

jection is required when the need and time for multiple vaccines coincide. In addition to the long-used, measles-mumps-rubella (MMR) and diphtheria-tetanus-pertussis (DTaP) combinations, available combinations include *Haemophilus b* (Hib) with hepatitis B (Comvax), DTaP with *Haemophilus b* (DTaP-HIB; TriHIBit), and hepatitis A and hepatitis B (Twinrix). Another strategy is to give multiple vaccines (in separate syringes, at different sites) at one visit to a health care provider when feasible. For example, several vaccines are recommended to be given at the same time for routine immunization of infants and young children. In addition, influenza and pneumococcal vaccines can be administered concurrently, and at least one study indicates that varicella and MMR can be given at the same office visit.

- Two vaccines were developed, marketed, then withdrawn from the market. Rotavirus vaccine was withdrawn because of adverse effects, and Lyme disease vaccine was apparently withdrawn because of infrequent use.

IMMUNIZATION

Immunization or vaccination involves administration of an antigen to induce antibody formation (for active immunity) or serum from immune people (for passive immunity). Preparations used for immunization are biologic products prepared by pharmaceutical companies and regulated by the Food and Drug Administration (FDA).

AGENTS FOR ACTIVE IMMUNITY

The biologic products used for active immunity are vaccines and toxoids. *Vaccines* are suspensions of microorganisms or their antigenic products that have been killed or attenuated (weakened or reduced in virulence) so that they can induce antibody formation while preventing or causing very mild forms of the disease. Many vaccines produce long-lasting immunity. Attenuated live vaccines produce immunity, usually lifelong, that is similar to that produced by natural infection. However, there is a small risk of producing disease with live vaccines, especially in people with impaired immune function. Vaccines developed with recombinant deoxyribonucleic acid (DNA) technology have a low risk for causing active disease.

Toxoids are bacterial toxins or products that have been modified to destroy toxicity while retaining antigenic properties (ie, ability to induce antibody formation). Immunization with toxoids is not permanent; scheduled repeat doses (boosters) are required to maintain immunity.

Additional components of vaccines and toxoids may include aluminum phosphate, aluminum hydroxide, or calcium phosphate. Products containing aluminum should be given intramuscularly only because they cannot be given intravenously and greater tissue irritation occurs with subcutaneous injections. These additives are used to delay absorption and increase antigenicity.

For maximum effectiveness, vaccines and toxoids must be given before exposure to the pathogenic microorganism. They should also be given by the recommended route to ensure the desired immunologic response.

Indications for Use

Clinical indications for use of vaccines and toxoids include the following:

1. Routine immunization of all children against diphtheria, *Haemophilus b* infection, hepatitis B, mumps, pertussis, pneumococcal infection, poliomyelitis, rubella (German measles), rubeola (red measles), tetanus, and varicella.
2. Immunization of adolescents and adults against diphtheria and tetanus.
3. Immunization of prepubertal girls or women of childbearing age against rubella. Rubella during the first trimester of pregnancy is associated with a high incidence of birth defects in the newborn.
4. Immunization of people at high risk of serious morbidity or mortality from a particular disease. For example, hepatitis B, influenza, and pneumococcal vaccines are recommended for selected groups of people.
5. Immunization of adults and children at high risk of exposure to a particular disease. For example, some diseases (eg, yellow fever) rarely occur in most parts of the world. Thus, immunization is recommended only for people who live in or travel to geographic areas where the disease can be contracted.

Contraindications to Use

Vaccines and toxoids are usually contraindicated during febrile illnesses; immunosuppressive drug therapy (see Chap. 45); immunodeficiency states; leukemia, lymphoma, or generalized malignancy; and pregnancy.

AGENTS FOR PASSIVE IMMUNITY

Immune serums are the biologic products used for passive immunity. They are used to provide temporary immunity in people exposed to or experiencing a particular disease. The goal of therapy is to prevent or modify the disease process (ie, decrease the incidence and severity of symptoms).

Immune globulin products are made from the serum of individuals with high concentrations of the specific antibody or immunoglobulin (Ig) required. They may consist of whole serum or the immunoglobulin portion of serum in which the specific antibodies are concentrated. Immunoglobulin fractions are preferred over whole serum because they are more likely to be effective. Plasma used to prepare these products is negative for hepatitis B surface antigen (HbsAg). Hyperimmune serums are available for cytomegalovirus, hepatitis