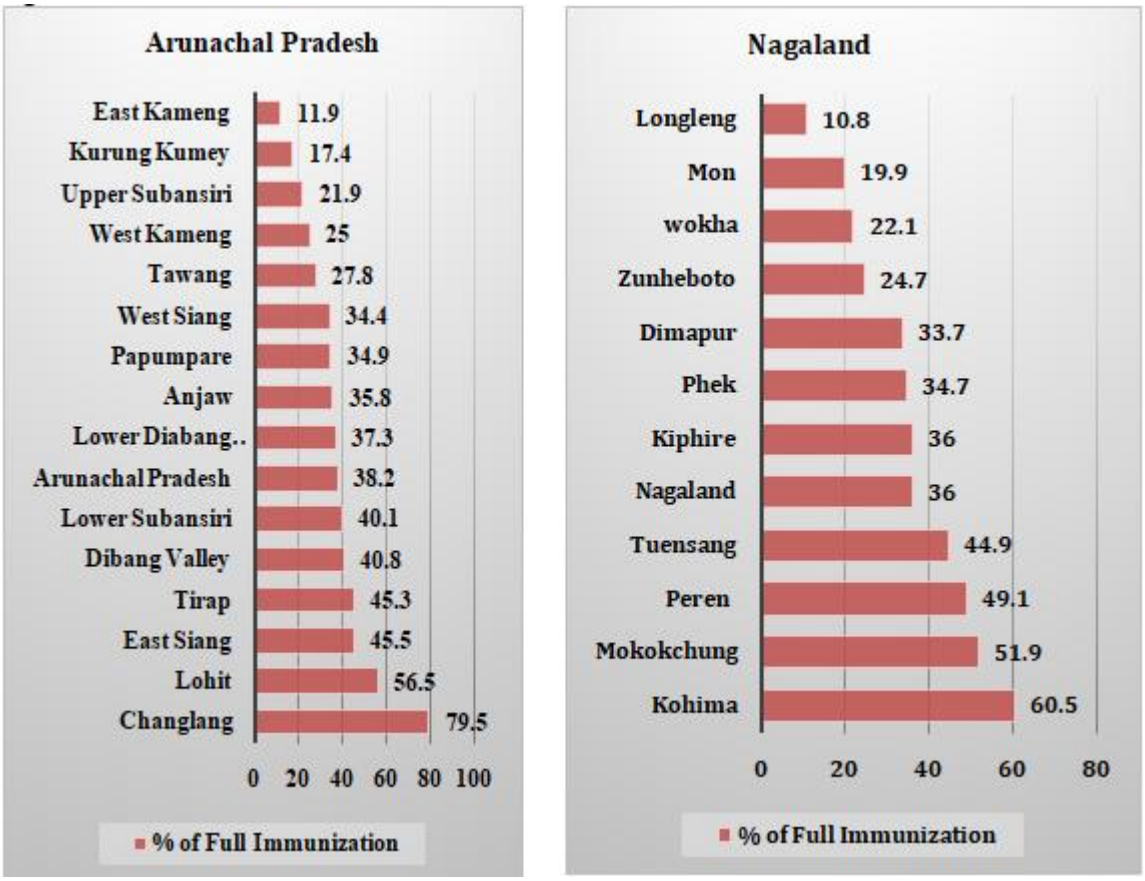

Figure 4

The district of Longleng in the mountainous parts had the least coverage of only 11%. Kohima the capital of the state had the maximum coverage of 61%. The rest of the districts had a coverage of 20% to 52% in the state of Nagaland. The state of Arunachal Pradesh had the total immunisation coverage of 38%. East Kameng district has a coverage of only 12% while the Changlang district had a coverage of 80%. Comparing the two states of Assam (low coverage) and Punjab (high coverage), we find that the state of Assam had a total coverage of 47%. However, there are wide variations across districts as shown in figure-5.

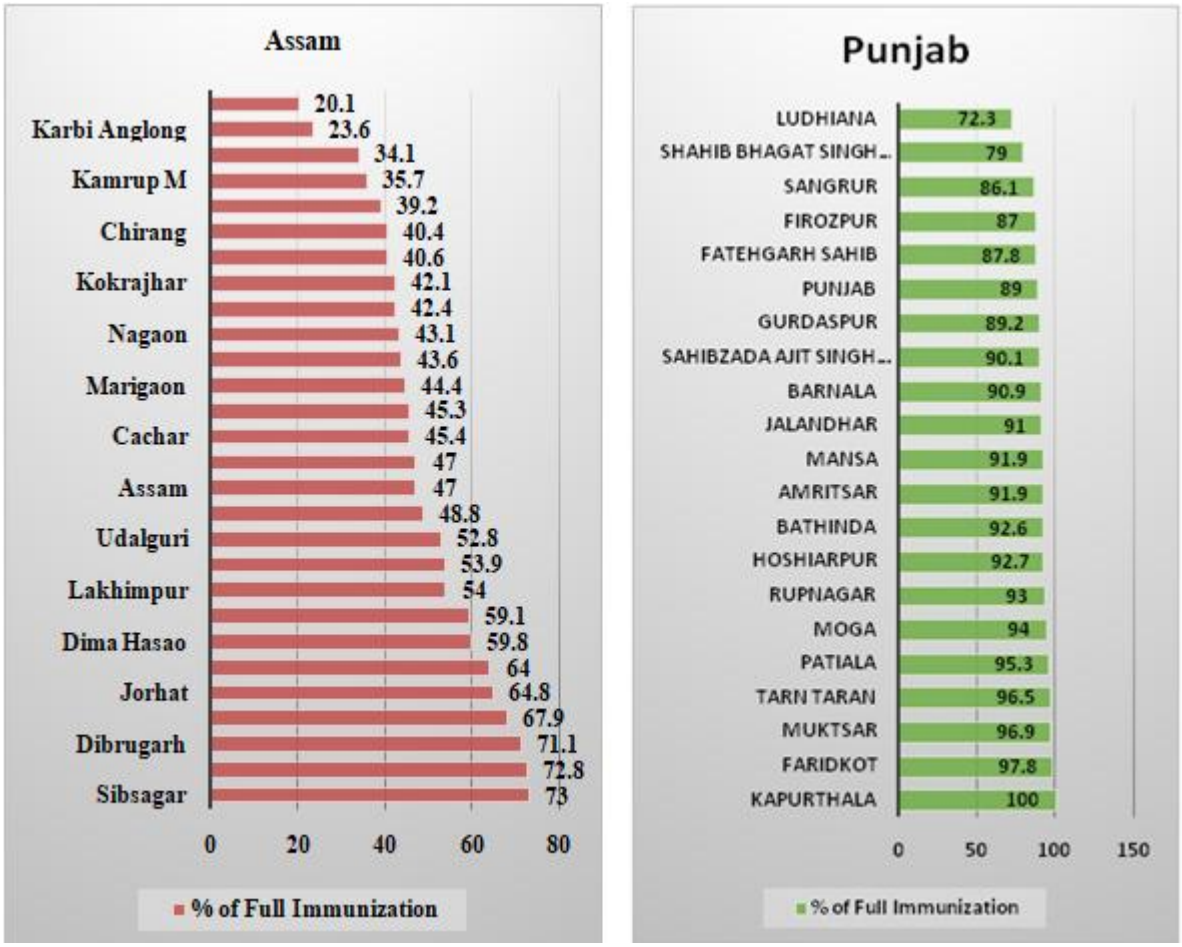

Figure 5

The least coverage of immunisation was in the district of Dhubri with 20% of coverage, while the most was in the district of Sibsagar with a coverage of 73%. The coverage of immunisation in the other districts of Assam was between 24% to 73%. However, the state of Punjab showed an equal distribution of immunisation with a better coverage. The district of Ludhiana had the least coverage of 72% which is higher than national average while Kapurthala in Punjab had a 100% immunisation coverage. The other districts of Punjab had a coverage from 79% to 98%.

Comparison between the full immunisation coverage and mortality due to vaccine preventable diseases among children aged under 5years

The coverage of BCG vaccine in the year 2005 was 78% which increased to 92% in 2016. A total increase of 14% was seen in the decade. According to the Global Disease Burden data the number of deaths due to tuberculosis in 2005 were 9154, which reduced by 68% with only 2913 deaths in 2016. The incidence of the children suffering from tuberculosis was 71,527 in 2005, which reduced by 41% to 42362 in 2016. The complete coverage of the DPT vaccine in India was 66% in 2005 with increase to 84.5% in 2016. There was an increase of 20% in a span of 10 years. The mortality among children under the age of 5 years due to either of the diseases like diphtheria, pertussis or tetanus was 59,216 in 2005, it decreased by 78% with 13,238 deaths in 2016. The incidence of these diseases was 4,617,444 in 2005 while 202,557 in 2016. There was a decrease by 56% in the incidence. The total coverage of Polio vaccine was 78% in 2005, which increased by only 4% to 82% in 2016. There was a decadal increase of 22% in the coverage of Measles vaccine. The mortality under the age of 5 years has decreased by 83% from 103,542 deaths in 2005 to 17,114 in 2016. The incidence of the new cases of measles was 12,383,882 in 2005, which reduced drastically by 70% with an incidence of 3,694,348 in 2016.

Table 2

Disease	% Increase in Vaccination coverage, during 2005 and 2016	% Reduction Under five mortality, during 2005 and 2016	% Reduction incidence (new cases), during 2005 and 2016
Tuberculosis	14	68	41
DPT[2]	19	78	56
Polio	4		
Measles	22	83	70

Percentage of Under-Five Mortality due to Vaccine Preventable diseases across states, India, 2005-2016.

The year 2005 had a 14% of under-five mortality due to the vaccine preventable diseases. In 2016, there was a decrease by 3% with the under-five mortality of 11%. All the union territories except Delhi had the mortality of 11% in 2005 while a decade later there was a decrease of 2%. Odisha and Himachal Pradesh were the only states in with the decadal difference of the mortality were only 1%. Uttarakhand and Manipur portrayed a decadal difference of 4% in the Under-Five Mortality due to the vaccine preventable diseases.

[2] Diphtheria, Pertussis and Tetanus.

States of West Bengal and Uttar Pradesh both showed a decadal decrease of 5% in the under-five mortality. The best improvement was seen in Arunachal, with maximum reduction in vaccine preventable diseases. It had the Under-Five Mortality due to vaccine preventable diseases of 26% in 2005, a drastic decrease of 50% as seen in 2016.Mizoram saw a 5% increase in vaccine preventable deaths, though the full immunization coverage went up from 47% to 51% from 2005-2016.There was no decline observed in the mortality due to the vaccine preventable diseases over a decade in the states of Tripura, Tamil Nadu, Kerala and Goa.

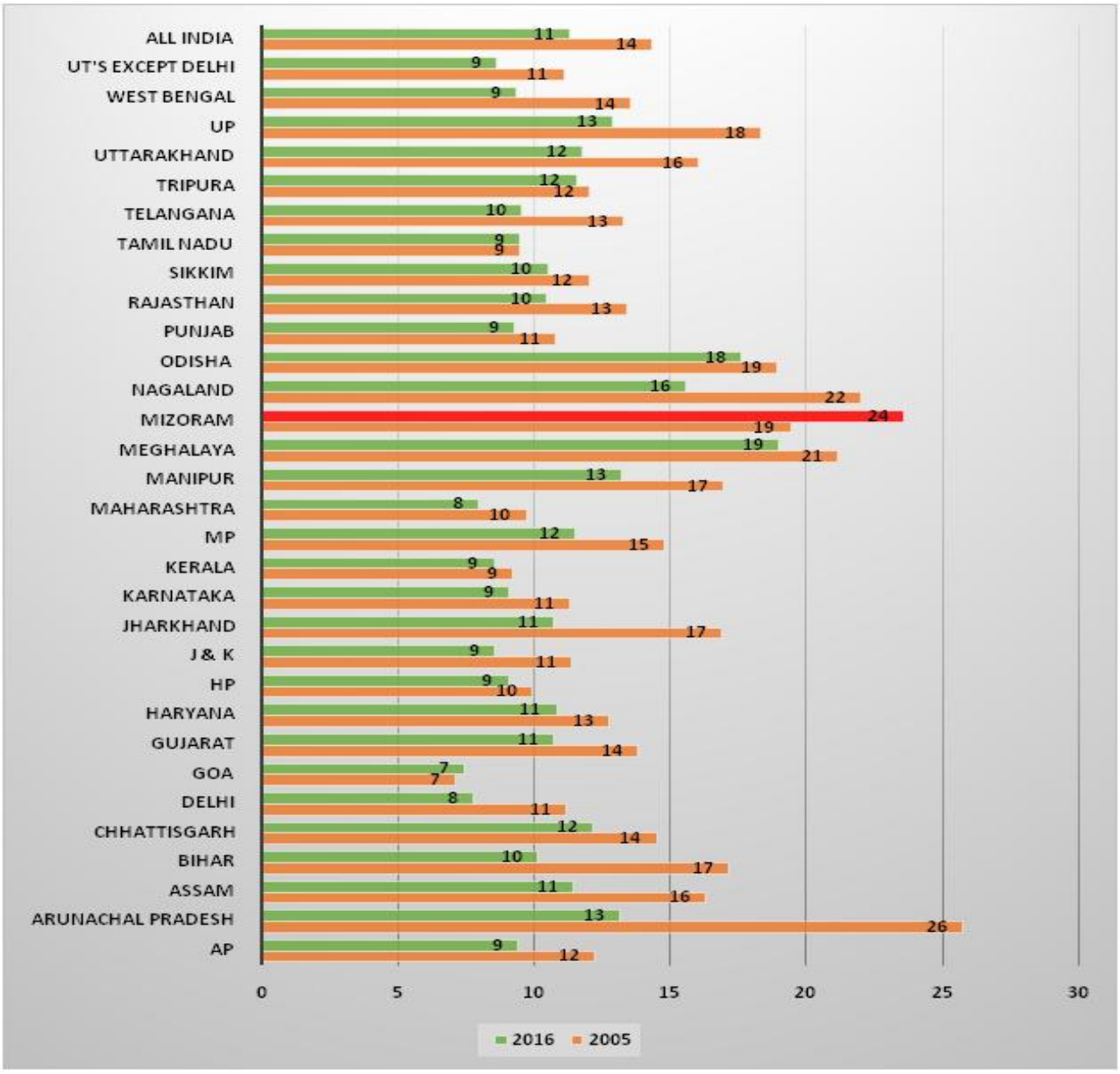

Figure 6

Comparison between the full immunization Coverage, under 5mortality and mortality due to vaccine preventable diseases in India

The trend analysis between the full immunization Coverage, under 5years mortality and mortality due to vaccine preventable diseases in India is significant. The full immunization coverage has increased by 18% from 44% to 62% in a decadal time span. In the same time span from 2005-2016 the mortality under the age of 5years has drastically decreased around 1.5 times from 74% to 50%. The mortality due to vaccine preventable diseases has also decreased by 3% from 14% to 11% in a decade in India.

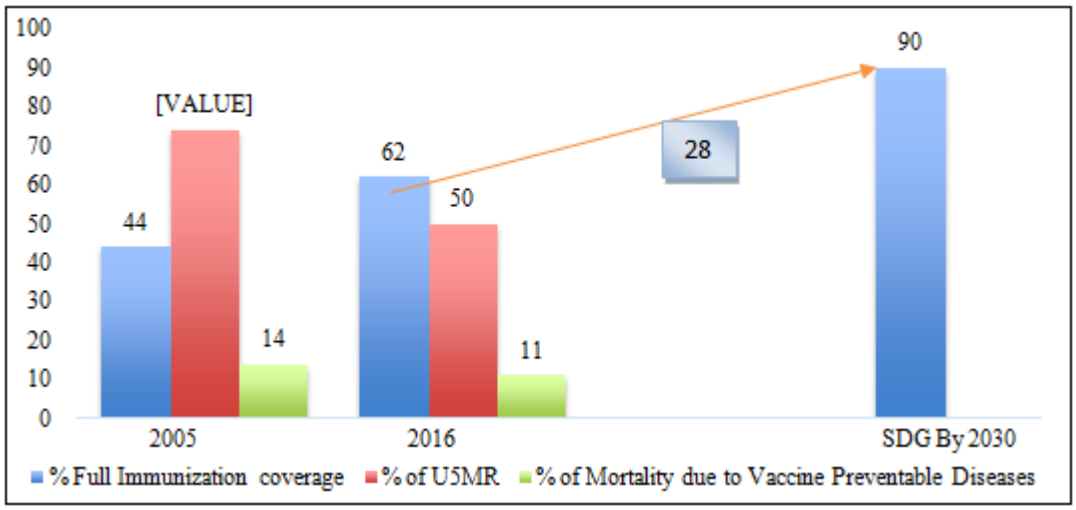

Figure 7

4. Discussions

The study observes immunization coverage in India had increased by 18% from 44% to 62% during 2005-2016.India has experienced impressive improvements in Immunization coverage and in reducing mortality as well as Incidence of Vaccine preventable diseases during the past one decade. The mortality rate for children under five and younger is at 50 per 1000 live births as per NFHS 4 estimates while 11% of mortality due to Vaccine preventable diseases contributes to Under-Five Mortality. However, the study observes a decadal increase of 18% full immunization coverage among 12-23 months' children which is a huge success. This is primarily seen in rural parts of India where there was an incredible escalation of 56% of full immunization coverage in a span of past ten years. The Government of India is appreciated for the growth by launching several initiatives like the formation of National Rural Health Mission was a milestone laid in 2005 to reached remotest part of the country. Several initiatives were taken like Mission Indradhanush (2014) with the aim of expanding immunization coverage to all children across India by year 2020. Also, the newly included vaccines like Rotavirus vaccine, Injectable Polio vaccine (IPV), Rubella vaccine, and Japanese Encephalitis (JE) vaccine (for adults) were included in the Universal Immunization Programme (UIP). Another appreciable initiative taken was SMS based electronic vaccine intelligence network (e-VIN) to monitor the real time of vaccine stocks and many more like the inclusion of Pentavalent Vaccine, National Vaccine Policy (2011), Intensified Indradhanush (2017) etc.

The study observes a state to state variation in immunization coverage and the contribution of only few states and their districts will lead India to achieve sustainable development goal of 90% national full immunization coverage by 2030. The states with almost similar geographical specifications like Nagaland show poor performance in terms of immunization coverage of 36% and Sikkim as better performing stands at 83%. Likewise, 2006, Nagaland has continued to be the lowest in 2016 as well as recorded even lowest coverage of institutional delivery and full immunization in rural parts(7). Similarly, full immunisation coverage in Kohima (61%) is six times that of the most deprived Long Leng district (11%) in Nagaland. Such stark inter-district disparities are reflective of elementary developmental challenges including primary healthcare service utilization, education, human resources, infrastructure as well as barriers both geographical as well as conflict-related. The hilly terrain of Nagaland is among the major concern in enabling rapid expansion of health infrastructure.

It was always said that EAG states have considerable differentials in child immunization by various individual (education gender, birth order), household (religion, caste, wealth), community (place of residence, state) characteristics.[6] The adverse effects of the low coverage of child immunization has led to high child morbidity and mortality.[7]While the study observes the full immunization coverage in five EAG states out of seven have increased by more than 25% which is a remarkable contribution to national average (62%). Overall it can be said that the tremendous improvement is due to monitoring of the initiatives under immunization and making possible to reach the remotest parts of the EAG states through community interventions.

This study estimates the Incidence and deaths of the VPD like Tuberculosis, DPT, Polio and measles. A considerable decline of 3% in mortality as well as incidence due to vaccine preventable diseases for a past decade is seen in this study, while still 11% of deaths among under five children are contributed by Vaccine Preventable diseases. It is estimated that two thirds of children who die of measles and the other preventable childhood diseases would have survived if they had immunized.[8]There was 83% of reduction in the mortality of children due to measles and 81% of measles coverage is a significant change over a decade. Moreover, 94 % of these deaths in India are concentrated in eleven states includes Nagaland, Arunachal Pradesh, Assam, Gujarat, Mizoram, Uttar Pradesh, Madhya Pradesh, Tripura, Rajasthan, Maharashtra and Uttarakhand. The effectiveness of the BCG vaccine against TB has been debated, with a range estimated from 0 to 80 percent.[9] Most proponents claim that it is effective against TB meningitis, but it is not commonly believed to prevent TB in adults nor its transmission. In India, there has been considerable increase in BCG coverage i.e. 92% and mortality due to TB

has been reduced by 68% that is laudable. The real impact of BCG may have been confounded by many other improvements in public health that could have contributed to the decrease in disease burden associated with tuberculosis.[9] Despite 82% of immunization coverage for Polio, no deaths were reported across India. An assumption of the WHO eradication program is that countries would be able to stop vaccination after wild poliovirus ceases transmission; however, the possible threat of a resurgence because of the continued likely circulation of oral poliovirus vaccine would seriously challenge that strategy. Vaccination against diphtheria has reduced the mortality and morbidity of diphtheria dramatically; however diphtheria is still a significant child health problem in countries with poor coverage of Expanded program on immunization (EPI). In countries endemic for diphtheria as in India, the disease occurs mostly as sporadic cases or in small outbreaks. Diphtheria is fatal in 5 - 10% of cases, with a higher mortality rate in young children. In this study it is seen that the reduction in the incidence of the diseases like diphtheria, pertussis and tetanus was 56%, while 19% increase in immunization coverage observed during 2005 to 2016.

Fortunately, India's spending on immunization has increased as total baseline expenditure was Rs 3,446 crore [1 crore = 10 million] (US$718 million), including shared personnel costs. In 2012, the government paid for 90 percent of the Programme. Total resource requirements for 2013-2017 are Rs 34,336 crore (US$ 5, 282 million). Allocations for vaccines increase from Rs 511 crore in 2013 to Rs 3,587 crore in 2017 as new vaccines are assumed to be introduced in the Programme. The projections show that the government immunization budget will be double in 2017 as compared to 2013. It will increase from Rs 4,570 crore in 2013 to Rs 9,451 crore in 2017 which further improves survival rate.[10]

In addition to the points of discussion, the findings from all the ten common review mission reports released by MOHFW suggests immunization services had a considerable number of process gaps that need to be urgently attended to, including micro-planning, alternate vaccine delivery, and mechanisms for follow up of missed cases. Further, poor knowledge and practices related to immunisation schedule, inventory management, and cold chain maintenance play a vital role in full immunization coverage. In India, record keeping is not streamlined, leading to data mismatches.

The report also suggests, states like Bihar and Uttar Pradesh, the number of existing facilities fail to reach basic services like immunization because of population ratio per sub-centre and high fertility. While immunisation programmes have been given attention in states with regard to outreach and fixed day services, gap in availability of vaccines and issues in cold chain management seem to have adversely affected progress in the current year. Lack of minimum required facilities and human resource densities also contribute to limiting progress in a significant way. While in West Bengal, the ASHA gets a fixed honorarium for carrying out predefined activities this in turn has got improvement in the immunization coverage. The immunisation performance in the state of Jammu and Kashmir has improved substantially as per DLHS-3 data. However, the state could further improve performance in this area through more rigorous follow up and tracking of defaulters. The state of Odisha had joint micro planning at district and block level (for immunisation, health check-ups and referrals) are found to be effective in bringing functionaries of two departments together in addressing common issues. While in all other states, immunisation session and VHND are being organised together, Odisha and Tamil Nadu report holding separate sessions for immunization and VHND, allowing for more time to undertake the entire gamut of outreach activities.

In India the interventions have always addressed the challenges of implementation like providing better immunization services, more health workers, new vaccines in the immunization schedule, vaccination coverage in remote areas, and programs like Mission Indradhanush for children who missed out in the routine immunization program. There is a growing literature showing that interventions lead to significant improvement in childhood vaccination coverage in low- and middle-income countries.[5] Community-level factors influence vaccination uptake, recent strategies to increase vaccination coverage have attempted to focus on community-based interventions. Importance is given to capacity building of nursing staff and auxiliary workers such as ANMs who play a crucial role in the National Immunisation Program. In order to mobilize people, create awareness and provide services at the doorsteps ASHA workers play a vital role. For the population living in the most remote and hard to reach areas, States have been supported with Mobile Medical Units (MMUs).

5. Conclusion

India’s infant mortality rate is 39, which means that an estimated 9.9 lakh babies die within one year of birth, mostly from preventable causes. However, the first phase of immunisation in April 2015, 2.1 crore children have been vaccinated against 10 preventable diseases -polio, severe forms of childhood tuberculosis, hepatitis B, diphtheria, pertussis, tetanus, pneumonia and diarrhoea caused haemophilus influenzae B, and measles across India. The significant increase in the coverage of complete immunization and reduction in the Vaccine Preventable Diseases in India may be due to the strategic actions taken by the National Health Mission. The full immunization coverage in India has increased to nearly about two folds in a span of 25 years. The Empowered Action Group (EAG) states also show a fascinating growth of more than 1.5 times in the full immunization of a growth over a decade. While the under-five mortality has decreased around 24% in a decadal time span. This huge success was contributed by the initiatives under NHM andthe government can anticipate to achieve the SDG goal of 90% national coverage by engaging communities to identify barriers in vaccination at the local level.

6. Future Scope

Most of the existing interventions are geared towards addressing supply-side challenges such as ensuring better immunization services and more focused implementation by deploying more health workers across health facilities,

introducing alternate vaccine delivery system, including new vaccines in the immunization schedule, organizing sessions in hard-to-reach areas, and initiating supplementary immunization activities for children who are missed out in the routine immunization program. But there is a growing body of literature showing that demand-side interventions lead to significant improvement in childhood vaccination coverage in low- and middle-income countries. Attention need to be given to all the poor vaccine coverage districts of all the eleven mortality contributing states includes Nagaland, Arunachal Pradesh, Assam, Gujarat, Mizoram, Uttar Pradesh, Madhya Pradesh, Tripura, Rajasthan, Maharashtra and Uttarakhand. However, Innovations and research need to be a part of immunization and awareness on seeking complete immunization must be done through community participation.

References

[1] "WHO | Immunization." 2018. *WHO*. http://www.who.int/topics/immunization/en/ (June 26, 2018).
[2] Hinman, A. R., W. A. Orenstein, and A. Schuchat. 2011. "Vaccine-Preventable Diseases, Immunizations, and the Epidemic Intelligence Service." *American Journal of Epidemiology* 174(suppl 11): S16–22. https://academic.oup.com/aje/article-lookup/doi/10.1093/aje/kwr306 (June 27, 2018).
[3] Patra, Nilanjan. *UNIVERSAL IMMUNIZATION PROGRAMME IN INDIA: THE DETERMINANTS OF CHILDHOOD IMMUNIZATION*. Indian Statistical Institute, Calcutta. http://www.isical.ac.in/~wemp/Papers/PaperNilanjanPatra.pdf (June 27, 2018).
[4] Vashishtha, Vipin M., and P. Kumar. 2013. "50 Years of Immunization in India: Progress and Future." *Indian Pediatrics*.
[5] Shrivastwa, Nijika et al. 2015. "Predictors of Vaccination in India for Children Aged 12–36 Months." *American Journal of Preventive Medicine* 49(6): S435–44. http://www.ncbi.nlm.nih.gov/pubmed/26297449 (June 27, 2018).
[6] Feldstein, Leora R et al. 2017. "Global Routine Vaccination Coverage, 2016." *MMWR. Morbidity and mortality weekly report* 66(45): 1252–55. http://www.ncbi.nlm.nih.gov/pubmed/29145357 (June 27, 2018).
[7] "NHP Indradhanush | National Health Portal Of India." https://www.nhp.gov.in/nhp-indradhanush_pg (June 27, 2018).
[8] Roush, Sandra W., Trudy V. Murphy, and and the Vaccine-Preventable Disease Table Working Group. 2007. "Historical Comparisons of Morbidity and Mortality for Vaccine-Preventable Diseases in the United States." *JAMA* 298(18): 2155. http://jama.jamanetwork.com/article.aspx?doi=10.1001/jama.298.18.2155 (June 27, 2018).
[9] Miller, Mark A., and John T. Sentz. 2006. Disease and Mortality in Sub-Saharan Africa *Vaccine-Preventable Diseases*. The International Bank for Reconstruction and Development / The World Bank. http://www.ncbi.nlm.nih.gov/pubmed/21290645 (June 27, 2018).
[10] "National Health Portal of India, Gateway to Authentic Health Information." https://www.nhp.gov.in/ (June 27, 2018).

Author Profile

Sowmya Thota received Master's in Public Health from University of Hyderabad, India, 2017. She started her career in Public Health by pursuing an internship wherein she evaluated a project "Safe Care Saving Lives Project" at Public Health Foundation of India in collaboration with Access health International to reduce the neonatal and maternal morbidity and mortality in two states of Andhra Pradesh and Telangana. A part from this, she has worked as a counsellor at "Voice 4 Girls organization" providing activity-based learning to the adolescent girls of low income schools on nutrition, education, menstrual hygiene and life skills to help them to take charge of their future. She possesses more than one year of Professional experience working with Public Health Planning division at National Health Systems Resource Centre in various expertise of public Health. Currently, she is working as a Senior research assistant for Health economics, financing and policy division at Public Health Foundation of India, New Delhi. Her research areas have been Palliative Care, Immunization, Adolescent Health, Health Insurance, Road Traffic Injuries, Intimate Partner Violence, Child Marriage etc.

Dr. Dnyaneshee. Dudhal is Health Administrator with a background as a Medical Doctor andan experience in catering the grass-root level community healthcare services. She has accumulated diverse knowledge of varied fields by pursuing internships in organizations like the National Health Resource Centre, New Delhi wherein she did a comparative study between the health indicators of the aspirational districts of the EAG states. She has also worked in Sciformix Technologies firm as a Research Intern wherein she did data extraction, compilation and statistical representation of rituximab and its biosimilar drugs- mathbera and reditux on non-hodgkins lymphoma. Apart from this she has been an administrative intern in the Public Health Department of the Urban Primary Health Centre, Navi Mumbai wherein she conducted a detailed study on the RNTCP program and studied the socio-demographic profiles with the morbidity patterns and treatment seeking behaviors of beneficiaries of the catchment area. Working with NGOs like Seva Mandir (Udaipur), Mamta Foundation, Ashray Intitiative for children etc. has given her hands on and grassroots level experience of working in the healthcare sector. Her research areas have been Cancer, Occupational health, Health insurance, Immunization, Non-communicable diseases, Quality Improvement in public healthcare etc.