CHAPTER II
CHAPTER II

REVIEW OF LITERATURE

2. Review of Literature

Review of literature is review of published and unpublished research and non-research literature is an integral component of any scientific research. It involves a systematic identification, location, scrutiny and summary of written material that contain information regarding a research problem. It broadens the understanding and gives an insight necessary for the development of a broad conceptual context into which the problem fits. The reviewed literature for the present study is organized under the following headings:

2.1(i) Literature related to immunization.
2.1(ii) Literature related to the immunization practices in urban parents.
2.1(iii) Literature related to the immunization practices in rural parents.
2.1(iv) Literature related to the immunization practices of health personnel.
2.1(v) Literature related to the comparison immunization practices in urban and rural population.
2.1(vi) Literature related to informational booklet on immunization.

2.1(i) Literature related to immunization:

The world has come a long way since George Bernard Shaw fulminated against vaccination in the 1920s. Vaccines are now widely regarded as an effective and cheap tool for improving health. Children in all countries are routinely immunized against major diseases, and the practice has become a central plank of global public health efforts. Despite these advances, however, immunization coverage remains far from universal, and the developing world in particular remains vulnerable to vaccine-preventable illnesses.

Edward Jenner first successfully ‘vaccinated’ against Small Pox he could hardly imagine that his experiment would change the future of public health. Immunization does prevent deaths and for last 3-4 decades it played a pivotal role in tackling infectious
disease throughout the globe. Immunization is perhaps the most popular among all public health interventions, as revealed by the fact that more than 100 million children are vaccinated annually with more than 1000 million doses of different vaccines. Vaccine preventable diseases are responsible for about one quarter of the 8.8 million deaths occurring annually among children under five years of age. Improving services to deliver traditional vaccines will reduce the number of deaths due to vaccine preventable diseases.47

Immunization is one of the greatest medical success stories in human history. Universal child immunization against vaccine-preventable diseases is recognized as one of the most cost-effective ways of reducing infant and child mortality in developing countries.48

The World Health Organization (WHO) launched the Expanded Programme on Immunization (EPI) in May 1974,49 followed by UNICEF in partnership with other stakeholders launched Universal Childhood Immunization (UCI) in 1984,50 after that GOI launched the same in India in 1978 with a view to provide protection to the children against disease, focus of the program with the main objective of immunization for infants against the six basic infections namely measles, poliomyelitis, diphtheria, pertussis, tetanus, and tuberculosis. In India, the basic childhood immunization service has been part of essential health services and accorded top priority in its health delivery system. Following the Alma Ata Declaration in 1978, the country had adopted the Expanded Programme on Immunization (EPI) and introduced six childhood vaccines—Bacillus Calmette- Guerin (BCG), DPT, Polio and measles.51

According to report of World Bank, Public health specialists generally perceive vaccination as a hugely beneficial investment as it is both cheap and very effective at a population level as the influential 1993 World Development Report, “Investing in Health”, listed the World Health Organization’s Expanded Program on Immunization as the first component of “the essential public health package”. The rapid progress towards universal vaccination coverage in the 1970s and 1980s has slowed in recent years. Declining funding for immunization has been mirrored in stagnating or falling coverage.
Assess and develop information booklet on immunization practices among parents and health personnel from selected urban versus rural areas.

UNICEF funding for vaccination fell from $182 million to $51.4 million between 1990 and 1998.\textsuperscript{52}

Globally, an estimated 24 million children remained unreached by the immunization programme in 2008, about three quarters of these unimmunized children live in ten countries. These are Chad, China, Congo, Ethiopia, India, Indonesia, Iraq, Nigeria, Pakistan and Uganda. It is serious concern that in South East Asian region immunization coverage is plateauing in last few years.\textsuperscript{53}

WHO and UNICEF recommended the main strategic areas in Global Immunization Vision and Strategy 2006 – 2015.\textsuperscript{54}

- Immunize ‘hard to reach’ infants and other age groups through a focus on the district level.
- Increased the availability and affordability of new life saving vaccines.
- Deliver key health interventions, including vitamin A supplementation and deworming medicine during immunization contacts.
- Strengthen cross-border collaboration and coordination to ensure a reliable supply of vaccine, sustainable financing of vaccination and epidemic preparedness.

Following the successful global eradication of smallpox in 1975 through effective vaccination programmes and strengthened surveillance, the Expanded Programme on Immunization (EPI) was launched in India in 1978 to control other VPDs. Initially, six diseases were selected: diphtheria, pertussis, tetanus, poliomyelitis, typhoid and childhood tuberculosis. The aim was to cover 80% of all infants. Subsequently, the programme was universalized and renamed as Universal Immunization Programme (UIP) in 1985.\textsuperscript{55}

UIP name still continues, although, the program has seen many changes since the very beginning. It was part of the technology mission since 1986 and was monitored under the 20-point program by the Prime Minister’s office. Going through the phases of Child Survival and Safe Motherhood (CSSM) program in 1992, Reproductive and Child Health – I (RCH - I) program, from 1997, and finally under National Rural Health
Assess and develop information booklet on immunization practices among parents and health personnel from selected urban versus rural areas.

Mission (NRHM) in 2005, it has witnessed many changes. But still after 25 years of implementation, the coverage of vaccines are poor in many states, more than 9 million infants still do not receive all the vaccines they should.\textsuperscript{56}

The UIP was independently reviewed, at least twice till 2000, first in 1989 and then in 1998. The major issues being reported are human resource gap, lack of adequate health infrastructure, poor micro-planning, low capacity to supervise, feedback at district and health facility level, inadequate supervisory visits, delay in taking corrective measures, failure to assess the program in terms of outcome, record not maintained properly and the reported coverage is always much higher than evaluated one, low managerial & support capacity, community participation and IEC still major constraints.\textsuperscript{57}

Vaccines may be broadly classified as live attenuated vaccines and killed/inactivated vaccines. Commonly used live attenuated vaccines include BCG, oral polio, measles, MMR and Chicken Pox vaccines. Killed vaccines may be inactivated toxins/ toxoids (Diphtheria/ Tetanus Toxoids), killed organisms (Whole Cell Pertussis vaccines) or most commonly subunit vaccines (Hib, Hepatitis B, Hepatitis A, Typhoid, Meningococcal, Influenza). Subunit vaccines comprising only of the polysaccharide antigens are called unconjugated vaccines. Conjugation of the polysaccharide with a protein carrier significantly improves the immune response as discussed later.\textsuperscript{58}

Periodically vaccine safety is assured this is the report regarding Vaccine Safety and Examine the Evidence. The safety and effectiveness of vaccines are under constant study. Because vaccines are designed to be given routinely during well-child care visits, they must be extraordinarily safe. Safety testing begins as soon as a new vaccine is contemplated, continues until it is approved by the FDA, and is monitored indefinitely after licensure. The American Academy of Pediatrics (AAP) works closely with the Centers for Disease Control and Prevention (CDC) to make recommendations for vaccine use.\textsuperscript{59}

A study conducted by Choudhury KA, Amin MM (1992) with aim of analysis of vaccine preventable diseases (VPD) in two block years, i.e., 1972-1975 and 1986-1989
showed an overall decline in morbidity and mortality. Improvement in morbidity was most noticeable in typhoid fever followed by polio and tetanus. However, in tuberculosis and measles with complications, there was a significant increase in admission rates 3.8 vs. 4.4% and 1.8 vs. 2.2%, respectively. Mortality in vaccine preventable diseases except polio has declined significantly.60

In Maharashtra, NFHS-2 field staff collected information from 5,830 households between 22 March 1999 and 20 June 1999 and interviewed 5,391 eligible women in these households. In addition, the survey collected information on 1,810 children born to eligible women in the three years preceding the survey. Child immunization is an important component of child-survival programmes in India, with efforts focusing on six serious but preventable diseases tuberculosis, diphtheria, pertussis, tetanus, polio, and measles. The objective of the Universal Immunization Programme (UIP), launched in 1985-86, was to extend immunization coverage against these diseases to at least 85 percent of infants by 1990.61

In Maharashtra, 78 percent of children ages 12-23 months are fully vaccinated, another 20 percent have received some but not all of the recommended vaccinations and only 2 percent have not been vaccinated at all. Ninety-four percent of children ages 12-23 months have been vaccinated against tuberculosis, 89 percent have received three doses of DPT vaccine, 91 percent have received three doses of polio vaccine, and 84 percent have received the measles vaccine.61

Despite the overall high rates of vaccinations in Maharashtra, children from disadvantaged groups are much less likely to be fully vaccinated. More than one out of three children of illiterate mothers and children belonging to the scheduled tribes are not fully vaccinated. Although girls are somewhat less likely than boys to be fully vaccinated, the percentage of girls who have not received any of the required vaccinations is almost the same (about 2 percent) as the percentage of such boys. In slum areas of Mumbai, 81 percent children are fully immunized, a slightly higher coverage rate than in either urban or rural areas overall. Immunization coverage has improved substantially in Maharashtra since NFHS-1, when 8 percent of children had not received
any vaccinations at all. The coverage of each vaccination has also improved. A large part of the expansion in the coverage of the three doses of polio is undoubtedly because of the introduction of the Pulse Polio Immunization Campaign in 1995. The coverage of Polio 0 rose slightly, from 6 percent in NFHS-1 to just 8 percent in NFHS-2.  

Dropout rates for the series of DPT and polio vaccinations have declined marginally since in NFHS-1, but they are still a problem. Overall, 6.7 percent of children who receive the first dose of either series do not receive the required third dose in the series. It is also recommended that children under age five years should receive oral doses of vitamin A every six months starting at age nine months. In Maharashtra, 65 percent of children age 12-35 months has received vitamin A supplementation, but only 37 percent received a dose of vitamin A in the six months preceding the survey. Whereas data of NFHS-3 revealed that the percentage of children between 12-23 months of age in Maharashtra, with full immunization was 58.8% and in the rural area of Maharashtra it was 49.8%.  

Even in aboard coverage was less due to misconception of Adverse Events Following Immunization. Active immunization has been able to turn many childhood diseases into distant memories in industrialized countries. It has been found to be one of the most cost-effective public health interventions. However, immunization coverage has continued to falter in Nigeria due to missed opportunities, non-availability of services and probably fears of adverse events that follow immunization. Therefore the study conducted by Tagbo, B.N., Uleanya, N.D. (2013) to determine mothers’ knowledge and perception of adverse events following immunization (AEFI) in Enugu. A structured interviewer administered questionnaire was administered to 235 mothers with at least one child < 5 years attending children outpatient clinics. Most mothers (50.1%) had tertiary education, 39.6% and 9.4% had secondary and primary education respectively while 0.9% had no formal education. Five did not know why children were immunized, 188 knew it was to prevent major killer diseases, 33 believed it was to prevent all diseases while 9 believed it was to treat diseases.
The knowledge of reason for immunization was significantly associated with maternal educational (p=0.000). Most (89.8%) also knew that the major content of vaccines was chemicals or substances that could help prevent killer diseases. While 1.3% believed vaccines contained harmful materials, 8.9% had no knowledge about the content of vaccines. This was significantly associated with maternal education (p=0.001). Majority (34%) were unable to mention any adverse event, 31.6% mentioned only one adverse event. While, 23.8% mentioned two, 10.6% mentioned three or more AEFI. Eighty percent would continue if their children suffered adverse events, 6% would not continue, 13.6% were undecided and 0.4% did not respond. There is poor maternal knowledge about immunization and the adverse events that could follow immunization. Community participation and sustained public awareness are needed to erode fears of AEFI.

The report was published regarding Observation of Supplementary Immunization Activity (SIA) in India by Malhotra V. (2012). Children less than 5 years of age, residing in a well-defined urban community in Punjab state, and had failed to report to polio booths on 19 February 2012, (Polio Sunday) during SIA formed the starting point of the study. Health care workers conducting house-to-house ‘search and vaccinate’ activities on subsequent two days were instructed to record the home addresses and/or cell phone numbers of these families. Reason for not reporting to polio booth was obtained personally, either through personal visit to their homes or through interview on cell phones. Statistical test appropriate for nominal data has been used to analyze the data. One thousand six hundred and forty-four children below the age of 5 years were immunized with OPV during the first round of SIA conducted in reference population during 19-21 February 2012. Out of these, 155 children (9.43%) from 113 families were not brought to polio booths on 19 February 2012 and were vaccinated during ‘search and vaccinate’ activities conducted on 20 and 21 February 2012. Ninety seven (85.84%) of these families could be contacted.

The study done by Sharma S.(2005) to focus on the status and performance during 1980-2004 of the child immunization programme in India, U.P. and Uttarakhand and to
suggest policy and programmes for realization of the goals of universal immunization services. Data sources on immunization coverage were used for the study to include secondary data from the National Family Health Surveys (NFHS) and RCH Surveys in U.P. Uttarakhand and all over India. The analyses reveal that a large number of children who have contact with services providers are missed out of subsequent services. It was found that there is a wide gap between routine data and survey data. Almost every other child in Uttarakhand and U.P is incompletely protected and one out every of three children is a dropout from the immunization programme. Uttarakhand has not reached the goal of universal immunization coverage despite a focused and intense immunization programme since 1985.64

It’s observed that since World War II, vaccination has had a major impact on global health, as the following list of successes shows:

• Smallpox, which had killed two million people per year until the late 1960s, was wiped out by 1979 after a massive worldwide immunization campaign.
• The number of polio cases fell from over 300,000 per year in the 1980s to just 2,000 in 2002.6
• Two-thirds of developing countries have eradicated neonatal tetanus.65
• Since the launch of the World Health Organization’s Expanded Program on Immunization (EPI) in 1974, the number of reported measles deaths has dropped from 6 million to less than 1 million per year.
• Whooping cough cases have fallen from 3 million per year to less than a quarter of a million.
• Diphtheria cases have declined from 80,000 in 1975 to less than 10,000 in 2003.66

The studies are also done on individual vaccines. So the seven vaccines included in immunization schedule are discussed as follows.

• **Bacillus Calmette Guerin (BCG):**

  The BCG vaccines has celebrated the 100th anniversary of their discovery in a decade at the beginning of the next century since Albert Calmette and Camille Guerin had presented it before the Academies des Sciences in 1908.
Tuberculosis kills more people than any other infectious disease about 3 million people a year, including almost 300,000 children under 15, and is producing over 7,000 deaths and over 24,000 new cases every day. Therefore, WHO declared a global health emergency in 1993. More badly, recently multi-drug resistant tubercle bacilli are emerging rapidly making TB patients incurable. Under these situations there is need of a potent anti-tuberculosis vaccine. At moment, the BCG vaccines are being used worldwide in the largest quantities in the world, but still most controversial vaccines anywhere. The Expanded Programme on Immunization (EPI) in 1974, when the EPI was launched by WHO, less than 5% of the world children were immunized against six infectious diseases including tuberculosis. In 1995 statistics, BCG gave the highest vaccination coverage, 87% higher than any other 5 vaccines of EPI for children. The BCG in EPI must have saved a lot of infants as the vaccine.\textsuperscript{67}

With the extended program of immunisation the coverage status of BCG vaccination in India has been very good, although it is still unsatisfactory in the eastern states. It is emphasized that BCG vaccination cannot prevent natural tuberculosis infection of the lungs and its local complications, although it reduces the haematogenous complications of primary infection.\textsuperscript{68}

The study was done by Colditz G.A.(1995) to quantify the efficacy of vaccination of infants with bacillus Calmette-Guérin (BCG) against tuberculosis. A total of 1264 articles and abstracts were reviewed for details on BCG vaccination, the availability of concurrent vaccinated and unvaccinated groups, and a tuberculosis outcome. Seventy articles were reviewed in depth for method of vaccine allocation used to create comparable groups, age at vaccination of study participants, comparability of surveillance and follow-up of recipient and concurrent control groups in trials, an appropriately defined control group in case-control studies, and outcome measures tuberculosis cases or deaths. Five prospective trials and eleven case-control studies of vaccination during infancy were included in the present analyses. The relative risk (RR) for tuberculosis in vaccinated versus unvaccinated infants was the measure of vaccine efficacy analyzed.\textsuperscript{69}
In a random-effects regression model of the nine case-control studies, study validity score explained 15% of the heterogeneity among study-estimated protective effects, suggesting that better studies reported greater efficacy. Three trials and six case-control studies provided some age-specific information that allowed us to examine the duration of BCG efficacy. Most of this evidence suggested that BCG efficacy may persist through 10 years after infant vaccination. Conclusion of the study was BCG vaccination of newborns and infants significantly reduces the risk of tuberculosis by over 50%, on average. Protection has been observed across many populations, study designs, and forms of tuberculosis. Rates of protection against cases that are confirmed by laboratory tests, reflecting reduced error in disease classification and consequently more accurate estimates of BCG efficacy, are highest at 83%.  

The study was conducted by Lanckriet C (1997) on efficacy of BCG vaccination of the newborn, evaluation by a follow-up study of contacts in Bangui. The efficacy of BCG vaccination given at birth is still controversial. One thousand children who had lived in contact with a recently diagnosed case of contagious tuberculosis were followed up for a period of 6 months in order to detect the occurrence of tuberculosis. Diagnosis of tuberculosis was made through a scoring system. Vaccine efficacy (VE) was calculated on the basis of the relative risk of contracting tuberculosis according to vaccination status. The efficacy of BCG was estimated to be 71% (95% confidence interval).  

The result remained practically the same after changing the definition used for tuberculosis (TB) cases. There was no difference between the two groups in the variables measuring intensity of contact with the source of contamination, but there was a difference in age distribution. Vaccine efficacy adjusted for this factor was the same as the crude VE. This study, based on a methodology that controls for most of the risks of bias inherent to field efficacy measurement, confirms the protective capacity of neonatal BCG against childhood tuberculosis. Therefore BCG vaccination at birth must remain a public health priority especially in countries with high incidence of the disease.  

The BCG vaccine has been found to be more effective against the most common form of tuberculosis than previously thought, according to a new study in Clinical Infectious
Diseases. Bacillus Calmette Guerin (BCG) vaccine is included in the childhood vaccination programme of many countries, and is the only licensed vaccine against tuberculosis (TB). However, it has previously been thought to only be effective against the less common forms of the disease that occur away from the lungs. Its efficacy against pulmonary TB, found in the lungs and by far the greatest burden of TB, has varied widely depending on location, ranging from 0% in South India to 80% in the UK.²¹

In order to better understand the reason behind this variability, conducted a systematic review of global literature on all reported BCG trials across 10 medical electronic databases, looking at the factors affecting its level of protection against pulmonary TB. The main reason for the apparent variation in protection against disease seen in previous studies was found to be due to prior infection reducing the efficacy of the vaccine. BCG vaccination for those with no history of prior TB infection, including young infants, showed a much higher efficacy against pulmonary TB. It is important that BCG is given as early as possible in a person's life, and ideally immediately after birth.²¹

**Polio:**

Viral vaccines have a long history that has been marked by successful events and by tragic accidents. Live viral vaccines are an extraordinary category of biological since, despite their reputed efficacy, they were developed by empirical experiments and patient epidemiological observation. From this point of view oral polio vaccine should be considered a 'miracle' since it became a major tool for public health in the 20th century. The first evidence that polio virus can be attenuated was provided in the early 1940s by Max Theiler, but it was Hilary Koprowsky who demonstrated further in 1952, that a rodent adapted strain was safe and able to immunize a limited number of volunteers. Koprowsky studies were confirmed later during a mass field trial in Africa.²²

However it is undeniable that the patient and systematic work of Albert B. Sabin was primordial in developing live oral attenuated polio vaccine. The excellence of Sabin's testing of poliovirus neuro virulence in the accurate studies that Sabin developed enabled him to select, after the cloning of viral populations by plaque assay, the best attenuated variants. It is interesting to remember that the real selective factor that allowed the
isolation of attenuated variants was ignored by Sabin and was put forward by Lwoff in the Pasteur Institute, when he described the role of temperature in the selection of cold attenuated mutants.  

Historically, the first to perform a successful mass vaccination with Sabin oral live polio vaccine were Russian scientists. Oral live polio vaccine was in some cases the origin of paralytic accidents and Sabin strains were involved occasionally in such events. Other attenuated poliovirus strains used in clinical trials as oral vaccine, such as Cox-Lederle type 1 and Usol-D bac type 3, generated in some instances clusters of vaccines that developed paralysis. An important achievement in the consistency of the Sabin vaccine was the transfer by Albert Sabin to the WHO of the seed material and the responsibility for surveying the quality control and licensing procedure of oral polio vaccine.  

The study was conducted by Sokhey J, Gupta C.(1988) on Stability of oral polio vaccine at different temperatures The stability of five batches of oral polio vaccine stored at −20, 4–8, 22 and 36°C for 7, 14 and 21 days was studied. The virus titrations were performed by the standard macro-method. There was little loss in virus titer when samples were kept at −20 and 4–8°C for 21 days, whereas the samples exposed to 36°C for 21 days showed almost complete loss in virus titer. The average loss in virus titer in a year was 0.47 at −20°C and 0.65 at 4–8°C when various samples were stored at these temperatures. At 22°C the average loss in virus titer after 21 days was about 1.50. The samples subjected to ten cycles of freezing and thawing did not show any loss in virus titre. Likewise there was not much loss in virus titre in three samples stored at 4–8°C for a year. Oral polio vaccine stabilized with magnesium chloride is quite a stable vaccine and maintenance of a proper cold chain is recommended for the delivery of a potent vaccine in countries with high ambient temperature.  

The study conducted by Raland W., Agharkhedkar S.(2010) with aim to assess the immunogenicity of novel bivalent types 1 and 3 oral poliovirus vaccine (bOPV). A randomised, double-blind, controlled trial was done to assess the superiority of monovalent type 2 OPV (mOPV2), mOPV3, or bOPV over trivalent OPV (tOPV), and
the non-inferiority of bivalent vaccine compared with mOPV1 and mOPV3. Parents or guardians and study investigators were masked to treatment allocation. Because of multiple comparisons, it defined \( p \leq 0.01 \) as statistically significant. 900 newborn babies were randomly assigned to one of five vaccine groups (about 180 patients per group); of these 70 (8%) discontinued, leaving 830 (92%) for analysis. The findings show the superiority of bOPV compared with tOPV, and the non-inferiority of bOPV compared with mOPV1 and mOPV3.\(^{74}\)

India recorded the last case of poliomyelitis on 13 January 2011, and has been polio-free since then. This spectacular success should motivate all stakeholders to further improve quality of polio-related activities, and not lead to any complacency. The success story of India also has lessons for remaining endemic nations especially Pakistan and Afghanistan that also require a herd immunity nearing 100% of children < 5 years of age to interrupt WPV transmission. Humanity is on the threshold on eradication of a disease that causes disability, disfigurement, de-humanization, discrimination and death. An advertisement by a two wheeler manufacture in India on television says turning back is not an option. Nothing could be truer for humanity’s march towards polio eradication.\(^{75}\)

In case of India there is large regional variation in full immunization and a clear north–south differential was observed. The coverage of polio vaccine is higher than that of BCG and measles vaccine in India and the states and there is slow improvement over time of period.\(^{75}\)

**Diphtheria, Pertussis, Tetanus (DPT):**

DPT (also DTP and DTwP) refers to a class of vaccines against three infectious diseases in humans: diphtheria, pertussis (whooping cough), and tetanus. The vaccine components include diphtheria and tetanus toxoids and killed whole cells of the organism that causes pertussis. The usual course of childhood immunization is five doses between 2 months and 15 years. For adults, separate combination (booster) vaccines are used that adjust the relative concentrations of their components. Despite sustained high coverage for childhood pertussis vaccination, pertussis remains poorly controlled in the United States. A total of 16,858 pertussis cases and 12 infant deaths were reported in 2009.\(^{15}\)
Despite high vaccination coverage, pertussis continues to be a great public health problem. Adults and adolescents are source of infection for infants who are too young to be completely vaccinated. The aim of the study is detect if there is a household transmission of pertussis. Presence of Bordetella pertussis among the household contacts of the children who had had the positive result for Bordetella pertussis by real-time polymerase chain reaction was detected. Of the 173 infants with clinical suspicion of pertussis, 48 (27.7%) turned out to be positive by PCR. The mothers of 19 (41.3% of all tested mothers) of them were also PCR positive for B. pertussis, being the family member most frequently infected. Despite high coverage of pertussis vaccination in Turkey, pertussis is prevalent both in incompletely protected infants and older children. High rate of presence of the bacteria in the household contacts depicts the importance of further pertussis booster vaccination in adolescents, adults and the targeted vaccination of the adults having close contacts with infants.76

Globally, DPT-3 coverage rose from 20% in 1980 to 81% in 2007. In the WHO South East Asian region, DPT-3 coverage rose from 7% to 69% during the same period. Coverage level of DPT may be considered as one of the best indicator of health system performance in any country.77

The study conducted in United States on Timing of Tdap Following Tetanus, diphtheria Safety. When Tdap was licensed in 2005, the safety of administering a booster dose of Tdap at intervals <5 years after Td or pediatric DTP/DTaP had not been studied in adults. However, evaluations in children and adolescents suggested that the safety of intervals as short as 18 months was acceptable. Rates of local and systemic reactions after Tdap vaccination in adults were lower than or comparable to rates in adolescents during United State prelicensure trials; therefore, the safety of using intervals as short as 2 years between Td and Tdap in adults was inferred. Additional data on the safety of administering Tdap <5 years after Td are now available.78

Beytout J, Launay O. (2009) & Talbot EA, Brown K. (2010) conducted two studies were with 387 persons aged 18 through 76 years who received a Tdap or combined Tdap-inactivated polio vaccine (Tdap-IPV) vaccination either within 21 days,
or < 2 years following a previous Td-containing vaccine. In both studies, immediate or short-term adverse events e.g., 30 minutes to 2 weeks after receipt of Tdap or Tdap-IPV were examined. The majority of these events were limited to local reactions, including pain (68%--83%), erythema (20%--25%), and swelling (19%--38%). Serious adverse events related to the receipt of Tdap or Tdap-IPV shortly after Td or Td-IPV vaccinations did not occur. However, the number of subjects in these studies was small and does not exclude the potential for rare, but serious, adverse events.79,80

The study was conducted by Shankar P., Gupta M. et al (2011) on the rural community development block of Khizrabad in the Yamunanagar district of Haryana state, India. This district was chosen because immunization coverage for all currently administered vaccines in 1-year-old children was 78% in 2004. The mothers of children who had not attended the immunization session 1 month after the first DPT vaccine dose were interviewed to identify the reason for dropping out. This pre-intervention cohort study comprised 4336 children aged less than 18 months who at the time of enrolment in the study had started or completed their immunization schedule. The post-intervention cohort comprised 5213 children who were registered prospectively at birth during the study.81

The majority (99.3%) of mothers consented to participation. The first, second and third DPT doses were administered during the study to 4810, 4775 and 4730 children, respectively. In addition, 814 children were admitted to the study hospitals from other blocks in Yamunanagar district. According to their parents’ reports, first, second and third DPT doses were administered to 477 (58.6%), 377 (46.3%) and 294 (36.1%) children, respectively. Although nearly 92% of the children in the pre-intervention cohort had received a third DPT dose by the age of 12 months, only 19% had received it by the age of 4 months, the age by which they should have received it according to the Indian national immunization schedule.81

A retrospective study done by Patel V., Bergamaschi C, et al.(2010) on analysis of hospital records revealed decline in diphtheria morbidity from 1985 to 1997 and an increased thereafter. Case fatality rate has reduced over time period and now it is around
Assess and develop information booklet on immunization practices among parents and health personnel from selected urban versus rural areas.

20%. Cases were found more during August to October months. Children less than five years of age accounted for 61.9% of total cases. The overall male to female case ratio was 1.06:1. Mortality was significantly higher in less than five year age group. 65.42% children had not received a single dose of DPT vaccine.\textsuperscript{82}

One study from Delhi was conducted by Sokhey J, Jain DC et al (2001) found a dropout rate between the first and third DPT dose. The main reason given was a lack of information about the vaccination session. Dealing with this problem requires a change in focus from providing “universal coverage” to providing “universal timely coverage”. This new focus should be communicated to clients and highlighted in continuing education for health-care workers.\textsuperscript{83}

DPT vaccine-induced lipoatrophy an observational study was conducted by Sardana K., Vijay K. (2007) in New Delhi. Diphtheria Pertussis Tetanus (DPT) vaccine is universally used in infants and children. It is generally safe and well tolerated. Local reactions such as erythema, induration, palpable nodules, and injection site abscess are well known. Injection site lipoatrophy has not been reported earlier. Retrospective review of all cases presenting with lipoatrophy developing at injection site following DPT administration was performed. In each case, the patients were extensively evaluated for other possible causes of lipoatrophy 8 infants (2 boys & 6 girls), age range 4–12 months, had presented with injection site lipoatrophy following DPT vaccination. The duration between the last injection and lipoatrophy ranged from 4 to 8 weeks. All had been administered the vaccine in the buttock instead of the thigh, as generally recommended in infants. Majority (6/8) developed lipoatrophy after the second dose. No systemic causes were found. DPT vaccine may, in rare instances, lead to injection site lipoatrophy. Inadvertent administration into the subcutaneous fat of the buttock may have been causative. Other possible mechanisms are discussed. Paramedics and general practitioners need to be educated to administer intramuscular vaccines in the thigh in infants and young children.\textsuperscript{84}

\textbf{Hepatitis B:}

43
The study conducted by Tandon B N, Acharya S K (1993) on Epidemiology of hepatitis B virus infection in India. The average estimated carrier rate of hepatitis B virus (HBV) in India is 4%, with a total pool of approximately 36 million carriers. Wide variations in social, economic, and health factors in different regions may explain variations in carrier rates from one part of the country to another. Professional blood donors constitute the major high risk group for HBV infection in India, with a hepatitis B surface antigen positivity rate of 14%. Blood transfusions represent the most important route of HBV transmission among adults.85

However, most of India's carrier pool is established in early childhood, predominantly by horizontal spread due to crowded living conditions and poor hygiene. Acute and sub-acute liver failure is common complications of viral hepatitis in India and HBV is reckoned to be the etiological agent in 42% and 45% of adult cases, respectively. HBV is reported to be responsible for 70% of cases of chronic hepatitis and 80% of cases of cirrhosis of the liver. About 60% of patients with hepatocellular carcinoma are HBV marker positive. Small numbers of patients have been reported to be infected with the pre-core mutant virus but none with the S mutant. Infection with hepatitis C virus or hepatitis delta virus is comparatively uncommon. In conclusion, hepatitis B is a major public health problem in India and will continue to be until appropriate nationwide vaccination programmes and other control measures are established.85

More than 90 countries have now included hepatitis B (HB) immunization into their National Immunization Programmes as a routine vaccine given to all infants and/or adolescents and many additional countries are planning for the introduction in the next two years. These countries include all industrial countries except the United Kingdom, Ireland, The Netherlands, the Scandinavian countries and Japan. Countries with routine HB immunization include about 45% of surviving newborns, but almost 70% of hepatitis B virus carriers live in countries with routine HB programmes. Population based studies of HB immunization from around the world are now being reported with as long as 10 to 15 years of follow-up, showing a reduction of the chronic HB carrier prevalence from high is 8% or greater to low is less than 2% endemicity in immunized cohorts of infants.
Reductions in the price of HB vaccines, a significant increase in the number of producers and the advent of combination vaccines including an HB component will make the vaccine available to more children world-wide, but economic constraints continue to hamper introduction of this vaccine to the children in the poorest countries.\textsuperscript{86}

The study was conducted by Gandhe S., Chadha M. (1999) to determine hepatitis B virus genotype and subtype distribution among HBV infected individuals with different clinical manifestations in western India, serum samples from 19 asymptomatic hepatitis B surface antigen carriers, 30 chronic hepatitis B patients, 8 acute hepatitis B patients, 5 fulminant hepatitis B patients, and with circulating HBV, DNA were genotyped and subtyped on the basis of the nucleotide sequence analysis of S region of the HBV genome. Genotype D was the predominant genotype circulating in western India (57/62; 91.93\%). All 19 asymptomatic hepatitis B surface antigen carriers, 8 acute hepatitis B patients, 5 fulminant hepatic failure patients and 25/30 chronic hepatitis B patients were circulating genotype D and ayw3/ayw2 subtypes. HBV genotype A was prevalent in 8\% (5/62) of the total number of patients and all belonged to chronic hepatitis B category. Subtyping analysis showed that all genotype A isolates were of subtype adw2. As most of the patients from different clinical categories were infected with HBV genotype D, it is concluded that this genotype did not influence the outcome of HBV infection.\textsuperscript{87}

Hepatitis B is a potentially life-threatening liver infection caused by the hepatitis B virus. It is a major global health problem. It can cause chronic liver disease and chronic infection and puts people at high risk of death from cirrhosis of the liver and liver cancer. More than 240 million people have chronic liver infections. About 6, 00,000 people die every year due to the acute or chronic consequences of hepatitis B. A vaccine against hepatitis B has been available since 1982. Hepatitis B vaccine is 95\% effective in preventing infection and its chronic consequences, and was the first vaccine against a major human cancer.\textsuperscript{88}

The hepatitis B vaccine is the mainstay of hepatitis B prevention. WHO recommends that all infants receive the hepatitis B vaccine as soon as possible after birth, preferably within 24 hours. The birth dose should be followed by 2 or 3 doses to
complete the primary series. In most cases, 1 of the following 2 options is considered appropriate: a 3-dose schedule of hepatitis B vaccine, with the first dose (monovalent) being given at birth and the second and third (monovalent or combined vaccine) given at the same time as the first and third doses of DTP vaccine or 4 doses, where a monovalent birth dose is followed by 3 monovalent or combined vaccine doses, usually given with other routine infant vaccines.\textsuperscript{88}

The complete vaccine series induces protective antibody levels in more than 95% of infants, children and young adults. Protection lasts at least 20 years and is possibly lifelong. The vaccine has an excellent record of safety and effectiveness. Since 1982, over one billion doses of hepatitis B vaccine have been used worldwide. In many countries, where 8–15% of children used to become chronically infected with the hepatitis B virus, vaccination has reduced the rate of chronic infection to less than 1% among immunized children.\textsuperscript{88}

The study was conducted by Lixia Wang, Junhua Li (2003) in China on Hepatitis B vaccination of newborn infants in rural areas. Two surveys were conducted, one before study implementation the baseline coverage survey and one after the follow-up coverage survey, to evaluate the impact of the interventions on timely administration of the birth dose of Hepatitis B vaccine. For both surveys, a modification of the WHO immunization cluster survey was used. In each of the three study groups, 40 villages clusters were randomly chosen with probability proportional to size. Interviewers enquired about receipt of immunizations and reasons for any delay in receiving the birth dose of Hep-B vaccine.\textsuperscript{89}

Interviewers also reviewed immunization cards kept by parents and immunization records at the offices of village and township health workers. Coverage of the birth dose of Hep-B vaccine administered on time increased in all three groups: from 8.0% to 57.9% in group 1, from 11.3% to 67.8% in group 2, and from 6.8% to 77.3% in group 3, with $P < 0.05$ for differences between each of the groups. A sample of parents was asked why their children had not been vaccinated within 24 hours after birth. Before the study, 78% of parents said the main reason was that they had not been informed by a health-care
provider about the importance of receiving Hep-B vaccine within 24 hours after birth. After the study, the proportion giving this response decreased to 41%. For children born at home, the second most common reason was residence too far from the immunization clinics.\textsuperscript{89}

**Measles:**

The estimation of the global burden of measles is challenging in the absence of reliable & comparable surveillance systems worldwide. A static model is described that enables estimation of measles morbidity, mortality, and disability for the year 2000 on the basis of country-specific information. This approach estimated a global incidence of 39.9 million measles cases, 777,000 deaths, 28 million disability-adjusted life years.\textsuperscript{47}

The World Health Organization regions of Africa and Southeast Asia had 70% of incident cases and 84% of measles-related deaths; 11 countries alone Afghanistan, Burkina Faso, Democratic Republic of the Congo, Ethiopia, India, Indonesia, Niger, Nigeria, Pakistan, Somalia, Uganda account for 66% of deaths. This approach quantifies the measles burden by considering country-specific indicators, which can be updated, permitting an assessment of country, regional, and global changes in the burden associated with measles infection.\textsuperscript{90}

The substantial reduction in measles death is largely due to intense efforts from WHO, UNICEF and other programmes to provide vitamin A supplementation and treatment as well as increase coverage of measles vaccine including offering a second opportunity for vaccination in countries with a high measles burden. Live attenuated measles vaccine was first introduced in the United States and many developed countries during the 1960s, licensure was based on prevention of measles disease and immunologic correlates of immunity as the primary outcomes.\textsuperscript{91}

The United Nation General Assembly Special Session on Children adopted a goal to reduce deaths owing to measles by half by the end of 2005, compared with 1999 estimates. This describes efforts and progress made towards this goal. It was assessed the trends in immunisation against measles on the basis of national implementation of the WHO/UNICEF comprehensive strategy for measles mortality reduction, and the
provision of a second opportunity for measles immunisation. They used a natural history model to evaluate trends in mortality due to measles. Between 1999 and 2005, according to our model mortality owing to measles was reduced by 60%, from an estimated 873,000 deaths in 1999 to 345,000 deaths in 2005. The largest percentage reduction in estimated measles mortality during this period was in the western Pacific region (81%), followed by Africa (75%) and the eastern Mediterranean region (62%). Africa achieved the largest total reduction, contributing 72% of the global reduction in measles mortality.92

Measles vaccination was included in UIP in 1985. Nearly 7.5 million deaths from measles were prevented through immunisation between 1999 and 2005, with supplemental immunisation activities and improved routine immunisation accounting for 2.3 million of these prevented deaths. The achievement of the 2005 global measles mortality reduction goal is evidence of what can be accomplished for child survival in countries with high childhood mortality when safe, cost-effective, and affordable interventions are backed by country-level political commitment and an effective international partnership.93

Measles vaccine is one of the safest and most effective vaccines currently available. Use of the vaccine has decreased the incidence of measles in both developed and developing countries. Nevertheless, preventable morbidity and mortality continue to occur. In the United States, the measles problem differs when it occurs among preschool-aged children or school-aged children. The former is due to insufficient vaccine delivery. For measles in school-aged and college students, the problem is primarily vaccine failure, which should eventually be solved by a two-dose schedule. In developing countries, the major problem is vaccine delivery. Use of measles vaccine in developing countries offers the promise of reducing disease rates in young infants; however, in both the United States and in developing countries, increasing immunization levels is essential.94

Singh et al. (1994) conducted study on Measles mortality in India: a review of community based studies. Study findings indicate that availability of health care facilities is a critical factor that affects the risk of measles mortality in any area. The findings show
that infants have the highest morbidity and mortality in either epidemic situations or non-epidemic situations. There are no gender differences. A few studies involved immunization against measles and health services. Although coverage is low in these studies, the case fatality ratios (CFRs) are found to be zero or under the median recorded. Immunization plays a role in decreasing the peak of outbreaks and in increasing the inter-epidemic interval. The impact of measles on immunized children is found to be less severe and unlikely to be fatal.\textsuperscript{20}

The study conducted by Jeanette W., Paul F. (1997) on additional evidence against measles vaccine administration to infants less than 12 months of age and altered immune response following active and passive immunization. Quantitative serologic responses following the inoculation of infants less than one year of age with live, further-attenuated measles virus vaccine were compared to those of infants and children inoculated after one year of age. Active and passive immunization resulted in reduced antibody formation in some infants, especially those less than 9 months of age. Thirty-seven infants identified as vaccine failures following their initial inoculation at less than one year of age were revaccinated after one year of age. In face of an observed response in many infants less than one year of age, it would appear prudent to withhold vaccine in this age group until the consequences of such an approach are better defined.\textsuperscript{95}

Study was done by John M. James M.D. (1995) on safe administration of the Measles Vaccine to Children Allergic to Eggs. The safety of administering the combined measles–mumps–rubella (MMR) vaccine to patients who are allergic to eggs has been debated for decades because of concern about potential anaphylaxis, since the live attenuated virus used in the vaccine is grown in cultured chick-embryo fibroblasts. All 54 children had positive results on skin testing with egg. Allergy to eggs was confirmed in 26 of the children by convincing histories of anaphylaxis after the ingestion of eggs, in 22 children by food-challenge tests, and in 6 patients by convincing histories of recent allergic reactions occurring after the ingestion of eggs. Of the 17 children who underwent skin testing with the MMR vaccine, 3 had positive results. All 54 children received the MMR vaccine as a single subcutaneous injection; none had an immediate or delayed
adverse reaction. The MMR vaccine can be safely administered in a single dose to children with allergy to eggs, even those with severe hypersensitivity.96

The study was done by Saul K. (1969) on attenuated Measles Vaccine their characteristics and Use. Further attenuated strains of measles virus may be distinguished from virulent strains by the following characteristics. Unlike virulent measles virus, attenuated strains induce an in apparent infection in 85% of vaccines. Symptoms such as fever, cough and rash, if present, are usually transient. Bacterial and central nervous system complications associated with natural measles infection are extremely rare after immunization. A 16-year, prospective study of immunologic response of 47 children who had natural measles and of 70 children immunized with live, further-attenuated measles vaccine revealed that all 47 children with natural measles infection had high titers of hemagglutination-inhibiting (HAI) antibody (≥1:64) one month after vaccination and 15% had low titers (1:2–1:4) 16 years after vaccination and all 70 children who received live, further-attenuated measles vaccine had high titers of HAI antibody (≥1:64) one month after vaccination. Re-immunization of children with undetectable HAI antibody induced a classic booster response. These prospective immunologic studies confirmed that immunity persists after immunization as well as after natural measles infection.97

The study conducted by Sudfeld C.R. (2010) on effectiveness of measles vaccination and vitamin A treatment. The current strategy utilized by WHO/United Nations Children’s Fund (UNICEF) to reach the Global Immunization Vision and Strategy 2010 measles reduction goal includes increasing coverage of measles vaccine, vitamin A treatment and supplementation in addition to offering two doses of vaccine to all children. The study conducted a systematic review of published randomized controlled trials (RCTs) and quasi-experimental (QE) studies in order to determine effect estimates of measles vaccine and vitamin-A treatment for the Lives Saved Tool. It utilized a standardized abstraction and grading format in order to determine effect estimates for measles mortality employing the standard Child. Health Epidemiology Research Group Rules for Evidence Review.98
The results identified three measles vaccine RCTs and two QE studies with data on prevention of measles disease. A meta-analysis of these studies found that vaccination was 85% effective in preventing measles disease, which will be used as a proxy for measles mortality in Lives Saved Tool for countries vaccinating before one year of age. The literature also suggests that a conservative 95% effect estimate is reasonable to employ when vaccinating at 1 year or later and 98% for two doses of vaccine based on serology reviews. It included six high-quality RCTs in the meta-analysis of vitamin A treatment of measles which found no significant reduction in measles mortality. However, when stratifying by vitamin A treatment dose, at least two doses were found to reduce measles mortality by 62% (95% CI 19–82). It concluded that measles vaccine and vitamin A treatment are effective interventions to prevent measles mortality in children.98

The study was done by John T.J, Choudhury P. (2009) on accelerating measles control in India. It was found measles coverage to be 71% and efficacy of 85%, then also actually 60.35% (71 x 0.85) child remains protected. Rest 40% still remains vulnerable for measles. Focal outbreaks of measles are frequently being reported.99

**Vitamin A Supplement:**

Vitamin A is an essential nutrient needed in small amounts for the normal functioning of the visual system, growth and development, maintenance of epithelial cellular integrity, immune function and reproduction. Severe deficiency of Vitamin A is known to produce corneal xerophthalmia, keratomalacia and blindness in children. Vitamin A deficiency (VAD) is mainly seen amongst the young children as they have high requirements due to increased physical growth and have low dietary intake. Further, episodes of illnesses such as acute respiratory tract infection and measles, which deplete Vitamin A reserves from the body, are common in this age group.100

In 1994, under the National Child Survival and Safe Motherhood (CSSM) Programme, the National Prophylaxis Programme Nutritional Blindness due to VAD was modified keeping in view of the vulnerability of VA deficiency in young children. Vitamin A supplementation was added in UIP in 1990.101
A study conducted by Toteja G.S, Singh P.(2002) with aim to identify vitamin A deficiency disorders in 16 Districts of India. The age group of eligible children for coverage was restricted to 9 to 36 months of age. Accordingly, each child was to receive five doses of VA before her/his 3rd birthday, children age 6-11 months, 1 dose of 100,000 IU of VA and in age 12- 36 months of age one dose of 200,000 IU of VA every six months. In view of operational feasibility, the administration of first dose of VA was linked to measles immunization. In 2006, the age group of eligible children was revised as 6-59 months. This was done after reconsidering the recommendations of WHO, UNICEF and Ministry of Women and Child Development. This was despite the evidence that clinical VAD was limited to a few isolated geographical pockets in the country. A National survey conducted by Indian Council of Medical Research (ICMR) in 2001, covering 16 districts in all five regions of the country showed that only three out of 16 districts had prevalence of Bitot spots (BS) of 0.5 per cent and more. 101

During the last four decades indicators of child health have shown substantial gains in different States in the country. The prevalence of severe under nutrition has come down significantly. Immunization coverage for measles and other vaccine preventable diseases has improved from 5-7 per cent in early seventies to currently 60-90 per cent, in different States. Similarly, there has been a significant improvement in the overall dietary intake of young children. The Government is also addressing the issue of food insecurity. The ICDS which covers 80 per cent of rural India provides nutritional supplements to children less than six years of age, nutrition education to mothers and also facilitates the distribution of vitamin A supplements. Improvements in infrastructure have led to better access to health care facilities. Food availability in India has improved in the last 30 years. All these factors have positively influenced the VA status of children and led to reduced prevalence of VAD in the country. 102

One of the largest trials exploring the role of massive-dose vitamin A administration in reducing childhood mortality was conducted in 72 blocks in Uttar Pradesh between 1999 and 2004 by Awasthis (2011). Children from different areas were given six-monthly massive doses of vitamin A, six-monthly de-worming or both or
neither. Approximately one million children were followed and mortality rates in children 1-6yrs of age were recorded. There was no significant difference in death rates between children who received the massive-dose of vitamin A and those who did not. Thus the collated evidence from India does not support the under-five mortality reduction claim of massive dose vitamin A prophylaxis.\textsuperscript{103}

The study conducted by Benn C.S.(2010) with aim to assess the effect on the immune response to measles of providing vitamin A together with measles vaccine. It was found that the two interventions were not independent. Vitamin A enhanced the antibody response to measles vaccine given at 9 months of age significantly, especially in boys. The effects were sustained over time; the children who had received vitamin A with their measles vaccine were more protected against measles at 6-8 years of age.\textsuperscript{104}

An observational study conducted during a vitamin A campaign in which missing vaccines were also provided, and a randomised trial testing the effect of two different doses of vitamin A during another campaign. It was tested the effect of providing vitamin A with BCG at birth in two randomised trials, and reanalyzed data from one of the original randomised trials of vitamin A supplementation from the perspective of vaccination status. In all studies the main outcome was mortality. The results document that vitamin A supplements do more than protect against vitamin A deficiency. They support the hypothesis that vitamin A supplements interact with vaccines with important consequences for mortality. First, a smaller dose of vitamin A was more beneficial than a larger dose for girls. Second, the effect of vitamin A given with DTP vaccine was significantly different from the effect of vitamin A given with measles vaccine, and children, who received vitamin A with DTP vaccine, had higher mortality than children, who had received vitamin A alone, or who did not receive anything. Third, vitamin A given with BCG at birth interacted negatively with subsequent DTP vaccines in girls. Fourth, the effect of vitamin A to older children in Ghana depended on vaccination status, being beneficial in boys, but harmful in girls who received DTP vaccine during follow-up. The results also show that boys and girls respond differently to vitamin A and vaccines.\textsuperscript{104}
Approximately 2,50,000 to 5,00,000 malnourished children in the developing world go blind each year from a deficiency of vitamin A, approximately half of whom die within a year of becoming blind. Vitamin A deficiency also diminishes the ability to fight infections. In countries where children are not immunized, infectious diseases like measles have higher fatality rates. As elucidated by Dr. Alfred Sommer, even mild, subclinical deficiency can also be a problem, as it may increase children's risk of developing respiratory and diarrheal infections, decrease growth rate, slow bone development, and decrease likelihood of survival from serious illness.\textsuperscript{8}

Vitamin A deficiency is estimated to affect approximately one third of children under the age of five around the world. It is estimated to claim the lives of 670,000 children under five annually. Vitamin A deficiency has the highest prevalence in Southeast Asia and Africa. According to the World Health Organization (WHO), vitamin A deficiency in developing countries vitamin A deficiency is a significant concern.\textsuperscript{8}

UNICEF and World Health Organization. Immunization summary: a statistical reference containing data through 2009 which was published in 2011. Vitamin A deficiency is a well-established risk factor for measles-related mortality. Treating children with high-dose supplements during the course of a measles episode can reduce measles-related deaths and complications by about 66 per cent and is therefore the standard of care for managing the disease. Preventive supplementation programmes are also important for the control of vitamin A deficiency in populations with a high measles burden. As part of the global drive to reduce measles deaths, UNICEF and WHO are concentrating efforts on 47 countries in which more than 95 per cent of measles deaths occur – all of which are vitamin A supplementation priority countries. Opportunities exist to co-administer high dose vitamin A supplements with the measles vaccine to infants at around nine months of age. For many infants at risk of vitamin A deficiency, this contact is often the first opportunity to receive a vitamin A supplement. Recent efforts to augment measles vaccine coverage through supplementary immunization activities have also proved effective for delivering vitamin A, enabling countries to reach approximately 70 per cent of targeted children with both interventions. Partly as a result of joint delivery
strategies, the number of measles priority countries achieving effective coverage with vitamin A has more than doubled from 7 in 1999 to 19 in 2004. To ensure that both interventions reach the greatest proportion of at-risk children in all 47 measles/vitamin A supplementation priority countries, these efforts need to continue.\textsuperscript{105}

**Literature related to the immunization practices in urban population:**

A study was conducted by Chhabra P.(2007) in two urbanized villages in east Delhi reported that coverage levels were 82.7% for BCG, 81.5% for DPT/OPV 1, 76.8% for DPT/OPV 2, 70.7% for DPT/OPV 3 and 65.3% for measles vaccine. It was 41.4% and 41.6% for DPT booster and MMR vaccine. Higher education of mother and father, father's occupation, residential status, place of birth and presence of immunization card were significant determinants for complete immunization on univariate analysis. On regression analysis mother's education (R=1.43), presence of immunization card R=2.05 and place of birth (R=3.80) remained significant.\textsuperscript{9}

The study was conducted by BholaNath, Singh J.V (2008) to determine the knowledge, attitude and practices about immunization among respondents of children aged 12-23 months. A total of 510 respondents were interviewed in the urban slums of Lucknow district of India, using 30 cluster sampling technique from January 2005 to April 2005. A pre-tested structured questionnaire was used to elicit the information about the knowledge, attitude and practices of the respondents regarding immunization. Knowledge regarding the disease prevented number of doses and correct age of administration of BCG was highest among all the categories of respondents. The paramedical worker was the main source of information to the respondents of completely (52.0%) and partially immunized (48.5%) children while community leaders for unimmunized children. Those availing private facilities were more completely immunized, as compared to the government facilities. 55.8% of those who took 20 minutes to reach the immunization site were completely immunized as compared to 64.1% of those who took more than 20 minutes. Considering the incomplete knowledge, and inappropriate practices of the people, the policy makers and medical professionals
require Herculean efforts to raise the knowledge and to break the old beliefs of the people.106

A study was done by WarisQidwai, Syed Sohail Ali (2007) to determine the knowledge, attitude and practices about immunization among family practice patients. A questionnaire based survey was developed in line with the study objectives. It was administered to patients visiting family physicians, after they were administered, informed consent and assurance with regards to confidentiality was provided. Epi-info and SPSS software was used for data management. A total of 97 patients were surveyed. The majority were men (59.8%) with a mean age of 29.69 years. Majority was unmarried (51.5%), with graduate and post-graduate education (73%), and in government and private service (48%). Vaccination was believed to prevent disease by 94%. Majority was informed about immunization by doctors and parents (94%). Media provided information about immunization to 62% of the patients. A 58% would recommend vaccination to others. Source about harmful effects of immunization was provided by friends and parents (80%). Hurdles against immunization were lack of education and lack of funds according to 43 (45%) and 29 (30%) respondents respectively. Education of population and mothers were ways to promote immunization according to 23 (24%) and 19 (20%) respondents respectively. Immunization were received against polio, measles and hepatitis "B" by 86 (89%), 51 (53%) and 26 (27%) respondents respectively. The study results have identified a strong need for education program for the masses about immunization, since major deficiencies have been identified. Further studies are strongly recommended along with debate on this important public health issue.107

Children of the urban poor suffer accentuated vulnerability to illnesses, as outbreaks of vaccine preventable diseases are more common in urban slums. So the study was conducted by Kadri A M, Singh A. (2010) to assess the immunization coverage among children aged 12-23 months in the urban slums of Ahmedabad, a cluster survey based on probability proportion to size advocated under multi-indicator cluster survey by WHO was used. With regard to vaccinations; it was found that coverage was the highest for BCG, DPT-1 and OPV-1 (83.3%) and the lowest for measles vaccine (71.7%). Only
66 (47.8%) children had received Vitamin A at the time of measles vaccination. The coverage rate for all the vaccines was slightly higher among males as compared to females. 70.3 per cent of the children were fully immunized and immunization coverage was found to be more among the males as compared to females though the difference was found to be statistically insignificant. The study reflects low immunization coverage and non-utilization of measles vaccination and Vitamin A supplementation.

The study conducted by Sharma B., Mahajan H.(2013) on immunization coverage and role of socio-demographic Variables Children are considered fully immunized if they receive one dose of BCG, three doses of DPT and polio vaccine each, and one measles vaccine. In India, only 44% of children aged 12–23 months are fully vaccinated and about 5% have not received any vaccination at all. Even if national immunization coverage levels are sufficiently high to block disease transmission, pockets of susceptibility may act as potential reservoirs of infection. This study was done to assess the immunization coverage in an urban slum area and determine various socio-demographic variables affecting the same. A total of 210 children were selected from study population using WHO’s 30 cluster sampling method. Coverage of BCG was found to be the highest (97.1%) while that of measles was the lowest. The main reason for noncompliance was given as child’s illness at the time of scheduled vaccination followed by lack of knowledge regarding importance of immunization. Low education status of mother, high birth order, and place of delivery were found to be positively associated with low vaccination coverage. Regular IEC activities like group talks, role plays, posters, pamphlets, competitions should be conducted in the community to ensure that immunization will become a ‘felt need’ of the mothers in the community.

The study was conducted by Joshi S. (2015) to assess knowledge, practices and attitude of immunization among mothers having under five children. The descriptive survey study design is used for this study. The settings for this study were the selected area in urban slums from Pune. The sample size selected for this study is 100 parents. Probability systematic sampling technique is used for selecting samples who met the designated set of criteria during the period of data collection. Structure interview
technique, checklist & attitude scale is used for data collection. The knowledge, practices and attitude of parent was satisfactory.\textsuperscript{110}

**Literature related to the immunization practices in rural population:**

A cross sectional survey study was conducted by Jain S K et al, (2006). The WHO 30 cluster technique was carried out as a field exercise by participants of 9th Field Epidemiology Training Programme (FETP) course by National Institute of Communicable Diseases (NICD) in rural areas of Alwar district of Rajasthan. Less than one third (28.9\%) of children, aged 12-23 months, were fully immunized with BCG, 3 DPT, 3 OPV and Measles vaccines; around a quarter (26.5\%) had not received even a single vaccine (non-immunized), and little less than half (44.5\%) were found partially immunized. Around half of the eligible children were vaccinated for BCG (55.9\%) and Measles (43.6\%). Though nearly two-third (66.8\%) were covered with first dose of DPT and OPV, but about one third of these children dropped out of third dose of DPT and OPV for various reasons.\textsuperscript{111}

National Family Health Survey (NFHS) data also had revealed that BCG coverage was 64.3\%; measles was 36.2\%; and coverage by DPT 1, 2, 3 and Polio 1,2 and 3 were 64.4\%, 57.0\%, 46.6\% and 77.5\%, 71.1\% and 54.4\% respectively in rural areas. The main reason for drop-out or non-immunization was lack of information about the immunization programme (41.3\%). Though nearly more than 96\% of the children were immunized through Government established centers, but immunization cards/documents were made available only to 27.6\% of the children.\textsuperscript{61}

The research study of Datar A et al (2007) reported that while there was under-provision of rural health infrastructure, their results showed that the availability of health infrastructure had only a modest effect on immunization coverage. Larger and better-equipped facilities had bigger effects on immunization coverage. The presence of community health workers in the village was not associated with increased immunization coverage.\textsuperscript{112}
A study was done by Wagh S, Mehendale A (2013) on Evaluation of primary immunization coverage and reasons for partial or non-immunization in Maharashtra. The Objectives of study were to find out the immunization coverage in 12-23 months children, assess the factor associated with partial / non immunization, to find out various reasons for partial / non immunization. The methodology adopted was cross sectional study which was conducted in Three PHC area of Wardha district Maharashtra by house to house survey. A total 1199 children were included in the study Chi square test was applied for statistical analysis. The result of study was 84.90% children were fully immunized to primary vaccine. The immunization coverage for BCG (96.7%) Vaccine was highest and lower for Measles (84.9%). Most common reason for partial immunization was unaware about the schedule of vaccine (36.5%), out of station (17.7%) & child was ill (14.9%). Parent’s education plays significant role in immunization status of children. IEC activities should be in community to avoid non-immunization in children. ¹¹³

A study was done by Joshi S. (2014) to evaluate primary immunization coverage among children in rural area of Kolhapur, Maharashtra. The descriptive cross-sectional study design is used for this study. The settings for this study were the selected area from rural area of Kolhapur. The objectives of the study were to assess immunization coverage among children in the age group 12-24 months, to find out reasons for non-compliance for primary immunization, to find out the gender inequality with child immunization. The sample size selected for this study is 200 children. Probability cluster sampling technique was used for selecting samples who met the designated set of criteria during the period of data collection. Structure interview technique was used for data collection. The 73.5% children were fully immunized to primary immunization. The immunization coverage for BCG vaccine (92.5%) was highest and lower for Measles (73.5%). Most common reason for partial immunization was unaware about the schedule of vaccine (30.2%) and inconvenient time (22.6%). The coverage also shows gender inequality as coverage is more male compare to female children. ¹¹⁴
A descriptive cross sectional study was done by Mandal S., Basu G (2013) in a rural block among 210 children between 12 - 23 months and their care givers for duration of 9 months with the objectives of assessment of their knowledge and practice on different aspects of immunization. WHO 30 cluster sampling method was used. The results revealed 14.8% were illiterate, 67.1% deliveries were institutional. The male:female children ratio was 3:2. Polio and measles were mostly heard one. One third of the care-givers knew the correct dose of measles vaccination whereas only 4.8% and 7.1% had the right knowledge of three doses for OPV and DPT. Fever (54.3%) and diarrhea (24.8%) cited as main side effects of vaccination. Lack of information, long distance, sick baby on the day of immunization were reported as main reasons of incomplete immunization. The coverage for majority of vaccines was above 90%. Immunization status had significant association with religion, literacy status and place of delivery. Appropriate information, dissemination and aggressive campaigning on immunization are the need of the hour.  

Considering the coverage level of Maharashtra lowering a study was conducted by Gupta P.K., Pore P. (2013) on evaluation of immunization coverage in the rural area of Maharashtra. 30 Cluster sampling technique was used. A cross-sectional study was conducted in the field practice area of the Rural Health Training Center (RHTC) using the WHO’s 30 cluster sampling method for evaluation of immunization coverage. A total of 1913 houses were surveyed. A total of 210 children aged 12-23 months were included in the study. It was found that 86.67% of the children were fully immunized against all the six vaccine-preventable diseases. The proportion of fully immunized children was marginally higher in males (87.61%) than in females (85.57%), and the immunization card was available with 60.95% of the subjects. The most common cause for partial immunization was that the time of immunization was inconvenient (36%). Sustained efforts are required to achieve universal coverage of immunization in the rural area of Pune district.
Assess and develop information booklet on immunization practices among parents and health personnel from selected urban versus rural areas.

**Literature related to the immunization practices of health personnel.**

The success of programmatic interventions has been thought of major importance by giving proper thrust to the human resource at the very grass root level. The health system research stresses on the integrative approach which can be multidisciplinary field, focuses on health services therefore WHO provided basic framework of six building box of health system which stresses upon the health professionals and their dependency on the support staff for success. Health care system research has taken an unprecedented interest in the recent past.

The study was done by Soeung S.C., Grundy J. (2008) on evaluation of immunization knowledge, practices, and service-delivery in the private sector in Cambodia. This study was of private-sector immunization services undertaken to assess scope of practice and quality of care and to identify opportunities for the development of models of collaboration between the public and the private health sector. A questionnaire survey was conducted with health providers at 127 private facilities; clinical practices were directly observed and a policy forum was held for government representatives, private healthcare providers, and international partners. In terms of prevalence of private-sector provision of immunization services, 93% of the private inpatient clinics surveyed provided immunization services.\(^1\)

The private sector demonstrated a lack of quality of care and management in terms of health workers' knowledge of immunization schedules, waste and vaccine management practices, and exchange of health information with the public sector. Policy and operational guidelines are required for private-sector immunization practices that address critical subject areas, such as setting of standards, capacity-building, public-sector monitoring, and exchange of health information between the public and the private sector. Such public/private collaborations will keep pace with the trends towards the development of private-sector provision of health services in developing countries.\(^1\)

The study conducted by Salmon D.A, Moulton L.H (2004) on Knowledge, attitudes, beliefs of school nurses, personnel and associations with nonmedical immunization exemptions. Objectives were studied school personnel involved in the
review of student's immunization status to determine whether personnel training, immunization-related knowledge, attitudes, and beliefs, use of alternative medicine, and sources of vaccine information were associated with the vaccination status of school children. Surveys were mailed to a stratified and random sample of 1000 schools in Colorado, Massachusetts, Missouri, and Washington. School personnel reported their training and perceptions of disease susceptibility and severity, vaccine efficacy and safety, key immunization beliefs, use of alternative medicine, confidence in organizations, sources, and credibility of vaccine information, and the rates of vaccine exemptions in their schools. Logistic regression analysis was used to explore associations between personnel factors and beliefs with the likelihood of a child having an exemption.118

Vaccine misconceptions were relatively common. For example, 19.0% of respondents were concerned that children's immune systems could be weakened by too many immunizations, and this belief was associated with an increased likelihood of a child in the school having an exemption. Most respondents had a moderate amount or great deal of confidence in state health departments (91.4%), the Centers for Disease Control and Prevention (CDC) (93.9%), local health departments (88.8%), health care providers (88.5%), the Food and Drug Administration (73.6%), and the health care system (65.2%). Fewer respondents had a moderate amount or great deal of confidence in the media (17.4%). A child attending a school with a respondent who had a moderate amount or great deal of confidence in local and state health departments was less likely to have an exemption than a child attending a school with a respondent who did not have a moderate amount or great deal of confidence in local and state health departments. Nurses or properly trained health personnel should be the primary school contacts for parents on immunization issues. Health departments and health care providers were used most often by school personnel for vaccine information.118

Health Care service delivery system is the main source or base for the implementation of programme or project. The study done by Gupta P. (2013) with aims to provide a standard model of follow up in BIMARU states if not all over India. The paper
is the outcome of the evaluation of the programme of Muskan Ek Abhiyaan, which was launched on October 2007 with the objective of achieving hundred percent immunizations of infants and pregnant women in the state of Bihar, India. The study used two stage thirty cluster analysis. Overall 1936 support workers were interviewed on various aspects for the availability of material and training. The 30 cluster survey is a two-stage cluster sample. Of these selected clusters the Peripheral health workers which included ASHA (Accredited Social Health Activist), ANM (Auxiliary Nurse Midwife) and AWW (Anganwadi Worker) were drawn randomly. The total sample constituted of 690 Anganwadi workers, 397 ANM and 896 ASHA were interviewed. Scenario of Immunisation has changed drastically over four years in Bihar and it is interesting to conclude that factors behind such thumping success are due to the change in the health system, its governance and marked strategic shift the previous programme intervention in otherwise one of the worst performing states of India.119

The study was done by Praveena D. (2015) to identify Vaccine wastage assessment in a primary care setting in urban India. Wastage is defined as loss by use, decay, erosion or leakage or through wastefulness. The World Health Organization reports over 50% vaccine wastage around the world. Despite the availability of many tools for reducing such wastage, high wastage rates are still occurring in countries. Vaccine wastage can be classified as occurring “in unopened vials” and “in opened vials”. Vaccine wastage is an important factor in forecasting vaccine needs. In the absence of local or national data on wastage rates, if incorrect figures are used, the country concerned may face serious vaccine shortages or be unable to consume received quantities, leading to increased wastage through expiry. It is therefore crucial that all immunization points using vaccines and that the stores handling them monitor their use continuously. Such monitoring can provide programme managers with good guidance on the introduction of corrective actions to reduce wastage whenever necessary. With the introduction of new vaccine management policies such as the application of multidose vial policy (MDVP), the effective use of vaccine vial monitors (VVMs), and improved immunization strategies and practices, vaccine wastage is expected to decrease.120
The study was done by Alister C.(2013) to assess Knowledge, Attitudes and Perceptions Study on Immunisations and Diarrhoea. The overall objective of this study was to determine people’s knowledge, attitudes and practices with regard to diarrhoea and immunisation with the aim of informing the EPI’s program communication strategy and plans, including information on potential threats and misconceptions that might affect uptake of the new vaccine. With regard to immunisation it can be concluded that in general people who participated in this study were knowledgeable about immunization. All of them have heard about this and that the most important sources of information were health workers: health education sessions precede the conduct of immunisation sessions and in some cases health workers do talk about immunisations. Participants also cited community leaders as sources of information on these issues. Very few cited the radio, newspapers and posters as sources of information. What is apparent from this study is that there is no apparent rejection of immunisation for most people most people fail to vaccinate their children as scheduled because of other logistical reasons such as mothers being away, mothers being sick, hilly terrains, mocking of mothers who deliver every years, vaccines not being available, experiencing side effects, non-availability of transport to vaccinators and the cancellation of immunisation sessions among other factors. There are also some people who dropped out because of experiencing adverse events such as children dying. While most health workers are friendly there are others who are not and they shout at mothers which makes mothers not to go back for immunisation. Side effects such as children having fever were linked to health workers having sex with their spouses before going to the under-five clinic for immunization.121

The major challenge that Malawi has to deal with is the small group of people belonging to faith groups who do not go to the hospital for treatment or to receive vaccinations. As per study have changed and have started taking their children for immunisation. The majority has however not changed and their stand is quite strong for example members of the Zion Church Jehovah witnesses do access vaccinations. Mothers and other community members such as village heads and VHC members welcomed the introduction of the vaccine against this disease is quite prevalent in the community. They
Assess and develop information booklet on immunization practices among parents and health personnel from selected urban versus rural areas.

however needed information about this vaccine and that social mobilization campaigns need to be conducted in order to create awareness in communities.  

A study done by Hueston W., Meade R.L., (1992) on to assess immunization utilization practices differ between rural and urban primary care physicians in Kentucky. Survey was done on 200 primary care physicians. The samples were Pediatricians, family physicians, and general practitioners in Kentucky. Participants completed a 20-item questionnaire that surveyed selected demographics with regard to the physician and practice, immunizations offered to children, and reasons why the responding physicians did not offer immunizations and where they referred patients for this service. Physicians practicing in rural counties offered immunizations to their patients less frequently than did urban physicians (54% vs 77%). Rural and urban physicians cited immunization costs to patients as the chief reason that immunizations were not used more often and referred patients primarily to county health departments. The conclusion of study is rising costs have limited physician use of immunizations in rural areas to a greater extent than that seen in urban areas. This may make access to immunizations more difficult for children living in rural areas.

The National Immunization Survey study on Knowledge, Attitudes and Practices (NIS-KAP) will be conducted by the National Immunization Program (NIP) to help

1. Identify public and health care provider perceptions and their influence on the immunization status of young children.
2. Identify parent and provider beliefs regarding the risks and benefits of vaccination, in general, and with respect to DTP/DTaP, hepatitis B, measles, and varicella vaccines, in particular.
3. Assess how parent and provider beliefs regarding the benefits and safety of DTP/DTaP, hepatitis B, measles, and varicella vaccines impact the child’s immunization status. The independent association between parent and provider beliefs and the child’s immunization status will be assessed by controlling for potential confounders and effect modifiers.
4. Assess whether providers’ beliefs regarding the benefits and safety of vaccines are associated with their participation in systems or programs, such as Vaccines for Children (VFC) program and community-wide immunization registries that aim to raise immunization coverage among children.

5. Monitor trends in public and provider attitudes regarding vaccine safety.

6. Assess how other provider characteristics (i.e., use of computerized tracking) independently impact immunization.

The National Immunization Schedule-Knowledge, Attitude, Practices NIS-KAP sample design involves recontacting a subsample of households that participated in the NIS survey. The NIS is a random-digit-dialing sample that is conducted on a quarterly basis. Pertaining to collection of the provider data, there are several important issues. The first emanates from the fact that without the consent of the child’s parent/guardian, health care providers cannot be contacted to ask about their immunization practices. In the NIS, 83 percent of parents’ consent to have their immunization providers contacted. The NIS-KAP study anticipates a comparable success rate since the request really will be for a re-consent from the original NIS sample case. If the NIS-KAP consent rate is substantially lower, the mean square error of NIS-KAP estimates will be affected. The pilot test will indicate likely consent rates in the study and enable procedures to be adopted to improve consent rates if necessary. This attempt to contact both participating households and immunization providers and elicit additional information will indicate the usefulness of this strategy to inform other health areas of interest.\textsuperscript{123}

UNICEF 2009 report says while 95% of infants received at least one antigen, less than 50% children are fully immunized in India. Non-availability of trained ANM/vaccinators and supervisors is another major deficiency. Urban underserved and migratory labourers still largely remained outside the purview of National immunization schedule. At different levels, data management, supervision and monitoring have major hiatus. With introduction of ADS, the immunization waste management has become a major issue for which, till date, no comprehensive policy has been formulated. A study revealed 73.9% of injections given in the immunization programme were unsafe. WHO
estimates that in South East Asia 31% of new HIV, 59% of hepatitis B and 92% of hepatitis C is contribution of unsafe injections. National immunization, if unsafe, may increase the risks of acquiring those diseases manifold for millions of healthy, innocent children.¹²⁴

To sustain high level of immunization coverage there is need for strict monitoring of the existing immunization programme as especially improving cold chain system. So the investigator also did review on studies related to cold chain maintenance.

**Cold Chain Maintenance:**

Cold chain maintenance is a continuous and cohesive process of preserving vaccines to ensure their availability and to maintain potency. Cold chain maintenance is a term defined as the materials, equipment and procedures used to maintain temperatures between +2°C to +8°C while in transit throughout the distribution and storage process for vaccines from the manufacture point up to the beneficiary; whereas cold chain also includes the people that is health workers engaged to maintain the equipment and temperature at peripheral levels. A cold chain break denotes a disruption in “cold chain maintenance”, which could contribute to significant clinical outcomes, such as adverse reactions and/or missed opportunities to vaccinate.¹²⁵

There have been commendable developments in newer technologies that may greatly influence the quality of immunization services. Vaccine Vial Monitor (VVM) is one such simple and effective tool, which can be used by health personnel to detect cold chain failure. Meticulous monitoring of temperature with newer technologies like electronic temperature or data logger would immensely benefit the program. Temperature monitoring tools would be a boon for safeguarding cold chain system at different storage points especially for freeze sensitive vaccines like HepB, DPT, DT and TT in addition to tracking temperature maintenance till the point of delivery. Another novel advancement is the introduction of auto disable (AD) syringes. Introduction of ADS has resolved the problem of sterilization, particularly in resource poor settings and difficult areas, and will ensure injection safety to a great extent.¹²⁶
The cold chain system in India is a vast network of 27,223 vaccine storage points having 199 walk in cooler (WIC), 38,393 ILRs, 28,372 Deep Freezers (DFs), 41,679 cold boxes and more than 1 million vaccine carriers in 2009. Every year, about 10% of electrical and 15-20% of non-electrical equipment require replacement. There is a vacancy of 509 cold chain handlers and 366 cold chain mechanics. Maintenance of equipment and expansion of cold chain points is another issue that involves large cost and organizational effort.\(^{126}\)

The study was conducted by Goel N.K, Swami H.M. (2004) on evaluation of cold chain system in Chandigarh during intensified pulse polio immunization campaign 2001-2002. The study design was cross sectional study conducted in seven centres, where OPV vials were stored prior to IPPI and 20 IPPI posts and 05 house to house teams. The result of study has shown that the cold chain sickness rate was found to be 9.7%. There were reports of breakdown of cold chain maintenance due to defective plugs and sockets, faults in thermostat, leakage of gas. All vaccine samples randomly selected were reported potent, as per the test reports provided by Central Research institute, Kasauli during the period of study. Temperature charting and cold chain maintenance was found satisfactory, but necessity of improvement, especially regarding the handling of vaccines by female health worker. Lids of vaccine carries not closed tightly, frequent opening of lids during immunization, direct exposure of vaccine to atmospheric temperature, keeping the vaccine vial in hand or pocket.\(^{127}\)

A baseline survey of total cold chain status was conducted in early 2008 by Mallik S., Mandal P. K (2011) in the hospitals and institutions in Kolkata Municipal area, a metro city of India. The survey revealed gross discrepancies in availability and distribution of cold chain equipment, innumerable cold chain points with improper utilization, lack of scientific knowledge regarding recent changes in cold chain guidelines as per Govt of India (GOI) protocol and lack of monitoring and supervision. Based on the findings of the survey, one intervention was undertaken to centralize and reorganize the equipment to only 40 cold chain points, to facilitate expert monitoring and supervision. Simultaneously an in depth training on immunization and cold chain was conducted.
Assess and develop information booklet on immunization practices among parents and health personnel from selected urban versus rural areas.

involving all the personnel directly accountable for immunization activity in these cold chain points. This study has been conducted with the objective to assess changes which occurred in the cold chain status following intervention. Another objective was to assess the awareness and skills of cold chain handlers about basics of cold chain maintenance. Stratified systematic random sampling method was used.128

The result of this study showed that it was evident that availability and adequacy of cold chain apparatus did not differ so much between baseline and after intervention, except the adequacy of vaccine carrier which improved significantly after the intervention (p= 0.02). While evaluating the exterior condition of cold chain apparatus, their placement, cold chain room as shown significant changes were observed in placement of cold chain apparatus 10 cm away from the wall and maintenance of stock security. Regarding interior condition of deep freeze and ILR as indicated significant changes were observed after intervention in the parameters ice pack correctly placed in deep freezer, vaccines not placed in deep freezer, vaccines placed orderly in ILR, diluents kept in ILR, vaccines kept at card board box and vaccines not mixed (p= 0.0000). The parameters encompassing the temperature maintenance in cold chain equipment were studied which included display of temperature chart outside the equipment, twice recording of temperature once in the morning and once in the afternoon and showing temperature within optimal range. All the parameters improved after intervention. Interview of cold chain handlers revealed poor knowledge of heat sensitive vaccines; lack of preventive maintenance, correct contingency plan and temperature monitoring on holidays. The findings could not be compared as no specific worker was designated as cold chain handler during baseline survey.128

The study conducted by Sundar M.(1994) on an evaluation of cold chain system for vaccines in Bangalore. The cold chain plays a major role in the universal immunization programme which helps in preventing against six major killer diseases in children. They collected 144 study samples randomly from different parts of Bangalore to know the training status of personnel, refrigeration facilities, storage, monitoring and potency of vaccines. It was observed that 6.6% of general practitioners were trained.
under Universal Immunization Programme, monitoring was not satisfactory, and two of the OPV samples from medical practitioners had an unsatisfactory titer dose. Comprehensive orientation/training on cold chain is essential for medical practitioners and other professionals.\textsuperscript{129}

The study was undertaken by Aggarwal K, Kannan AT, et al (2002) with the objective of observing operational aspects of 609 pulse polio booths established during Intensified Pulse Polio Campaign in East Delhi on National Immunisation Days (NID) during 2001-2002 through well designed format. The average number of persons present on duty at polio booths was 3.73 against a recommendation of 4 per booth. All the booths had vaccine carriers but some of them were not following the guidelines laid for maintaining the cold chain. One sixth 15.4\% of the booths needed fresh supplies of vaccine carrier. There is need for deployment of motivated trained manpower at polio booths to ensure the success of Pulse Polio Campaign. Maintenance of cold chain and quality assurance of vaccine administered to children in the field remain a challenge. More than half (55.7\%) booths did not have any volunteer. Absence of volunteers from the community is more than half of the booths warrant for strengthening the linkages between the governmental agencies and the community.\textsuperscript{130}

The study conducted by Thakker Y. (1992) to assess quality of storage of vaccines in the community. The survey design was adopted for general practices and child health clinics, and monitoring of storage temperatures of selected refrigerators. The setting of the study was Central Manchester and Bradford health districts. Samples were 45 general practices and five child health clinics, of which 40 (80\%) responded. Eight practices were selected for refrigeration monitoring. The main outcome measures were adherence to vaccine storage, temperature range to which vaccines were exposed over two weeks. Of the 40 respondents, only 16 were aware of the appropriate storage conditions for the vaccines; eight had minimum and maximum thermometers but only one of these was monitored daily. In six of the eight practices selected for monitoring of refrigeration temperatures the vaccines were exposed to either subzero temperatures three fridges or temperatures up to 16 degrees C (three). Two of these were specialised drug
storage refrigerators with an incorporated thermostat and external temperature gauges. The conclusion of study was vaccines were exposed to temperatures that may reduce their potency. Safe storage of vaccines in the clinics cannot be ensured without adhering to the recommended guidelines. Provisions of adequate equipment and training for staff in maintaining the “cold chain” and the use and care of equipment are important components of a successful immunisation programme.\textsuperscript{131}

The study conducted Lewis P.R., Reimer R.F. (2000) with aim to describe the implementation of guidelines for vaccine storage in general practice, and their effectiveness in achieving optimum vaccine storage temperatures in fridges. The study design was repeated cross-sectional surveys over time phase-1 1996/97, phase-2 1998/99, phase-3 1999/2000. Each practice was surveyed about how they stored vaccines. A data logger recorded fridge temperatures over six days. Individual feedback and advice were given. Main outcome measures were proportion of fridges maintaining a temperature in the 2-8 degrees C range; fridges freezing; practices with one person responsible for vaccine storage; bridge temperature checked daily; fridges storing no items other than vaccines; bridges with thermometers; and associations between storage practices and fridge temperatures. The result of study showed that, in phase 1, 102 fridges, and in phase 3, a random sample of 36 practices was surveyed.\textsuperscript{132}

The findings for phase 1 and phase 3 respectively were: 31% and 50% of fridges were in the 2-8 degrees C range; 36% and 25% were <0 degrees C; one person was responsible in 52% and 53% of cases; 20% and 38% reported daily checks; 74% and 94% of fridges had no extraneous items and 53% and 86% of fridges had thermometers. No statistically significant associations were found between vaccine storage practices and bridge temperatures. It was concluded that despite improvements in vaccine storage practices, a quarter of fridges were freezing, thereby compromising the potency of many of the immunisation schedule vaccines.\textsuperscript{132}

The study was done by Berhane Y, Demissie M. (2000) to assess the status of the cold chain at peripheral vaccine stores in Ethiopia. Study design was Institution based cross-sectional survey in two rural and one urban administrative area was included in the
study. Sixty seven health institutions providing static vaccination services were included in the study but cold chain system was assessed fully in only sixty four. Data were collected by interviewing health workers and by directly observing the cold chain equipment and records using structured forms. The result shows that conditions of the cold chain system were described based on 64 of the 67 centres visited, three were excluded because of non-functioning cold chain. Complete temperature record was observed in 37 (57.8%) of the centres. Thermometer was not available in four (6.3%) and thermometer reading was found to be outside the optimal range in another seven (10.9%) centres. Vaccine storage in the refrigerator was not proper in 47 (73.4%) centres. Majority of the centres had neither trained personnel nor budget for maintenance of the cold chain.133

A cross-sectional study has been done by Ortega M.P. et al (2008) made at 46 primary care vaccination points. The data was gathered by means of a personal interview by one single researcher. The participation rate was 93.5% (43/46). In all cases, there was a maximum and minimum thermometer and monthly temperature record. An unsuitable temperature was found in three cases (6.97%). The percentage of professionals who were aware of the effect freezing has on vaccines varied greatly: 53.5%, 51.2%, 44.2% and 53.5% for diphtheria-tetanus-pertussis (DTP), hepatitis B (HBV), oral polio (OPV) and measles-mumps-rubella (MMR) respectively. And only 32% were familiar with the shake test. It was concluded that the professionals were found to be properly trained regarding the effect which high temperatures have on vaccines, but it is necessary for their training with regard to the instability of adsorbed preparations when frozen must be further strengthened.134

The study was conducted by Aggarwal A, Singh AJ (1995) on evaluation of cold chain system in rural areas of Haryana. Evaluation of cold chain system was done in a time bound study during August and September months of 1992 in two districts of Haryana as there were frequent breakdowns of ice-lined refrigerators during the previous year. The study revealed that defective stabilizers and electricity plugs and sockets were the reason of breakdown in many cases. Temperature maintenance and functioning of
deep freezers was satisfactory. Retrospective analysis showed that the polio vaccine samples picked up during 1990-92 were found to be satisfactory by CRI, Kasauli. Use of two ice-pick carrier and thermos flasks was associated with poor temperature maintenance. Seven vaccine carriers out of 25 examined had cracked wall lining. Lids of carriers were also not kept tight during vaccination sessions. Response lag of the health workers and medical officers in case of breakdowns was delayed. A one day refresher course exclusively on cold chain maintenance at community health center level is recommended.

The study was conducted by Samant Y. et al (2007) to evaluate the relationship between the adequacy of cold chain infrastructure and the proper use of Vaccine Vial Monitor in a rural district of India. Forty-six health centers in a rural district were included in our evaluation of the cold chain equipment and the Vaccine Vial Monitors. Cold chain equipment and vaccine vials within each health center were evaluated for adherence to WHO cold chain maintenance protocols and the Vaccine Vial Monitor stage, respectively. Among the 46 health centers, Vaccine Vial Monitor stage I was found at 58% of the health centers, 33% of the health centers reported stage II and 9% reported a stage III, indicating weaknesses in the cold chain mechanism. Cold chain for the OPV was not adequately maintained at primary and sub-health centers in this rural district. Well maintained ice packs and vaccine carriers will help ensure delivery and availability of a safe and potent vaccine to children in rural areas of India.

There are many practical problems impeding vaccine delivery. Delivering vaccines to patients requires functioning freezers and refrigerators which in turn require a constant supply of energy, good roads and reliable transport to move the vaccines from port to clinic, clinics with access to people who need to be immunized, parents who know the value of vaccination, trained medical staff to deliver the dose and sterile syringes. The emphasis is to be given to the maintenance of cold chain system during the orientation, training of all health personnel involved in immunization.
Literature related to the comparison immunization practices in urban & rural population.

The Regional Variation in child immunization in Maharashtra, India was studied by Wankhede D (2011). The objectives were to analyze the differentials & determinants in coverage of child immunization levels by geographical region, to assess the change of child immunization levels by vaccine and dropouts in BCG, to Measles by geographical region, to find out the socio-economic and gender inequality in child immunization by geographical region of Maharashtra. The differential and changes in immunization coverage has been analyzed through analysis using cross tabulation. The percentage coverage of vaccines was calculated to know the changes and dropouts between different doses of BCG to Measles. The results also demonstrate that the coverage of measles vaccine is lower than BCG.137

The situation is more prominent in Northern Maharashtra, the lower coverage of all vaccines therefore dropouts is higher by all demographic and socioeconomic characteristics in Northern Maharashtra, followed by Vidharbha and Marathwada. Western Maharashtra and Konkan region have higher coverage of both vaccines therefore dropouts are too lower, Gender and regional inequality in child immunization in Maharashtra by region has showing, Northern Maharashtra and Vidharbha region has higher inequality against girls in both rural and urban area, Hindu, Muslin Scheduled caste, scheduled tribe, higher age Mother, Higher Birth order, illiterate parents, poorest and poor wealth quintile, Whereas in Western Maharashtra region have favorable condition to girls to immunized than boys by all background condition followed by Konkan region.137

Literature concerning vaccination rates in India indicates a considerable disparity between children in urban compared with rural areas. In addition 75% of the health infrastructure, medical personnel, other health resources are concentrated in urban areas of India, whereas only 27% of the population lives in the urban parts of the country. The weak health infrastructure & unsanitary conditions contribute to the increased incidence of diseases like polio, cholera, hepatitis in rural compared with the urban areas.40
An urgent need at present is to strengthen routine immunization coverage in the country with EPI vaccines. India is self-sufficient in production of vaccines used in UIP. As such the availability of the vaccine is not an issue. For improving coverage, immunization needs to be brought closer to the communities. There is need to improve immunization practices at fixed sites along with better monitoring and supervision. Effective behavior change and communication would increase the demand for vaccination. There is certainly a need for introducing innovative methods and practices. In Bihar, ‘Muskan ek Abhiyan’ an innovative initiative started in 2007 is a good example, where a partnership of Government organization, agencies and highly motivated social workers has paid rich dividends. Full vaccination coverage, a mere 11%, in 1992 increased to only 33% in 2005-06 but zoomed to 55% in 2008. 120,138.

India has one of the largest UPI in the world in terms of number of beneficiaries that is 27 million infants and 30 million pregnant women, quantities of vaccines used, geographical spread and manpower involved. Though there have been major achievements, there remain several gaps in the programme, both in terms of coverage as well as quality of services. The Multi Year Strategic Plan (2005-2010) suggested priority actions in the following areas such as ensuring regularity of sessions, adequate staffing, monitoring, safe injection, improved cold chain and vaccine logistics management and social awareness.126

2.1(vi) Literature related to informational booklet on immunization.

A study conducted by Joshi S.(2014) to assess the effect of booklet on selected immunization among mothers in selected urban areas of Pune. The research method adopted for the study was pre- experimental research design with an evaluative approach. Purposive sampling method was used to select 100 mothers of under-five children. A structured questionnaire was prepared for assessing the knowledge of the mothers. Mothers had better knowledge about general immunization schedule. Most of the mothers (26%) responded because of time limitation their children were not immunized and (4%) mothers had respond sickness was the reason for non-immunization of child. maximum
mothers (56.75%) were having knowledge regarding general immunization in pre-test and 80.25% in post-test knowledge score. Only 31% mothers were having knowledge regarding typhoid vaccination. Significantly there is increase in knowledge in post-test is observed. Mean knowledge scores about selected immunization obtained by mothers in pre-test was 9.45 and in post-test 14.48. This difference was statistically highly significant at 0.01 levels with z value of -11.43. Analysis shows there is high inclination of post test score than in pre-test knowledge score related to general immunization schedule, Hepatitis B, Chicken-pox, MMR, Typhoid and Hib vaccination. After administration of planned teaching it was found that the post-test mean percentage knowledge score in all the content area were higher than the pre-test mean percentage knowledge scores.  

A comparative study done by Joshi S. (2013) to assess information booklet on immunization practices among health personnel from selected urban versus rural areas of Pune district. The cross-sectional descriptive study design is used for this study. The settings for this study were the selected area in urban & rural area from Pune city. Structure interview technique and observation checklist is used for data collection. In urban area majority 70% had information regarding immunization, 60% did not know the need of immunization, 70% did not have record of immunization. Whereas in rural area majority 52.5% had no information regarding immunization, 32.5% know the need of immunization, 72.5% did not had record of immunization. Majority health personnel from urban had better information than rural area. The practices of parent in urban area are better than rural area as p value is less than 0.05.  

A study was conducted by Christina V. (2006) on assess the effectiveness of information booklet on vaccine preventable diseases among the mothers of under five children in Karnataka. Pre-experimental research design was used. Sample size was 60. The study findings shows that the knowledge of mother is significantly increased (p-value < 0.05) after administration of booklet.  

Study was done by D'Souza V, Umarani J. (2014) on teaching package improves mothers knowledge on vaccine preventable diseases and vaccination. An evalulative
assess and develop information booklet on immunization practices among parents and health personnel from selected urban versus rural areas.

Approach with quasi experimental - Two group pre-test and post-test design was adopted. The sample comprised of 100 mothers in selected hospitals of Mangalore who were selected by purposive sampling technique and assigned to control and experimental group. On first day pre-test was conducted with a structured knowledge questionnaire to both control and experimental group and teaching package was given only to the experimental group followed by post-test and information booklet to both the groups on 7th day. The mean and standard deviation of post-test knowledge score of mothers in experimental group (27.80 ± 3.010) was much greater than pre-test value (10.44 ± 2.323). There is no change in pre and post-test knowledge score in control group (9.74 ± 1.805). The calculated’ value t98=34.54 was greater than the table value 1.68 at 0.05 level of significance. This indicates that the teaching package was effective in improving the level of mothers knowledge. The study findings concluded that the mothers were benefited by teaching package on vaccination and vaccine preventable diseases.

The above review shows that our population is not adequately covered under immunization. Immunization is often cited as being one of the greatest public health achievements of 20th century, but effective immunization requires population coverage levels of 90 to 95% depending upon the vaccine-preventable disease. State routine immunization monitoring system needs to be geared up for effective 100 per cent immunization coverage. There are very few studies done on rural population. Therefore there is need find immunization practices among parents & health personnel in urban as well as in rural population and the reasons for non-compliance.

2.2 Summary

The chapter on review of literature is divided in five subdivisions. These literatures are related to immunization, related to the immunization practices in urban parents, related to the immunization practices in rural parents, related to the immunization practices of health personnel and related to the comparison immunization practices in urban and rural population.