Review Article

A REVIEW ON DETAILS OF VACCINE, VACCINATION AND IMMUNIZATION SCHEDULE

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ABSTRACT

A vaccine is a biological preparation that provides active acquired immunity to a particular disease. A vaccine typically contains agent that resembles a disease causing micro-organism and is often made from weakened or killed form of microbe, its toxin is one of its surface protein. Vaccine stimulates the body's immune system to recognize the agent as a threat, destroy it, and keep a record of it, so that the immune system can more easily recognize and destroy any of these micro-organisms that encounters later. Vaccination is a process of administration of vaccine into a living mechanism; it is a most effective method of prevention for infectious disease. The present article helps to understand importance of routinely get vaccine which protects infants and Childs from more than dozen diseases. This article also helps to parents/guardians for understanding the immunization schedule and getting their child vaccinated on time which will help to protect their child against 15 vaccine preventable diseases.

Keywords: Vaccine, Vaccination, Immunization schedule, Varicella, MMR, IPV, Polio, Rotavirus.

INTRODUCTION

What is a vaccine?

The word "vaccine" originates from the Latin Variolae vaccinae (cowpox), which Edward Jenner demonstrated in 1798 could prevent smallpox in humans.[1] Today the term 'vaccine' applies to all biological preparations, produced from living organisms, that enhance immunity against disease and either prevent (prophylactic vaccines) or, in some cases, treat disease (therapeutic vaccines). Vaccines are administered in liquid form, either by injection, by oral, or by intranasal routes.

Vaccines are composed of either the entire disease-causing microorganism or some of its components.[1, 2] They may be constructed in several ways which are mentioned as follow and on the same basis they are named as follow:

1. **Live Attenuated Vaccines:**
   From living organisms that have been weakened, usually from cultivation under sub-optimal conditions (also called attenuation), or from genetic modification, which has the effect of reducing their ability to cause disease;
2. **Inactivated Vaccines:**
   From whole organisms that have been inactivated by chemical, thermal or other means;
3. **Recombinant Sub-Unit Vaccines:**
   From components of the disease-causing organism, such as specific proteins and polysaccharides, or nucleic acids;
4. **Toxoids:**
   From inactivated toxins of toxin-producing bacteria;
5. **Conjugate Polysaccharide Vaccines:**
   From the linkage (conjugation) of polysaccharides to proteins (this increases the effectiveness of polysaccharide vaccines in young children).

In addition to all the above mentioned types of vaccines we are also able for combining several serotypes of a disease- causing organism in a single vaccine, vaccines against different disease-causing organisms can be combined to provide protection against several different diseases. These combination vaccines may contain different types of vaccines. Combination vaccines against different diseases such as

diphtheria, tetanus, pertussis, Heamophilus influenzae type b, Hepatitis B, and polio, are commonly used in childhood immunization schedules. These vaccines incorporate both viral and bacterial vaccines and contain toxoids, purified protein sub-unit vaccine, conjugated polysaccharide vaccine, recombinant protein vaccine, and inactivated viral vaccine respectively.[1, 2, 3]

WHAT DOES A VACCINE CONTAIN?

In addition to the bulk antigen that goes into a vaccine, vaccines are formulated (mixed) with other fluids (such as water or saline), additives or preservatives, and sometimes adjuvants. Collectively, these ingredients are known as the excipients. These ensure the quality and potency of the vaccine over its shelf-life. Vaccines are always formulated so as to be both safe and immunogenic when injected into humans. Vaccines are usually formulated as liquids, but may be freeze-dried (lyophilized) for reconstitution immediately prior to the time of injection.[4, 5]

DETAILS OF VACCINATION

As a parent, one should want to know why vaccinating your child is important.

In the past, diseases such as smallpox and polio struck fear into the hearts of parents, as an infection in their child or community could mean death or paralysis. Today, thanks to the development of vaccines, smallpox has been totally eradicated and other infections such as polio and measles have nearly been eliminated.[7]

- Why is it important for children to be vaccinated?

  Children need to be vaccinated in order to protect them from certain infectious diseases.[7]
- Why should all children be vaccinated?

  Vaccinations prevent the spread of disease within the community.[8]
- Where do I go to have my child vaccinated?

  Your local clinics and community health centres in South Africa will provide free vaccinations for your child.[8]
- When should my child be vaccinated?

  At birth, 6 weeks, 10 weeks, 14Weeks, 9 months, 18 months, 6 years and at 12 years old.
- Does my child need to have all the vaccinations?

  Yes, your child must have all the vaccinations on the attached schedule.
- Which diseases will the vaccinations protect my child from?

  Tuberculosis, Polio, Rotavirus Gastroenteritis, Diphtheria, Tetanus, Whooping cough, Haemophilus Influenzae type B, Hepatitis B, Pneumococcal Infection, and Measles are the vaccinations that your child will be protected against.
- Are vaccinations safe?

  As a result of medical research vaccinations are getting safer and more effective all the time.[8]

IMMUNIZATION SCHEDULE:

Table 1: Sequence of Vaccines required to be given at the various completed ages in terms of weeks, months and Years

Age of Child	Vaccine Needed	How & Where is it Given?
At birth	BCG Bacilles Calmette Guerin	Right arm
	OPV (O) Oral Polio Vaccine	Drops by mouth
	Hep-B(1)	Intramuscular / Right thigh
6 weeks	RV (1) Rotavirus Vaccine	Liquid by mouth
	DTap-1, IPV-1, Hib(1) Diphtheria, Tetanus, acellular Pertussis, Inactivated Polio Vaccine and Haemophilus influenzae type b Combined	Intramuscular/Left thigh
	Heb B (2) Hepatitis B Vaccine	Intramuscular / Right thigh
	PCV (1) Pneumococcal Conjugated Vaccine	Intramuscular / Right thigh
10 weeks	DTaP-2, IPV-2, Hib(2) Diphtheria, Tetanus, acellular Pertussis, Inactivated Polio Vaccine and Haemophilus influenzae type b Combined	Intramuscular / Left thigh
	PCV (2) Pneumococcal Conjugated Vaccine	Intramuscular / Right thigh
	RV (2) Rotavirus Vaccine*	Liquid by mouth
14 weeks	DTap-3, IPV-3, Hib (3) Diphtheria, Tetanus, acellular Pertussis, Inactivated Polio Vaccine and Haemophilus influenzae type b Combined	Intramuscular / Left thigh
	RV (3) Rotavirus Vaccine*	Liquid by mouth
	PCV (3) Pneumococcal Conjugated Vaccine	Intramuscular / Right thigh
6 Months	OPV (1) Oral Polio Vaccine	Drops by mouth
	Hep-B (3)	Intramuscular / Right thigh

9 months	Measles Vaccine (1) (MMR-1)	Intramuscular / Left thigh
	OPV (2) Oral Polio Vaccine	Drops by mouth
12 Months	Hep-A (1) Hepatitis A Vaccine	Intramuscular / Right thigh
15 Months	Measles Vaccine (2) (MMR-2)	Intramuscular / Left thigh
	Varicella-1	Subcutaneously injected
	PCV Booster (Pneumococcal Conjugated Vaccine)	Intramuscular / Right thigh
16 to 18 months	DTwP B1, IPV B1, Hib B1 Diphtheria, Tetanus, acellular Pertussis, Inactivated Polio Vaccine and Haemophilus influenzae type b Combined	Intramuscular / Left thigh
18 Months	Hep-A (2) Hepatitis A Vaccine 2nd Dose	Intramuscular / Right thigh
4 to 6 Years	(DTwP B2) Diphtheria, Tetanus, acellular Pertussis.	Intramuscular / Left thigh
	OPV (3) Oral Polio Vaccine	Drops by mouth
	Varicella-2	Subcutaneously injected
	Measles Vaccine (3) (MMR-3)	Intramuscular / Left thigh
12 years (Both boys and girls)	Td Vaccine Tetanus and reduced strength of diphtheria Vaccine	Intramuscular / Left arm

*Rotavirus should not be administered after 24 Weeks.

DETAILS OF VACCINE PREVENTABLE DISEASES AND VACCINES THAT PREVENTS THEM

Details for the vaccine preventable diseases are listed as follow in sequential manner.

1. **Tuberculosis (TB):**

TB is a contagious (disease spread by contact) infection that commonly affects the lungs.[9] People with active TB often contaminate the air with bacteria when they cough or sneeze.[9] These bacteria can stay in the air for several hours. If another per- son breathes the bacteria in, they may become infected. TB kills about 3 million people worldwide, every year.[9]

Symptoms:

Coughing, night sweats and generally feeling unwell, with decreased energy and appetite are the most common symptom.[9]

Why vaccinate?

TB is a leading infectious cause of deaths in adults, killing about 1.5 million people every year. The BCG vaccination (given to prevent TB) is given to more than 80% of the world's children.[10]

2. **POLIOMYELITIS (POLIO)**

Polio is a highly contagious, viral infection that affects nerves and can produce permanent muscle weakness, paralysis and sometimes death. Polio is caused by a virus and is spread by digesting contaminated material.[11]

Symptoms:

In the majority of polio infections there will be no symptoms. Of the infected people with symptoms, most will have mild symptoms including fever, headache, sore throat and vomiting.[11]

Why vaccinate?

Extensive vaccination has almost eradicated polio in developed countries.[7] However, cases still occur in regions with incomplete vaccination such as sub-Saharan Africa and Southern Asia.[12] The injectable polio vaccine given during childhood produces protection in more than 95% of recipients.[12]

3. **ROTAVIRUS GASTROENTERITIS:**

Rotavirus is one of the most common causes of diarrhoea in children and spreads quickly and easily.[13, 14] Rotavirus infects nearly every child before their 5th birthday.[13] Diarrhoea from rotavirus can quickly lead to dehydration. Dehydration can result in hospitalisation and even death for children who do not receive treatment in time.[15, 16]

Symptoms:

Symptoms begin with fever and vomiting, followed by watery diarrhoea, which typically lasts 5 to 7 days. If fluid losses are not replaced, dehydration develops .This makes the child weak and listless.[14]

Why vaccinate?

In South Africa approximately 6 children die every day from severe rotavirus.[17, 18] Worldwide, approximately 600 000 children die each year from rotavirus.[14] Rotavirus vaccination is now available at your local clinic for all infants older than six weeks and younger than 24 weeks of age.

4. **DIPTHERIA:**

Diphtheria is a contagious, sometimes fatal infection of the upper respiratory tract.[19]The bacteria that cause diphtheria are usually spread in droplets of moisture coughed into the air.[19]

Symptoms:

Symptoms include; sore throat chills, general feeling of illness and fever. The lymph nodes in the neck may swell.[19]

Why vaccinate?

Diphtheriaisreadilypreventablebymeans ofvaccination.[19] In children younger than 5 who are not vaccinated, the mortality rate can be as high as 20%.[20]

5. **TETANUS (LOCKJAW)**

Tetanus results from a toxin produced by the anaerobic bacteria Clostridium tetani. The toxin makes muscles become rigid and contract involuntarily.[21] Tetanus bacteria may enter the body through wounds contaminated with soil or faeces and skin punctures.[21]

Symptoms:

Muscles contract and become rigid. Spasms usually begin in the jaw and throat, followed by the neck, shoulder, face and then the abdomen and limbs.[21]

Why vaccinate?

Worldwide, about 50% of people who have tetanus die.[21] Preventing tetanus is far better than treating tetanus. Tetanus rarely develops in people who have completed a primary series of tetanus vaccinations and have had vaccinations every 10 years as recommended.[21]

6. **PERTUSSIS (WHOOPINGCOUGH)**

Pertussis is a highly contagious infection caused by the bacteria Bordetella pertussis , which results in fits of coughing that usually end in a prolonged, high-pitched, deeply in drawn breath (the whoop).[22]

Symptoms:

The disease is divided into 3 stages: [22]

• First stage – lasts for 1 or 2 weeks. Symptoms include mild cold like symptoms. (Sneezing, runny nose, hacking cough at night and a general feeling of illness)

• Second stage – lasts for 2 to 4 weeks. Coughing fits develop followed by the whoop. The cough often produces large amounts of thick mucous

• Third stage–lasts two to four weeks. Cough decreases and then stops

Why vaccinate?

Complications of pertussis can include pneumonia, ear infections and in rare instances brain damage.[22] Active immunization is part of the standard childhood vaccination schedule.

7. **HAEMOPHILUS INFLUENZAE TYPE-B (Hib)**

Haemophilus influenzae type B (Hib) can cause infection in the respiratory tract, which can spread to other organs.[23] It spreads through the bloodstream and infects the joints, bones, lungs, skin, face, neck, eyes, urinary tract and other organs.[23]These bacteria may cause two severe, often fatal infections: meningitis and epiglottitis.[23] The bacteria are spread by an infected person sneezing or coughing respiratory droplets into the air, which are then inhaled by someone else.[23]

Symptoms:

Symptoms depend on the part of the body affected. e.g. meningitis may present with fever, headache, stiff neck and vomiting.[23]

Why vaccinate?

Vaccines are available for children older than 6 weeks of age in South Africa and have decreased the incidence of serious infection by 99%.[24]

8. **HEPATITIS-B (HEP-B)**

Hepatitis B is generally more serious than hepatitis A and is occasionally fatal. Hepatitis B is also spread through contact with saliva, tears, breast milk, urine, vaginal fluid and semen.[25]A pregnant woman infected with hepatitis B can transmit the virus to her baby during birth.[25]

Symptoms:

Symptoms can be mild or severe. They include decreased appetite, nausea, vomiting (acute) or as serious as fatal liver failure (Chronic).[25]

Why vaccinate?

Hepatitis B becomes chronic in 5 to 7% of people.[25]The vaccine can prevent

chronic hepatitis B in more than 80% of cases.[25]

9. PNEUMOCOCCAL INFECTION

Pneumococcal infections are caused by a gram-positive bacteria (pneumococcus).[26] These bacteria are dispersed into the air when infected people cough or sneeze and are then inhaled by someone else.[26] The most common infections caused by pneumococcus are pneumonia, meningitis, sinusitis and middle ear infections.[26]

Symptoms:

Symptoms depend on the part of the body affected. The most common symptoms are fever, cough, headache, a general feeling of illness and ear pains.[26]

Why vaccinate?

Pneumococcal vaccines help protect against bacterial infections such as ear infections, sinusitis, pneumonia and meningitis.[26]

10. MEASLES:

Measles is a highly contagious viral infection that is most common in children.[27]It is spread mainly by air borne droplets of moisture coughed out by an infected person, or by touching items contaminated by such droplets.[27]It is contagious for several days before and after the rash develops. [27]

Symptoms:

The infected child first develops a fever, runny nose, hacking cough and redeyes.[27] Tiny white spots appear inside the mouth followed by a sore throat.[27] A mildly itchy rash appears 3 to 5 days after the start of symptoms.[27] Starting around the ears and spreading to the trunk, arms and legs, the rash starts off as flat red areas that soon become raised.[27] The child may develop a very high temperature (40° C).[27]

Why vaccinate?

Worldwide, measles infects about 20 million people annually, causing about 200000 deaths, primarily in children.[28] Complications can be severe and include pneumonia, encephalitis (infection of the brain) and middle ear infections.[27]

Table 2: Tabular Summary of the Vaccine preventable Diseases and Vaccines that Prevents them

Diseases	Vaccine	Disease spread by	Disease symptoms
Chickenpox	**Varicella vaccine** protects against chickenpox.	Air, direct contact	Rash, tiredness, headache, fever
Diphtheria	**DTaP*** vaccine protects against diphtheria.	Air, direct contact	Sore throat, mild fever, weakness, swollen glands in neck
Hib	**Hib** vaccine protects against Haemophilus influenzae type b.	Air, direct contact	May be no symptoms unless bacteria enter the blood
Hepatitis A	**HepA** vaccine protects against hepatitis A.	Direct contact, contaminated food or water	May be no symptoms, fever, stomach pain, loss of appetite, fatigue, vomiting, jaundice (yellowing of skin and eyes), dark urine
Hepatitis B	**HepB** vaccine protects against hepatitis B.	Contact with blood or body fluids	May be no symptoms, fever, headache, weakness, vomiting, jaundice (yellowing of skin and eyes), joint pain
Influenza (Flu)	**Flu vaccine** protects against influenza.	Air, direct contact	Fever, muscle pain, sore throat, cough, extreme fatigue
Measles	**MMR**** vaccine protects against measles.	Air, direct contact	Rash, fever, cough, runny nose, pinkeye
Mumps	**MMR**** vaccine protects against mumps.	Air, direct contact	Swollen salivary glands (under the jaw), fever, headache, tiredness, muscle pain
Pertussis	**DTaP*** vaccine protects against pertussis (whooping cough).	Air, direct contact	Severe cough, runny nose, apnea (a pause in breathing in infants)
Polio	**IPV** vaccine protects against polio.	Air, direct contact, through the mouth	May be no symptoms, sore throat, fever, nausea, headache
Pneumococcal	**PCV** vaccine protects against pneumococcus.	Air, direct contact	May be no symptoms, pneumonia (infection in the lungs)
Rotavirus	**RV** vaccine protects against rotavirus.	Through the mouth	Diarrhea, fever, vomiting
Rubella	**MMR**** vaccine protects against rubella.	Air, direct contact	Children infected with rubella virus sometimes have a rash, fever, swollen lymph nodes
Tetanus	**DTaP*** vaccine protects against tetanus.	Exposure through cuts in skin	Stiffness in neck and abdominal muscles, difficulty swallowing, muscle spasms, fever

* DTaP combines protection against diphtheria, tetanus, and pertussis.
**MMR combines protection against measles, mumps, and rubella.

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