occur by natural means, as by infection, in which case it is termed *naturally acquired active immunity*, or it may develop in response to administration of a specific vaccine or toxoid, in which case it is *artificially acquired active immunity*. In either case, the body builds up its own defense in response to the antigen.

Vaccines are administered primarily for prophylactic action, to develop acquired active immunity. Vaccines may contain living attenuated (weakened) or killed microorganisms or fractions of these microorganisms. Toxoids are bacterial toxins modified and detoxified with moderate heat and chemical treatment so that the antigenic properties remain while the substance is rendered nontoxic. Although toxoids do not cause disease, exposure of immunocompetent persons may result in antibody production that will protect the person against disease caused by the natural toxin. A problem with toxoids is that they produce inadequate immunologic responses when administered alone. Therefore, they are often combined with adjuvants (e.g., alum, aluminum phosphate, aluminum hydroxide) that enhance their antigenicity. These agents do so through their insoluble nature, which acts to keep the immunogens in tissue for longer periods and, thus, prolongs the immune response.

A vaccine composed of killed whole bacteria or viruses or substructures of these is known as an inactivated vaccine. Vaccines that contain live but significantly weakened microorganisms are attenuated vaccines. Both types are capable of producing immunity. However, the attenuated vaccines typically have more antigenicity so are more likely to confer permanent immunity. To maintain adequate antibody titers, inactivated vaccines must be administered again over time.

With live vaccines, caution must be exercised with immunocompromised patients. This group of patients includes those with HIV infection, thymic abnormalities, lymphoma, leukemia, generalized malignancy, or advanced debilitating diseases or who are receiving corticosteroids, alkylating agents, antimetabolites, or radiation chemotherapy. These patients are unable to mount immune responses against even weakened microorganisms. The result could be a disseminated bacterial or viral infection. Thus, inactivated vaccines should be employed for these patients.

Immunization during pregnancy is another concern. Live attenuated vaccines should be avoided for pregnant patients because of the danger of transmission of the microorganism to the fetus. For example, measles, mumps, and rubella (MMR) vaccine should not be administered during pregnancy, and pregnancy should be avoided for 1 month following vaccination with monovalent measles vaccine and 4 weeks following MMR or other rubella-containing vaccines.

### Passive Immunity

Passive acquired immunity occurs by introduction of the immunoglobulins produced in another individual (human or animal) into the host, who is not involved in their production. In similar fashion to active acquired immunity, passive acquired immunity can be classified as natural or artificial.

Naturally acquired passive immunity occurs by placental transmission of immunoglobulin gamma (IgG) from the mother to the fetus. Because of the transfer of these immunoglobulins, the infant may have passive immunity to diphtheria, tetanus, measles, mumps, and other infections for the first 4 to 6 months of life.

Several biologic products containing immunoglobulins provide passive immunity. These are limited to provision of temporary prophylaxis to susceptible individuals, for example, during an epidemic, and to supplying immediate immunoglobulins for the treatment of infections and toxicities. Notable in this category are the antivenins for treatment of snakebite (e.g., North American coral snake antivenin) and spiders (e.g., black widow spider antivenin).

The acquired passive immunity provided by immunoglobulins is not long lasting, usually 1 to 2 weeks. Their important feature is that they offer the susceptible patient protection during a critical period of exposure (e.g., the patient exposed to diphtheria). Immunoglobulins do not last long because