WEEKLY FOCUS
#39 WEEK 1 MAY 2021

VISIONIAS
INSPIRING INNOVATION

# Universal IMMUNISATION TOWARDS A HEALTHIER AND A SAFER WORLD

## INTRODUCTION

The COVID-19 pandemic has reminded the world of the power of vaccines to fight diseases and save lives. Presently, across the world vaccines have been helpful in prevention of more than 20 life-threatening diseases, enabling people of all ages live longer, healthier lives. However, important challenges still remain ranging from insufficient access to vaccines to hesitancy and complacency in taking vaccines that can undermine past achievements.

Moving forward, strong immunization systems will be needed to ensure that people everywhere are protected against COVID-19 and other diseases. In this direction, global agencies like the World Health Organization (WHO), UNICEF, GAVI and others have recently launched the **Immunisation Agenda 2030 (IA2030)** that positions immunization as a key contributor to people's fundamental right to enjoy the highest attainable physical and mental health and also as an investment in the future.

Under this scenario, it becomes crucial for us to understand what is the overall process of immunisation, what are the benefits associated with universal immunisation, how is India progressing on this front, what are the emerging challenges in achieving universal immunisation and what steps can be taken ahead in this direction for creating a healthier, safer, more prosperous world for all.

## IA2030: TARGETS TO BE ACHIEVED BY 2030

1. Avoid 50 million vaccine-preventable infections.
2. Achieve 90% coverage for essential vaccines given in childhood and adolescence.
3. Reduce the number of zero-dose children by 50%.
   - (Zero-dose children are those who have received no vaccines through immunisation programmes.)
4. Complete 500 national or subnational introductions of new or under-utilized vaccines.
   This include vaccines for COVID-19, rotavirus, or human papillomavirus (HPV).



# WHAT IS IMMUNISATION AND HOW DOES IT WORK?

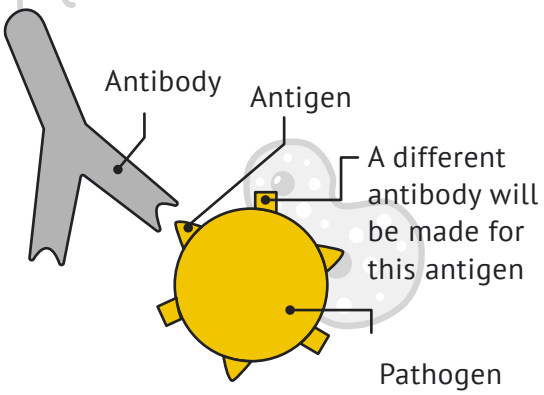
**Immunization is the process whereby a person is made immune or resistant to an infectious disease,** typically by the administration of a vaccine. Immunizations are **also called as vaccinations, needles, shots or jabs.**

- The great advantage of immunisation over natural infections is that immunisation has a much **lower risk of adverse outcomes.**
- Most vaccines are given by needle (injection) but some are given by mouth (orally) or sprayed into the nose (nasally).

**Vaccines work by stimulating the body's defence mechanisms** (collectively referred to as the **immune system;** *See flowchart)* against infection.

**Working of a vaccine:**

- **Identifying the antigen:** Each pathogen has unique distinguishing components, known as antigens, which enable the immune system to differentiate between 'self' (the body) and 'non-self' (the foreign material). This helps identify the antigen that is to be destroyed.
- **Development of unique antibodies for antigens:** The first time the immune system sees a new antigen, it needs to prepare to destroy it. During this time, the pathogen can multiply and cause disease.
- **Remembering the antigen and associated antibody:** If the same antigen is seen again, the immune system is poised to confine and destroy the organism rapidly. This is known as adaptive immunity. (*See flowchart* for different types of immunity.) When **adaptive immunity** in a region crosses a certain percentage of the population, the transmission in the population drastically slows down, thus creating what is known as **Herd Immunity.**



**Vaccines utilise this adaptive immunity and memory to expose the body to the antigen** without causing disease, so that when then live pathogen infects the body, the response is rapid and the pathogen is prevented from causing disease.

## HUMAN IMMUNE SYSTEM

**Internal**

**White Blood Cells** also known as **Leukocytes** Stored in different places in the body, which are referred to as lymphoid organs i.e. Thymus, Spleen, Bone Marrow and Lymph nodes.

**External**

First line of defense against pathogens — such as the skin, nasal hair and mucous membranes of the throat and gut.

**Phagocytes**

Surround and absorb pathogens and break them down, effectively eating them. These include Neutrophils, Monocytes, Macrophages and Mast cells.

**Lymphocytes**

Help the body to remember previous invaders and recognize them if they come back to attack again.

**B lymphocytes**

Produce antibodies and help alert the T lymphocytes.

Antibodies are part of a large family of chemicals called immunoglobulins, which play many roles in the immune response.These are Immunoglobulin G (IgG), IgM, IgA, IgE and IgD.

**T lymphocytes**

Destroy compromised cells in the body and help alert other leukocytes.

**Helper T cells (Th cells)**

Coordinate the immune response. Some communicate with other cells, and some stimulate B cells to produce more antibodies. Others attract more T cells or cell-eating phagocytes.

**Killer T cells (cytotoxic T lymphocytes)**

Attack other cells. They are particularly useful for fighting viruses. Work by recognizing small parts of the virus on the outside of infected cells and destroying the infected cells.

## TYPES OF IMMUNITY

**Innate immunity**

Includes the **external barriers of our body —** the first line of defense against pathogens — such as the skin and mucous membranes of the throat and gut.

This response is more general and non-specific.

If the pathogen manages to dodge the innate immune system, adaptive or acquired immunity kicks in.

**Adaptive (acquired) immunity**

Develops with exposure to diseases or through vaccinations resulting in a library of antibodies to different pathogens.

This is sometimes referred to as **immunological memory** because our immune system remembers previous enemies.

**Passive immunity**

Borrowed from another source, but it does not last indefinitely.

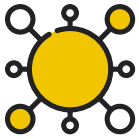
For instance, a baby receives antibodies from the mother through the placenta and breast milk.

This protects the baby from some infections during the early years of their life.

# DIFFERENT KINDS OF VACCINES

**RNA**
Ribonucleic acid (RNA) vacines work by introducing an mRNA sequence (the molecule which tells cells what to build) to the system which is coded for a specific antigen.

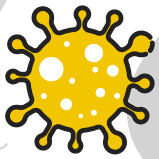
**DNA**
Short for deoxyribonucleic acid, DNA is another of the crucial macromolecules for life. A DNA vaccine involves the direct introduction into appropriate tissues of a plasmid-a doubled-stranded molecule which exist in bacterial cells.



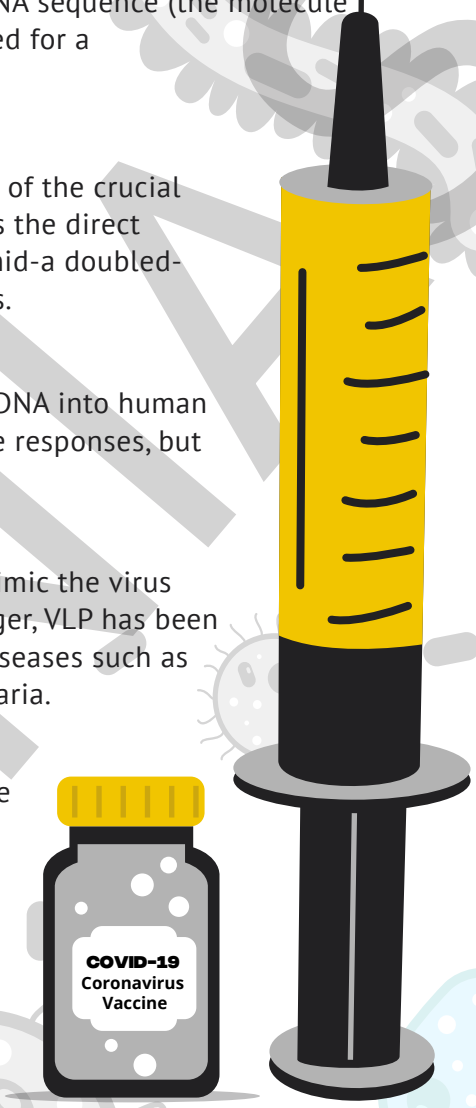
**Non Replicating Viral vector**
Vaccines use live but genetically modified viruses to carry DNA into human cells. Here the virus can trigger the desired human immune responses, but canot replicate in human cells.

**Virus-like particle**
This type of vaccine contains molecules that mimic the virus but are not infectious and, therefore, not a danger, VLP has been an effective way of creating vaccines against diseases such as human papillomavirus (HPV), hepatitis and malaria.

**Protein sub-unit**
This kind of vaccine uses a part of the virus, in this case the protein component. These vaccines can also be used on almost anyone, including people with weakened immune systems and long-term health problems.



**Inactivated virus**
These vaccines use the dead version of the virus that causes a disease.




## VARIOUS TYPES OF COVID-19 VACCINES AND TECHNOLOGIES USED

| Vaccine Name | Technology |
|---|---|
| Covaxin (India) | Inactivated Virus |
| Covishield (India) | Non Replicating Viral Vector |
| Oxford Uni-AstraZeneca (UK) | Non Replicating Viral Vector |
| Moderna (US) | RNA |
| Pfizer-BioNTech (US & Germany) | RNA |
| SputnikV (Russia) | Non Replicating Viral Vector |
| Sinovac (China) | Inactivated Virus |
| Novavax (US) | Protein sub unit |
| Jannsen (US & Belgium) | Non Replicating Viral Vector |

# WHAT ARE THE BENEFITS ASSOCIATED WITH UNIVERSAL IMMUNISATION?

With trends of globalisation and increased interactions of people across the world, spread of any infectious disease can be controlled only when people across the world are protected against that particular disease. For this, universal immunisation has to be the global aim.

Benefits of immunisation can be well understood further by its interlinkages with major Sustainable Development Goals (SDGs):

## CONTRIBUTIONS AND RELEVANCE OF IMMUNIZATION TO 14 OF THE 17 SDGS

**1 NO POVERTY**

Immunisation play a key role in **eliminating poverty,** by reducing treatment costs and inceasing longer, term productivity by averting losses due to disability and death.

**2 ZERO HUNGER**

Immunisation and **nutrition** go hand in hand. Malnourished individuals, especially children, are more likely to die from infectious diseases such as diarrhoea, measles and pneumonia.

**3 GOOD HEALTH AND WELL-BEING**

Vaccination is one of the most cost- effective ways of saving lives and promoting good **health ad well-being.**

**4 QUALITY EDUCATION**

Immunisation increases **educational attainment** as it improves long-term cognitive development. Children who are immunized tend to attain more years of schooling and score higher in cognitive tests than those who are unvaccinated.

**5 GENDER EQUALITY**

Removal of gender-related barriers to vaccination contributes to **gender equality,** as it supports women's full participation and equal opportunities for accessing health services.

**6 CLEAN WATER AND SANITATION**

When vaccination is complementary to **clean water, sanitation and hygiene,** it prevents diarrhoeal diseases, which are the leading cause of child mortality in low-income countries.

**7 AFFORDABLE AND CLEAN ENERGY**

Immunization logistics increasingly involve use of cleaner, more sustainable techniques based on solar and other **renewable sources of energy.**

**8 DECENT WORK AND ECONOMIC GROWTH**

Immunization promotes a **healthy and productive workforce,** which contributes to the economy.

**9 INDUSTRY, INNOVATION AND INFRASTRUCTURE**

Vaccine manufacture contributes to national industrial **infrastructure** in low and middle-income countries

**10 REDUCED INEQUALITIES**

Immunization prevents diseases that affect **the most marginalized groups,** especially those in poor urban or remote rural settings and in areas of conflict.

**11 SUSTAINABLE CITIES AND COMMUNITIES**

Immunization protect urban public health and interrupts disease transmission, ensuring **sustainable cities and communities.**

**13 CLIMATE ACTION**

Immunization is critical to building people's resilience to and mitigating the risk of disease outbreaks linked to **climate change,** such as yellow fever, malaria, meningitis & cholera.

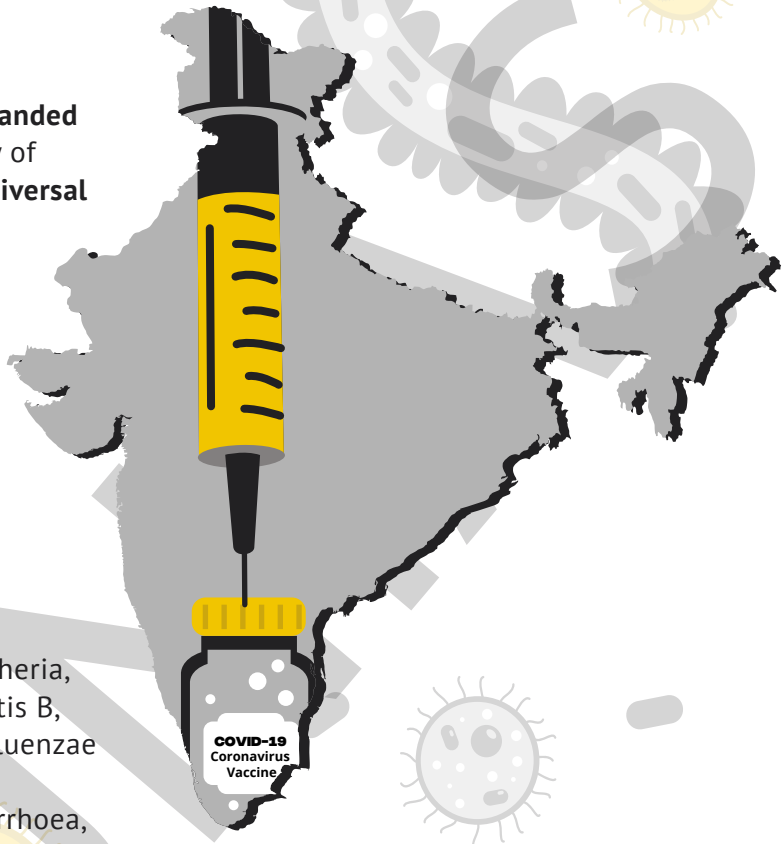
**16**

**Effective, safe, people-centred health system** are the backbone of social institutions, and vaccination is often the regular point of contact of the population with the system.

**17 PARTNERSHIPS FOR THE GOALS**

Immunization programmes broaden **partnerships** and multisectoral approaches, ensuring that civil society, communities and the private sector work together towards common goals.

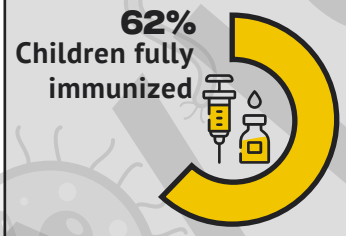
# HOW IS INDIA PROGRESSING ON ITS IMMUNISATION PROGRAMMES?




Immunization program in India was introduced as **Expanded Program of Immunization** (EPI) in 1978 by the Ministry of Health and Family Welfare, which later became the **Universal Immunization Program (UIP)** by 1985.

- Universal Immunization Programme (UIP) is **one of the largest public health programmes** targeting close of 2.67 crore new-borns and 2.9 crore pregnant women annually.
- UIP is a **part of** Child Survival and Safe Motherhood Programme , National Reproductive and Child Health Programme and is one of the key areas under National Rural Health Mission (NRHM).
- Under UIP, immunization is provided free of cost against **12 vaccine preventable diseases:**
  - **nationally against 9 diseases:** Tuberculosis, Diphtheria, Pertussis, Tetanus, Polio, Measles, Rubella, Hepatitis B, Meningitis & Pneumonia due to Haemophilus Influenzae type b (Hib);
  - **sub-nationally against 3 diseases –** Rotavirus diarrhoea, Pneumococcal Pneumonia and Japanese Encephalitis (JE). Japanese Encephalitis vaccine is provided only in endemic districts.
  - **Few new vaccines have also been introduced** under the programme which include rotavirus vaccine, inactivated polio vaccine (IPV), adult JE vaccine, pneumococcal conjugate vaccine (PCV) and measles-rubella (MR) vaccine.
  - A child is said to be **fully immunized if child receives all due vaccines** as per national immunization schedule **within first year of age.**

## CHILD IMMUNISATION COVERAGE IN INDIA

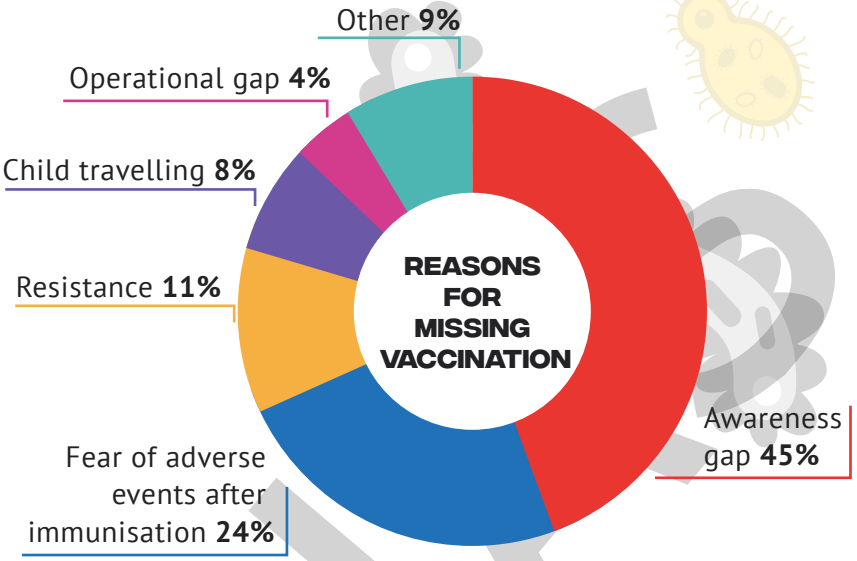



- **91.9%** BCG
- **72.8%** 3 doses of polio vaccine
- **81.1%** Measles vaccine
- **62.8%** 3 doses of Hepatitis B vaccine
- **78.4%** 3 doses of DPT vaccine

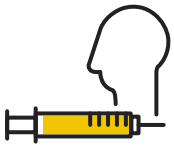
BCG- Bacille Calimette Guerin to protect against Tuberculosis | DPT - Diphtheria, Pertussis, Tetanus
Source: National Family Health Survey 4

- **Under UIP, targeted special drives named Mission Indradhanush (MI),** Intensified MI (IMI 1.0) and IMI 2.0 were launched in the year 2014, 2017 and 2019 respectively. These aimed to ensure reaching the unreached population with all available vaccines and accelerate the coverage of immunisation.
- **Recently, IMI 3.0 was launched** in 2021 to cover all the children and pregnant women who have missed their vaccine doses during the COVID-19 pandemic in order to achieve universal immunisation.
  - Since its first phase, Mission Indradhanush has have **covered 690 districts and vaccinated 37.64 million children and 9.46 million pregnant women.**

- India has been using **Electronic Vaccine Intelligence Network (eVIN) to strengthen immunisation supply chain across the country.**
  - CoWIN platform and app launched recently are an extension of the eVIN to keep a track of the Covid-19 vaccination programme in real-time.
- As per National Family Health Survey 4 data,
  - **Punjab had the highest vaccination coverage** (89.1%) followed by Goa, West Bengal, Sikkim and Kerala.
  - **Nagaland had the poorest vaccination coverage** (35.7%) followed by Arunachal Pradesh, Assam, Mizoram and Gujarat.
  - There is a **huge gap of vaccine coverage between the urban and rural areas in India.** This gap is found to be maximum instates like Kerala, Chhattisgarh and Haryana.




## KEY TERMINOLOGIES WITH REGARD TO VACCINATION



**Vaccine efficacy:** It is the percentage reduction in disease incidence in a vaccinated group compared to an unvaccinated group under optimal/ controlled conditions.

**Vaccine effectiveness:** It is a measure of the real-world application of a laboratory experiment. It is critical in making decisions about the long-term use of vaccines. Vaccine effectiveness can be affected by various reasons like maintaining cold chain, accessibility of health care, affordability of vaccine etc.

**Vaccine potency:** It is the ability of the vaccine to adequately protect the vaccinated persons. Vaccine potency can diminish when the vaccine is exposed to inappropriate temperatures and once lost, vaccine potency cannot be regained.

**Adult Vaccines:** Immunization is not just for children. Protection from some childhood vaccines can wear off over time. Adults are also at risk for vaccine-preventable disease due to age, job, lifestyle, travel, or health conditions. This include vaccination for diseases like Chickenpox, Shingles, Rubella, Tetanus, HPV, Hepatitis A&B etc.

**Vaccines for Non-Communicable Diseases (NCDs):** Like traditional vaccines, NCD vaccines work by modulating the human immune system, but target cells, proteins or other molecules that are associated with the NCD in question rather than pathogens or pathogen-infected cells. Efforts are underway to develop NCD vaccines to address cancer, hypertension, obesity, asthma, arthritis, among others.

# WHAT ARE THE EMERGING CHALLENGES IN ACHIEVING UNIVERSAL IMMUNISATION?

Global immunisation coverage has reached 85% but has plateaued over the last decade, leaving almost **20 million children unprotected.** Major reasons for the same include:

- **Misinformation:** In the age of digital media, spread of misinformation about the safety and effectiveness of vaccines occurs faster than ever. For instance, a wide variety of disinformation presently surrounds COVID-19 vaccines from discrediting the threat of COVID-19 to conspiracy theories that vaccines could alter human DNA. This results in fear among **people leading to vaccine hesitancy.**
  - World Health Organization has termed this as **"infodemic",** an overabundance of information — some accurate, some not — that spreads alongside a disease outbreak. For instance, concerns regarding **Antibody-dependent enhancement (ADE)** (ADE is a phenomenon in which virus-reactive antibodies increase the efficiency of virus infection).
    - But the concerns regarding ADE from COVID vaccines are **unfounded on two counts,** one, the genetic mechanisms of the **vaccines developed is such that it does not encourage ADE** and two, no ADE has been documented from cases of reinfection or breakthrough infections thus suggesting that **these claims have no scientific backing.**
  - Also, **adverse reaction to vaccines,** though extremely limited in both extent and number are **blown out of proportion.** This further encourages vaccine hesitancy.
- **Disruption caused due to COVID vaccinations:** Routine immunisation delivery declined during the COVID-19 pandemic because both these programmes are being implemented in parallel, using much of the same human resources and physical infrastructure.
- **Climate change and natural disasters:** Climate change is disrupting seasonal disease patterns, shifting the timing, duration and pattern of their transmission thus altering the endemicity of infectious diseases. For instance, new populations will be exposed to vector-borne diseases such as malaria and dengue, and more flooding will increase the spread of waterborne diseases such as cholera. This **creates hurdles in implementing existing immunisation strategies.**

- **Conflict and political instability:** Civil conflict can rapidly lead to loss of health service infrastructure and shortages of trained health workers, often for extended periods, thereby disrupting delivery of immunization services.
- **Optimizing and maintaining supplies:** Every year, many countries experience disruptions in their supplies of vaccines, often because of a mismatch between global production levels and needs.
- **Price of vaccines** is a key barrier to access and can delay the introduction of new vaccines into low- and middle-income countries. There are also regulatory, financing and procurement barriers to sustainable vaccine supplies.

- **Low rate of Maternal Vaccination:** Vaccination of pregnant women can protect mother against vaccine-preventable infections such as Tetanus, and also directly protect the fetus and infant via transfer of antibodies from the mother to the fetus.
  - However, barriers such as perceptions about disease severity, lack of knowledge and vaccine hesitancy, lack of infrastructure, and societal factors including social norms, family influence, and religion are responsible for low uptake of vaccines among pregnant women.
- **Challenges in achieving vaccination-induced herd immunity :** Due to the changing characteristics of the pathogen and its interactions with the immune system (for instance multiple variants of a viral species) and also the inability of certain population groups to generate protective immunity in response to vaccination.
  - For instance, vaccination responses tend to be weaker in the adults due to the phenomenon known as **immunosenescence** (i.e. age-related decline in immunity due to a number of causes). This contributes to lower population immunity thresholds, thus weakening herd immunity.

These implementation issues are further compounded by the **vaccine development issues** such as lack of funding, dearth of 'knowledge base' in immunology, inadequate experience in life cycle immunization, legal challenges to conduct clinical trials and issues related to Intellectual Property Rights (IPRs).

# HOW CAN WE OVERCOME THESE CHALLENGES AND CREATE GROUND FOR UNIVERSAL IMMUNIZATION?

- **Adequate, predictable supplies of appropriate, affordable vaccines of assured quality** must be available at points of service delivery, and stock-outs must be avoided.
- **Tailored strategies are necessary** for understanding and overcoming barriers to vaccination, particularly gender- related barriers of caregivers and health workers to accessing immunization services.
- **New approaches** are required to reach older age groups and to deliver people-centred immunization services, integrated with primary health care.
- **Need to increase health literacy and build resilience against misinformation** to enhance and sustain trust in vaccines and immunization services in communities.
- **The environmental impact of vaccine waste,** from excess packaging to the release of harmful pollutants during burning, will have to be addressed more comprehensively and minimized.
- **Targeted ways to reduce inequity:** The benefits of immunization must be shared equitably among and within countries and giving priority to the populations that are not currently being reached, particularly the most marginalized communities, those living in fragile and conflict-affected settings and mobile populations, especially those moving across borders.
  - To pave the way for equitable distribution of COVID vaccines, GAVI has recently launched the **COVAX facility** (a platform to support research and development of a wide range of COVID vaccines and negotiate their pricing).
- **Research and Innovation:** Along with development of new vaccines, progressive steps must continue on accelerating innovation to improve programme performance, surveillance and quality and to increase access to data.

# CONCLUSION

Immunisation has helped to reduce the morbidity and mortality among children and other vulnerable groups against vaccine preventable diseases throughout the world. In spite of the success stories and achievements and the best efforts taken by each nation worldwide in achieving maximum immunisation coverage, emerging gaps in immunising children and vulnerable people in the society can lead to outbreaks and re-emergence of already controlled vaccine preventable diseases.

Just as the battle against infectious diseases requires agile, flexible immunization programmes, a global vaccine and immunization strategy must also constantly adjust to changing needs and opportunities to respond to rapid shifts in disease epidemiology, technological advances, community needs, financial realities and political contexts.

At the same time, vaccines must not be regarded as the sole intervention for disease control and improving the quality of people's lives. Disease prevention also demands attention to the social determinants of health such as nutrition, safe water, sanitation and so on.

*It is advisable to read this document in conjunction with other weekly focus document on "India's Vaccination Drives" to know about the story of India's rise to become a global leader in vaccine manufacturing, its persisting challenges and potential opportunities.*

**SCAN QR CODE**

# TOPIC AT A GLANCE

## Immunisation

- **A process whereby a person is made immune or resistant to an infectious disease,** typically by the administration of a vaccine.
- Has a much **lower risk of adverse outcomes** in comparison to a natural infection.

## Working of a Vaccine

**Vaccines utilises body's adaptive immunity and memory to expose the body to the antigen** and **work by stimulating the body's defence mechanisms i.e. the immune system** against infection. This includes 3 main processes:

- **Identifying the antigen** that is to be destroyed
- **Development of unique antibodies for antigens**
- **Remembering the antigen and associated antibody**

## Different types of Vaccines

- RNA
- DNA
- Non-Replicating Viral Vector
- Virus like particle
- Protein Sub-Unit
- Inactivated Virus

## Immunisation for all: Benefits and Contributions to SDGs

| | | |
|---|---|---|
| Eliminating poverty by reducing treatment cost and increasing productivity (SDG 1) | Ensures nutrition retention in a child's body (SDG 2) | Promoting good health and well-being (SDG 3) |
| Increases Educational attainment (SDG 4) | Removing gender barriers to vaccination promotes Gender Equality (SDG 5) | Vaccination along with clean water, sanitation and hygiene reduces child mortality (SDG6) |
| Immunisation logistics promote renewable sources of energy (SDG 7) | Promotes healthy and productive workforce thus contributing to economy (SDG 8) | Vaccine manufacturing contributes to infrastructure development (SDG 9) |
| Reduces inequalities by preventing diseases affecting marginalised sections (SDG 10) | Ensures sustainable cities and communities by preventing disease transmission (SDG 11) | Building resilience to diseases linked to climate change (SDG 13) |
| Epitomises people centric health system which forms the backbone of peace and justice (SDG 16) | Broaden partnerships and multisectoral approaches towards a common goal (SDG 17) | |

## India's progress in Universal Immunisation

- **Immunization programs and initiatives in India:**
  - **Expanded Program of Immunization** (EPI) in 1978
  - **Universal Immunization Program (UIP)** by 1985 providing free vaccination against 12 vaccine preventable diseases.
  - **Targeted special drives named Mission Indradhanush (MI) to** accelerate immunisation coverage
  - **Electronic Vaccine Intelligence Network (eVIN) to** strengthen immunisation supply chain across country.
- **Progress as per NFHS 4 data:**
  - 62% children are fully immunised in India
  - Punjab had the highest vaccination coverage (89.1%) and Nagaland had the poorest vaccination coverage(35.7%)
  - Huge gap of vaccine coverage exists between the urban and rural areas in India

## Emerging challenges in achieving universal immunisation

- **Misinformation** about the safety and effectiveness of vaccines **leading to vaccine hesitancy**
- **Disruption in routine immunisations** due to COVID vaccinations
- **Climate change and natural disasters** creates hurdles in implementing existing immunisation strategies
- **Conflict and political instability** disrupting delivery of immunization services
- **Disruptions in global vaccine supplies** due to mismatch in production and need.
- **Price of vaccines along with** regulatory, financing and procurement barriers
- **Low rate of Maternal Vaccination due to societal and other factors.**
- **Challenges in achieving vaccination-induced herd immunity** due to factors like virus mutations and immunosenescence among adult population.

## Imperatives for Universal Immunisation

- **Ensuring adequate and predictable supplies of appropriate, affordable and quality vaccines.**
- **Tailored strategies** for understanding and overcoming barriers to vaccination
- **Increasing health literacy and building resilience against misinformation**
- **Addressing the environmental impact of vaccine waste**
- **Targeted ways to reduce vaccine inequity**
- **Continued vaccine research and innovation**