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Immunization

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Abstract

Immunization has become a vital part of public health and disease prevention, and yet, it remains a controversial topic in our society today. Immunization has contributed to increased life expectancy and improved quality of life. The first vaccine is credited to Edward Jenner, who in 1796 inoculated a 13-year-old boy with the virus responsible for cowpox, and he demonstrated immunity to smallpox. The first smallpox vaccine was created in 1798 using that premise. The first milestone this action plan hopes to achieve is the worldwide eradication of polio. A vaccine is a pharmacologic compound that improves a person's immunity to a particular disease. When a disease-causing bacterium or virus invades the human body, the immune system recognizes the material as foreign, usually by detecting specific protein portions of the invading organism, known as antigens. Vaccines contain a form of the disease-causing agent, whether it be a weakened or killed form of the microbe itself, an inactivated version of its toxins, or a protein from the surface of the microbe. By introducing a form of the agent, the vaccine presents the antigen to the immune system, allowing it to recognize the antigen as foreign and develop antibodies and memory T-lymphocytes against those antigens. This allows a more rapid and robust immune response should the body be exposed to the organism in the future. In the absence of vaccination, the first exposure to the natural organism may prove fatal before the immune system can mount a sufficient immune response.

Key words: Immunization,smallpox,immunity,vaccine.

IMMUNIZATION

Introduction: Immunization is a global health and development success story, saving millions of lives every year. Vaccines reduce risks of getting a disease by working with body's natural defense to build protection. When baby gets a vaccine, the immune system responds. We now have vaccines to prevent more than 20 life-threatening diseases, helping people of all ages live longer, healthier lives. Immunization currently prevents 3.5-5 million deaths every year from diseases like diphtheria, tetanus, pertusis, influenza and measles. Immunization is a key component of primary health care and an indisputable human right. It's also one of the best health investments money can buy. Vaccines are also critical to the prevention and control of infectious disease outbreaks. They underpin global health security and will be a vital tool in the battle against antimicrobial resistance.

Definition of immunization: A process by which a person becomes protected against a disease through vaccination. This term is often used interchangeably with vaccination or inoculation.

Objectives of vaccine or immunization programme

There is the potential to develop a protective vaccine/ immunization programme for all infectious diseases, although some pathogens are considerably more challenging candidates than others. Whether or not such vaccines are developed and deployed is related to the severity and economic impact of the disease on the community as well as the effects upon the individual. Various factors governing the likelihood of an immunization programme being adopted are discussed below.

1) Disease Severity

The severity of the disease in terms of its morbidity and mortality, the probability of permanent injury to its survivors and the likelihood of infection must be sufficient to warrant the costly development of a vaccine and its subsequent use.

2) Vaccine Effectiveness

Vaccination and immunization programmes seldom confer 100% protection against the target disease. More commonly the degree of protection is 60-95%. In such instances, although individuals receiving treatment have a high probability of becoming immune, virtually all members of a community must be treated in order to reduce the actual proportion of susceptible individuals to below the threshold for epidemic spread of the disease

3) Safety

No medical or therapeutic procedure comes without some risk to the patient, but all possible steps are taken to ensure safety, quality and efficacy of vaccines and immunological products. The risks associated with immunization procedures are constantly reviewed and balanced against the risks associated with contracting the disease.

4) Public Perceptions

Public confidence in the safety of vaccines and immunization procedures is essential if compliance is to match the needs of the community. The correlation between actual risk and perception of risk is not always reliable, however. In this respect, public concern and anxiety in the mid-1970s over the perceived safety of pertussis vaccine led to a reduction in coverage of the target group from about 80% to 30%. Major epidemics of whooping cough, with over 100 000 notified cases, followed in the late 1970s and early 1980s. By 1992, public confidence had returned and coverage had increased to 92%, with a considerable associated decrease in disease incidence

5) Cost

Cheap, effective vaccines are an essential component of the global battle against infectious disease.

6) Longevity of Immunity

The ideal of any vaccine is to provide lifelong protection of the individual against disease. Immunological memory depends on the survival of cloned populations of B-and T-lymphocytes (memory cells). Although these lymphocytes can persist in the body for many decades, the duration of protection varies from one individual to another and depends on the vaccine; commonly ranging between 10 and 20 years.

https://www.pharmacy180.com/article/objectives-of-a-vaccine-immunization-programme-508/

Types of vaccine

Vaccines are medications that are used to make people immune to certain diseases. They contain the bacteria or virus, or parts of the bacteria or virus,that cause illness and disease.

The bacteria or virus is included in the vaccine so that the immune system can be taught to recognize and produce antibodies against it if a person is exposed to it naturally, without the person ever experiencing any symptoms of illness or disease.

The main types of vaccines that act in different ways are:

- Live-attenuated vaccines
- Inactivated vaccines
- Subunit, recombinant, conjugate, and polysaccharide vaccines
- Toxoid vaccines

- mRNA vaccines
- Viral vector vaccines

There is a risk of side effects with all vaccines, but some are less likely to cause side effects than others.

Live-attenuated vaccines

Live-attenuated vaccines inject a live version of the germ or virus that causes a disease into the body. Although the germ is a live specimen, it is a weakened version that does not cause any symptoms of infection as it is unable to reproduce once it is in the body.

Live-attenuated vaccines can be made to create immunity against viruses or bacteria, but they are more commonly used for viruses.

This type of vaccine works by allowing a virus or germ to reproduce enough for the body to make memory B-cells, which are a type of cell that can recognize and remember a virus and generate an immune response against it for many years after their initial response.

Live-attenuated vaccines trigger an immune response that is similar to what would occur during a natural infection, but the person is not able to pass on the virus to other people and will not become ill with the disease the virus causes.

A person will usually get lifelong immunity from disease through live-attenuated vaccines, and only one or two doses of the vaccine are usually needed to provide this immunity.

The types of diseases that live-attenuated vaccines are used for include:

- Measles, mumps, and rubella (MMR combined vaccine)
- Rotavirus
- Smallpox
- Chickenpox
- Yellow fever

As a live version of the virus or bacteria is included in this type of vaccine, medical advice should be sought before the vaccine is given as it may not be suitable for people with weakened immune systems or long-term health conditions.

Live-attenuated vaccines also need to be kept cool while they are stored, so they may not be suitable for use in environments where there is little access to refrigeration.

Inactivated vaccines

An inactivated vaccine uses a strain of a bacteria or virus that has been killed with heat or chemicals. This dead version of the virus or bacteria is then injected into the body.

Inactivated vaccines are the earliest type of vaccine to be produced, and they do not trigger an immune response that is as strong as that triggered by live-attenuated vaccines.

Inactivated vaccines do not offer lifelong immunity and need topping up over time, but they may cause fewer side effects than live-attenuated vaccines.

The types of diseases that inactivated vaccines are used for include:

- Hepatitis A
- Flu
- Polio
- Rabies

Subunit, recombinant, conjugate, and polysaccharide vaccines

Subunit, recombinant, conjugate, and polysaccharide vaccines use particular parts of the germ or virus. They can trigger very strong immune responses in the body because they use a specific part of the germ.

Although the immune responses are strong, these types of vaccines may need topping up over time. They are suitable for people with weakened immune systems and long-term health conditions.

These types of vaccines are used to create immunity against the following diseases:

- Hib (Hemophilus influenza type b)
- Hepatitis B
- Human papillomavirus (HPV)
- Whooping cough
- Pneumococcal disease
- Meningococcal disease
- Shingles

Subunit vaccines

Antigens from the surface of the germ or virus are responsible for triggering an immune response in the body. Subunit vaccines isolate specific antigens from a germ or virus for use

in the vaccine, and these antigens are specifically chosen according to the strength of the immune response they generate.Subunit vaccines do not cause many side effects because they are so specifically targeted.

Recombinant vaccines

Recombinant vaccines are made through genetic engineering. The gene that creates the protein for a bacteria or virus is isolated and placed inside another cell's genes. When that cell reproduces, it produces vaccine proteins that mean the immune system will recognize the protein and protect the body against it.

Conjugate vaccines

Conjugate vaccines use two different components. Conjugate vaccines use parts from the outer antigen coat of the bacteria or virus, which are not strong enough to cause illness or generate an immune response in the body.These weak antigen coats are linked to a stronger carrier protein using chemicals, and this combination of the weak antigen coat and stronger carrier proteins triggers the immune system to act more aggressively against the weak antigen.

Polysaccharide vaccines

Polysaccharide vaccines use sugar molecules (known as polysaccharides) from the outer layer of a bacteria or virus. These sugar molecules are chemically linked to carrier proteins and work similarly to conjugate vaccines.

Toxoid vaccines

Toxoid vaccines use toxins created by the bacteria or virus to create immunity to the specific parts of the bacteria or virus that cause disease and not the entire bacteria or virus. The immune response is focused on this specific toxin. Toxoid vaccines do not offer lifelong immunity and need to be topped up over time. Toxoid vaccines are used to create immunity against diphtheria and tetanus.

mRNA vaccines

This technology has been in development for decades. mRNA vaccines have benefits such as short manufacturing times and low manufacturing costs. However, they have to be kept at low temperatures due to the fragility of the mRNA.mRNA vaccines work by triggering an immune response from proteins they synthesize. They induce both cellular and humoral immunity.The first mRNA vaccine was approved for COVID-19. There is some misinformation that mRNA vaccines can alter a person's DNA. However, they are not able to do this.

Viral vector vaccines

Viral vector vaccines modify another virus and use it as a vector to deliver protection from the intended virus. Some of the viruses used as vectors include adenovirus, influenza, measles virus and vesicular stomatitis virus (VSV).

Recent uses of viral vector technology have been in Ebola virus and COVID-19, and studies into its use for Zika, flu and HIV are ongoing.

DNA and recombinant vector vaccines

DNA and recombinant vector vaccines (also known as platform-based vaccines) are two new types of vaccines currently under development.

DNA vaccines include DNA that creates specific antigens from a germ. Once injected into the body, the DNA for the germ is reproduced by the body and is recognized by the immune system. The immune response will then protect the body against further infection and will continue to protect the future.

DNA vaccines are thought to be more effective than protein or antigen-based vaccines because the antigen can sometimes be degraded or consumed by the body before the immune system can generate a full attack against the antigen.

Recombinant vector vaccines work as a natural infection and are good at training the immune system to recognize and attack germs. They work by reproducing a live virus that has been

engineered to carry extra genes from the germ infecting the body. The extra number of genes produce the proteins that the immune system needs to recognize and protect against.

Importance of immunization

Prevention is better than cure. Immunization prevents the diseases from occurrence or recurrence. There are many diseases and life-threatening infections that have no medical treatments. These conditions may cause severe complications, and sometimes turn fatal. Here are a few reasons why there is need to take care of immunization of child.

- Prevents autoimmune disorders. Immunization enhances the ability of the immunity in the body. It is a self-mechanism. A stronger immunity relates to good health.
- Not all children are born with a healthy immune system. Some are born with impaired immunity while others may fall prey to auto-immune conditions. Those people may not nurture good resistance even after vaccination. The only solution is immunization to brace against certain diseases.
- Every parent wants their children to grow healthy and stay protected. Immunization prevents severe illness, and safeguard from the vaccine-preventable diseases. Some of the vaccine-preventable diseases include Hepatitis B, paralysis of limbs, amputation of legs or arms, brain damage, hearing loss, brain malfunction that when left untreated causes death.
- Child's immunity is fragile. They are prone to diseases, even for a mild change of weather or change in food habit. Immunization prevents spreading of diseases from one child to another.
- Cost of immunization (vaccines) is far lower than treatment of the diseases itself.
- Some of the infections may turn epidemic, affecting the whole community. Immunized people pose low to no risk of epidemic diseases.
- Immunization is the only solution that eradicated Polio in infants. Booster vaccines and immunizations in the childhood secure the health.
- Immunization prevents a number of complicated disorders. For instance, a pile of autoimmune disorders affects mankind. From diabetes to osteoarthritis, these diseases have no permanent cure. Developing a stronger immune system reduces the risk of auto-immune conditions.
- Vaccination is safe and effective. All vaccines undergo long and careful review by scientists, doctors, and the federal government to make sure they are safe.

Types of immunity

Immunity to a disease is achieved through the presence of antibodies to that disease in a person's system. Antibodies are proteins produced by the body to neutralize or destroy toxins or disease-carrying organisms. Antibodies are disease-specific. For example, measles antibody will protect a person who is exposed to measles disease but will have no effect if he or she is exposed to mumps.

There are two types of immunity: active and passive.

Active Immunity

Active Immunity results when exposure to a disease organism triggers the immune system to produce antibodies to that disease. Active immunity can be acquired through natural immunity or vaccine-induced immunity.

- Natural immunity is acquired from exposure to the disease organism through infection with the actual disease.
- Vaccine-induced immunity is acquired through the introduction of a killed or weakened form of the disease organism through vaccination.

Either way, if an immune person comes into contact with that disease in the future, their immune system will recognize it and immediately produce the antibodies needed to fight it. Active immunity is long-lasting, and sometimes life-long.

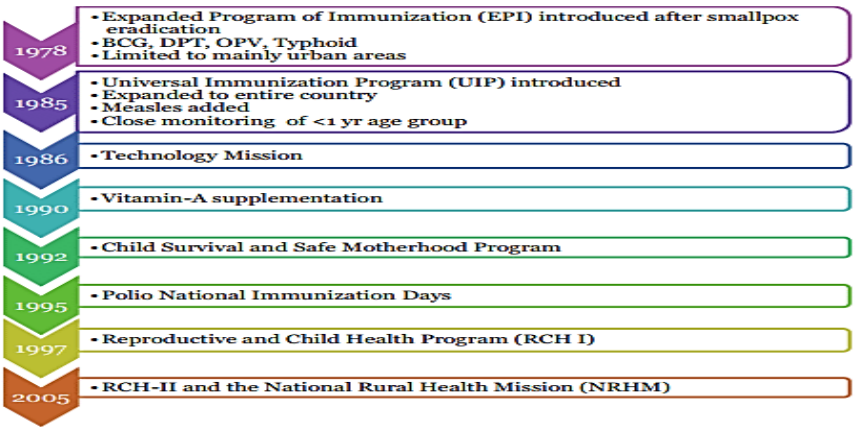
Passive Immunity

Passive immunity is provided when a person is given antibodies to a disease rather than producing them through his or her own immune system.

- A newborn baby acquires passive immunity from its mother through the placenta.
- People can also get passive immunity through antibody-containing blood products such as immune globulin, which may be given when immediate protection from a specific disease is needed.

The major advantage to passive immunity is that protection is immediate, whereas active immunity takes time (usually several weeks) to develop. However, passive immunity lasts only for a few weeks or months. Only active immunity is long-lasting.

Milestones of immunization in India



National immunization schedule

Age	Vaccine given
Birth	Bacillus Calmette Guerin (BCG), Oral Polio Vaccine (OPV)-0 dose, Hepatitis B birth dose
6 weeks	OPV-1, Pentavalent-1, Rotavirus Vaccine (RVV)-1, Fractional dose of Inactivated Polio Vaccine (fIPV)-1, **Pneumococcal Conjugate Vaccine (PCV) -1***
10 weeks	OPV-2, Pentavalent-2, RVV-2
14 weeks	OPV-3, Pentavalent-3, fIPV-2, RVV-3, **PCV-2***
9-12 months	Measles & Rubella (MR)-1, **JE-1**** , **PCV-Booster***
16-24 months	MR-2, **JE-2****, Diphtheria, Pertussis & Tetanus (DPT)-Booster-1, OPV – Booster
5-6 years	DPT-Booster-2
10 years	Tetanus & adult Diphtheria (Td)
16 years	Td
Pregnant mothers	Td-1, Td-2 or Td-Booster***

* **PCV** in selected states/districts: Bihar, Himachal Pradesh, Madhya Pradesh, Uttar Pradesh (selected districts) and Rajasthan; in Haryana as state initiative

** JE in endemic districts only

*** One dose if previously vaccinated within 3 years

Conclusion

Vaccination is the most effective strategy to prevent infections, reduce the severity of illness, and save lives during seasonal outbreaks and pandemics. Vaccines for contagious diseases have strong spillover effects, given that immunization interrupts the disease transmission process and reduces the likelihood that an infection will harm others.

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