chapter 54

Immunologic Agents

Key Terms

active immunity
antibody
antigen
antigen–antibody response
attenuated
booster
cell-mediated immunity
globulin
humoral immunity
immune globulin
immunity
passive immunity
toxin
toxoid
vaccine

Chapter Objectives

On completion of this chapter, the student will:

- Discuss humoral immunity and cell-mediated immunity.
- Distinguish between and define the different types of immunity.
- Discuss the use of vaccines, toxoids, immune globulins, and antivenins to provide immunity against disease.
- Discuss preadministration and ongoing assessments the nurse should perform on the patient receiving an immunologic agent.
- Identify nursing diagnoses particular to a patient receiving an immunologic agent.
- Discuss ways to promote an optimal response, management of common adverse reactions, special considerations, and important points to keep in mind when educating a patient taking an immunologic agent.

Immunity refers to the ability of the body to identify and resist microorganisms that are potentially harmful. This ability enables the body to fight or prevent infectious disease and inhibit tissue and organ damage. The immune system is not confined to any one part of the body. Immune stem cells, formed in the bone marrow, may remain in the bone marrow until maturation or migrate to different body sites for maturation. After maturation, most immune cells circulate into the body and exert specific effects. The immune system has two distinct, but overlapping, mechanisms with which to fight invading organisms:

- Cell-mediated defenses (cellular immunity)
- Antibody-mediated defenses (humoral immunity)

CELL-MEDIATED IMMUNITY

Cell-mediated immunity (CMI) is the result of the activity of many leukocyte actions, reactions, and interactions that range from simple to complex. This type of immunity is dependent on the actions of the T lymphocytes, which are responsible for a delayed type of immune response. The T lymphocyte becomes sensitized by its first contact with a specific antigen. Subsequent exposure to an antigen stimulates multiple reactions aimed at destroying or inactivating the offending antigen. T lymphocytes and macrophages (large cells that surround, engulf, and digest microorganisms and cellular debris) work together in CMI to destroy the antigen. T lymphocytes attack the antigens directly, rather than produce antibodies (as is done in humoral immunity). Cellular reactions may also occur without macrophages.

Several T lymphocytes (T cells) are involved in CMI:

- Helper T4 cells—function within the bloodstream identifying and destroying antigens
- Helper T1 cells—increase B lymphocyte antibody production
- Helper T2 cells—increase activity of cytotoxic (killer) T cells, which attack the cell directly by altering the cell membrane and causing cell lysis (destruction)
- Suppressor T cells—suppress the immune response
- Memory T lymphocytes—recognize previous contact with antigens and activate an immune response

The T lymphocytes defend against viral infections, fungal infections, and some bacterial infections. If CMI is lost, as in the case of acquired immunodeficiency

syndrome, the body is unable to protect itself against many viral, bacterial, and fungal infections.

HUMORAL IMMUNITY

In **humoral immunity** special lymphocytes (white blood cells), called B lymphocytes, produce circulating antibodies to act against a foreign substance. This type of immunity is based on the antigen–antibody response. An **antigen** is a substance, usually a protein, that stimulates the body to produce antibodies. An **antibody** is a globulin (protein) produced by the B lymphocytes as a defense against an antigen. Humoral immunity protects the body against bacterial and viral infections.

Specific antibodies are formed for a specific antigen, that is, chickenpox antibodies are formed when the person is exposed to the chickenpox virus (the antigen). This is called an **antigen–antibody response.** Once manufactured, antibodies circulate in the bloodstream, sometimes for only a short time and, at other times, for the life of the person. When an antigen enters the body, specific antibodies neutralize the specific invading antigen; this is called immunity. Thus, the individual with specific circulating antibodies is immune (or has immunity) to a specific antigen. Immunity is the resistance that an individual has against disease.

Cell-mediated and humoral immunity are interdependent, that is, CMI influences the function of the B lymphocytes, and humoral immunity influences the function of the T lymphocytes.

ACTIVE AND PASSIVE IMMUNITY

Active and passive immunity involve the use of agents that stimulate antibody formation (active immunity) or the injection of ready-made antibodies found in the serum of immune individuals or animals (passive immunity). The following sections describe active and passive immunity.

Active Immunity

When a person is exposed to certain infectious microorganisms (antigens), the body begins to form antibodies (or build an immunity) to the invading microorganism. This is called **active immunity.** The two types of active immunity are naturally acquired active immunity and artificially acquired active immunity. The Summary Drug Table: Agents for Active Immunization identifies agents that produce active immunity.

Naturally Acquired Active Immunity

Naturally acquired active immunity occurs when the person is exposed to a disease, experiences the disease, and the body manufactures antibodies to provide future immunity to the disease. It is called active immunity because the antibodies were produced by the person who had the disease (Fig. 54-1). Thus, having the disease produces immunity. Display 54-1 provides an example of naturally acquired active immunity.

DISPLAY 54-1 ● Example of Naturally Acquired Active Immunity

An example is when the individual is exposed to chickenpox for the first time and has no immunity to the disease. The body immediately begins to manufacture antibodies against the chickenpox virus. However, the production of a sufficient quantity of antibodies takes time, and the individual gets the disease. At the time of exposure and while the individual still has chickenpox, the body continues to manufacture antibodies. These antibodies circulate in the individual's bloodstream for life. In the future, any exposure to the chickenpox virus results in the antibodies mobilizing to destroy the invading antigen.

ARTIFICIALLY ACQUIRED ACTIVE IMMUNITY

Artificially acquired active immunity occurs when an individual is given a killed or weakened antigen, which stimulates the formation of antibodies against the antigen. The antigen does not cause the disease, but the individual will still manufacture specific antibodies against the disease. When a vaccine containing an **attenuated** (weakened) antigen is given, the individual may experience a few minor symptoms of the disease or even a mild form of the disease, but the symptoms are almost always milder and usually last for a short time.

The decision to use an attenuated, rather than a killed, virus as a vaccine to provide immunity is based on research. For example, many antigens, when killed, show a poor antibody response, whereas when the antigen is merely weakened, a good antibody response occurs. Immunization against a specific disease(s) provides artificially acquired active immunity. Display 54-2 gives an example of artificially acquired active immunity.

DISPLAY 54-2 ● Example of Artificially Acquired Active Immunity

An example of the use of an attenuated virus is the administration of the measles vaccine to an individual who has not had measles. The measles (rubeola) vaccine contains the live, attenuated measles virus. The individual receiving the vaccine develops a mild or modified measles infection, which then produces immunity against the rubeola virus. The measles vaccine protects 95% of the recipients for several years or, for some individuals, for life. An example of a killed virus used for immunization is the cholera vaccine. This vaccine protects those who receive the vaccine for about 3 to 6 months.

SUMMARY DRUG TABLE AGENTS FOR ACTIVE IMMUNIZATION

GENERIC DRUG	TRADE NAME*	USES	ADVERSE REACTIONS	DOSAGE RANGES
Vaccines, Bacterial				
bcg vaccine *bee-see-gee-vak'-seen*	Tice BCG	Infants and children with negative tuberculin skin test who are at high risk of intimate and prolonged exposure to pulmonary tuberculosis	Rare; minor local reactions such as local tenderness, pain at injection site, malaise, nausea, diarrhea, headache, fever	0.2–0.3 mL percutaneous
Cholera vaccine *kol'-er-ah-vak'-seen*	*generic*	Immunization against cholera in individuals traveling to or living in countries where cholera is endemic or epidemic	Same as for BCG vaccine	0.2–0.3 mL SC, IM with a booster of 0.5 mL at 10 y
Haemophilus influenzae type b conjugate and hepatitis B vaccine *he'-maw-fil-us in-flu-en'-zah kon-jew'-gate hep'-ah-tie'-tus bee-vak'-seen*	ActHIB, Comvax, HibTITER Vaccine, PedvaxHIB	Routine immunization of children	Same as for BCG vaccine	0.5 mL IM
Lyme disease vaccine (recombinant OspA) *lime-vak'-seen*	LYMErix	Active immunizations against Lyme disease in individuals 15–70 years of age who are at risk of contracting the disease	Same as for BCG vaccine	30 mcg IM, SC at 0, 1, and 12 months
Meningococcal polysaccharide vaccine *men-in-jo'-kok'-al po-ly-sack'-a-ride vak'-seen*	Menomune A/C/Y/W-135	Active immunization against invasive meningococcal disease	Same as for BCG vaccine	0.5 mL SC only
pneumococcal vaccine, polyvalent *new-mo-kok'-kal vak'-seen*	Pneumovax 23, Pnu-Imune 23	Immunization against pneumococcal pneumonia and bacteremia caused by the types of pneumococci included in the vaccine	Same as for BCG vaccine	0.5 mL SC or IM
pneumococcal 7-valent conjugate vaccine (diphtheria CRM197 protein) *new-mo-kok'-kal-vak'-seen*	Prevnar	Active immunization against *Streptococcus pneumoniae* for infants and toddlers	Rare; minor local reactions such as local tenderness, pain at injection site, decreased appetite, irritability, drowsiness, malaise, nausea, diarrhea, fever	0.5 mL IM
Typhoid vaccine *tye'-foid-vak'-seen*	Typhim Vi, Vivotif Berna, *generic*	Immunization against typhoid	Same as for BCG vaccine	Oral: One capsule on alternate days 1h before a meal for a total of 4 capsules Parenteral: Adults and children 10 years and older, 2 doses of 0.5 mL SC; children younger than 10 years, 2 doses of 0.25 mL SC Booster: 0.1–0.5 mL intradermally

(*continued*)

SUMMARY DRUG TABLE AGENTS FOR ACTIVE IMMUNIZATION (*Continued*)

GENERIC NAME	TRADE NAME*	USES	ADVERSE REACTIONS	DOSAGE RANGES
Vaccines, Viral				
measles virus vaccine, live, attenuated *me'-zuls-vak'-seen*	Attenuvax	Active immunization against measles	Same as for BCG vaccine	0.5 mL SC
rubella virus vaccine, live *ru-bell'-a-vi'-rus-vak'-seen*	Meruvax II	Selective active immunization against rubella	Same as for BCG vaccine	Total volume of reconstituted vial SC
mumps virus vaccine, live *mumps-vi'-rus-vak'-seen*	Mumpsvax	Selective active immunization against mumps	Same as for BCG vaccine	0.5 mL SC (total volume of reconstituted vaccine)
rubella and mumps virus vaccine, live *ru-bell'-a-and mumps-vi'-rus-vak'-seen*	Biavax-II	Active immunization against rubella and mumps	Same as for BCG vaccine	0.5 mL SC
measles (rubeola) and rubella virus vaccine, live *me'-zuls-ru-be'-o-la and ru-bell'-ah*	M-R-Vax II	Active immunization against rubeola and rubella	Same as for BCG vaccine	0.5 mL SC
poliovirus vaccine, live, oral, trivalent (OPV; TOPV; Sabin) *po-lee'-o-vi'-rus-live*	Orimune	Active immunization against poliovirus	Rare; malaise, nausea, diarrhea, fever	Three doses 0.5 mL PO at specified intervals
Poliovirus vaccine, inactivated (IPV) *po-lee'-o-vi'-rus vak'-seen*	IPOL	Active immunizations for the poliovirus	Same as for BCG vaccine	Three doses of 0.5 mL SC at 2 months, 4 months, and 12–15 months; chidren receive a booster dose before entering school
Influenza virus vaccine *in-flu'-en-za-vi'-rus vak'-seen*	FluShield, Fluvirin, Fluzone	Active immunization against the specific influenza virus strains contained in the formulation	Same as for BCG vaccine	One or two doses of 0.25–0.5 mL IM
Japanese encephalitis virus vaccine *en-ceph'-ah-lie-tis vak'-seen*	JE-VAX	For active immunization against Japanese encephalitis for individuals older than 1 year	Same as for BCG vaccine	Three doses given to adults and children > 3 years: 1 mL SC on days 0, 7, and 30; children 1–3 years: 0.5 mL SC on days 0, 7, and 30
rotavirus vaccine *row'-ta-vi'-rus-vak'-seen*	RotaShield	Prevention of gastroenteritis caused by rotavirus serotypes contained in the vaccines	Fever, decreased appetite, abdominal cramping, irritability, and decreased activity	Three 2.5-mL doses given orally
yellow fever vaccine	YF-Vax	Active immunity against yellow fever virus, primarily among travelers to yellow fever endemic areas	Malaise, usually appearing 7–14 days after administration, myalgia, and headache	0.5 mL SC; booster dose suggested q10 years

SUMMARY DRUG TABLE AGENTS FOR ACTIVE IMMUNIZATION (*Continued*)

GENERIC NAME	TRADE NAME*	USES	ADVERSE REACTIONS	DOSAGE RANGES
hepatitis B vaccine, recombinant *hep-ah-tie'-tis-B-vak'-seen*	Engerix-B, Recombivax HB	Immunization against infections caused by all known subtypes of hepatitis B virus	Headache, light-headedness, vertigo, dizziness, paresthesia, insomnia, disturbed sleep, pruritus, rash, urticaria, erythema, nausea, vomiting, abdominal pain, dyspepsia, constipation, anorexia, diarrhea, hypersensitivity, local pain and soreness at injection site, swelling, induration, or tenderness at injection site, arthralgia, influenza-like symptoms, fatigue, tinnitus, earache	3–4 doses of 0.5–2 mL
hepatitis A vaccine, inactivated *hep-ah-tie'-tis A vak'-seen*	Havrix, Vaqta	Active immunization of individuals 2 months of age and older against disease caused by hepatitis A virus (HAV)	Headache, hypertonic episode, insomnia, photophobia, vertigo, pruritus, rash, urticaria, erythema, dermatitis, anorexia, nausea, abdominal pain, diarrhea, vomiting, arthralgia, pharyngitis, cough, fatigue, fever, and malaise, soreness, pain, tenderness, induration, redness, swelling, or rash at injection site	Administered IM; dosage varies with product. See package insert for specific dosages.
hepatitis A, inactivated and hepatitis B, recombinant vaccine *hep-ah-tie'-tis A in-ac'-ti-va-ted hep-ah-tie-tis B vak'-seen*	Twinrix	Active immunization against hepatitis A and B viruses	Same as for hepatitis A, inactivated	Administered IM in single-dose vial and single-dose prefilled syringes. See package insert for recommended dose.
varicella virus vaccine *var-i-sel-a-vak'-seen*	Varivax	Vaccination against varicella in people older than 1 year	Children: Upper respiratory illness, cough, irritability, nervousness, fatigue, disturbed sleep, diarrhea, loss of appetite, vomiting, otitis, diaper rash, headache, teething, malaise Adults: fever; injection site complaints of soreness, erythema, swelling, induration and numbness, varicellalike rash; upper respiratory illness; headache; fatigue; cough; myalgia; disturbed sleep; nausea; diarrhea; stiff neck; irritability; nervousness; constipation	Children 1–12 years: one dose 0.5 mL SC Adults: 0.5 mL; SC two doses
rabies vaccine *ray'-bees-vak'-seen*	Imovax Rabies I.D. Vaccine (human diploid cell), Imovax Rabies Vaccine (human diploid cell), RabAvert,	Pre-exposure: immunization of people with greater than usual risk of exposure to rabies virus by reason of occupation (eg, veterinarians laboratory workers, animal handlers, forest rangers, people staying more than	Transient pain, erythema, swelling or itching at the injection site, headache, nausea, abdominal pain, muscle aches, and dizziness	Pre-exposure prophylaxis: on days 0, 7, 21 to 28 and then q2–5 years based on antibody titers 1 mL IM (Imovax Rabies Vaccine or Rabies Vaccine Adsorbed) or

(*continued*)

SUMMARY DRUG TABLE AGENTS FOR ACTIVE IMMUNIZATION (*Continued*)

GENERIC NAME	TRADE NAME*	USES	ADVERSE REACTIONS	DOSAGE RANGES
	Rabies Vaccine Adsorbed	1 month in countries where rabies is a constant threat); post-exposure prophylaxis: bite by a carrier animal that is unprovoked and rabies is present in the area		0.1 mL I.D. (Imovax Rabies I.D.) Postexposure: Do not give intradermally, only IM, 20 IU/kg as soon as possible after exposure, followed by IM vaccine doses on days 0, 3, 7, 14 and 28
Toxoids				
tetanus toxoid *tet'-ah-nus-toks'-oyd*	Tetanus Toxoid, Adsorbed Tetanus Toxoid, Fluid	Active immunization of children older than 6 weeks and adults against tetanus	Cochlear lesion, brachial plexus neuropathies, paralysis of the radial nerve, accommodation paresis, EEG disturbances, urticaria, rash, malaise, fever, chills, pain, hypotension, nausea, and local redness, warmth, edema, induration and sterile abscess at injection site	0.5 mL IM
Diphtheria and tetanus toxoids, combined (DT;Td) *dip-ther'-ee-ah-tet'-ah-nus-toks'-oyds*	Diphtheria and Tetanus Toxoids, adsorbed (for pediatric use), Diphtheria and Tetanus Toxoids, adsorbed (for adult use)	Immunization against diphtheria and tetanus	See adverse reactions for both diphtheria and tetanus toxoids.	See package inserts for specific dosage.
Diphtheria and tetanus toxoids and acellular pertussis vaccine, adsorbed (DTaP) *dip-ther'-ee-ah-tet'-ah-nu-toks'-oyds-a-sell'-u-lar-per-tuss'-us*	Certiva, Infanrix, Tripedia	Active immunization against diphtheria, tetanus, and pertussis simultaneously	See adverse reactions for diphtheria and tetanus toxoids, and pertussis vaccine.	Follow package instructions for preparation and IM administration.
diphtheria and tetanus toxoids, acellular pertussis and *Haemophilus influenzae* type B	TriHIBit	Active immunization against diphtheria, tetanus, and pertussis and *Haemophilus influenzae type* B	See adverse reactions for diphtheria and tetanus toxoids, pertussis, and *Haemophilus influenzae* type B.	See package insert for specific dosages. For IM administration only, usual dose is 0.5 mL
Vaccine diphtheria and tetanus toxoids and acellular pertussis adsorbed, hepatitis B (recombinant) and inactivated poliovirus combined	Pediarix	Active immunization against diphtheria, tetanus, pertussis and all known subtypes of hepatitis B virus, and poliomyelitis immunization	See adverse reactions against individual vaccines.	Primary immunization series: 3 doses of 0.5 mL at 6- to 8-week intervals IM (first dose is 2 months of age, but may be given as early as 6 weeks of age)

*The term *generic* indicates the drug is available in generic form.

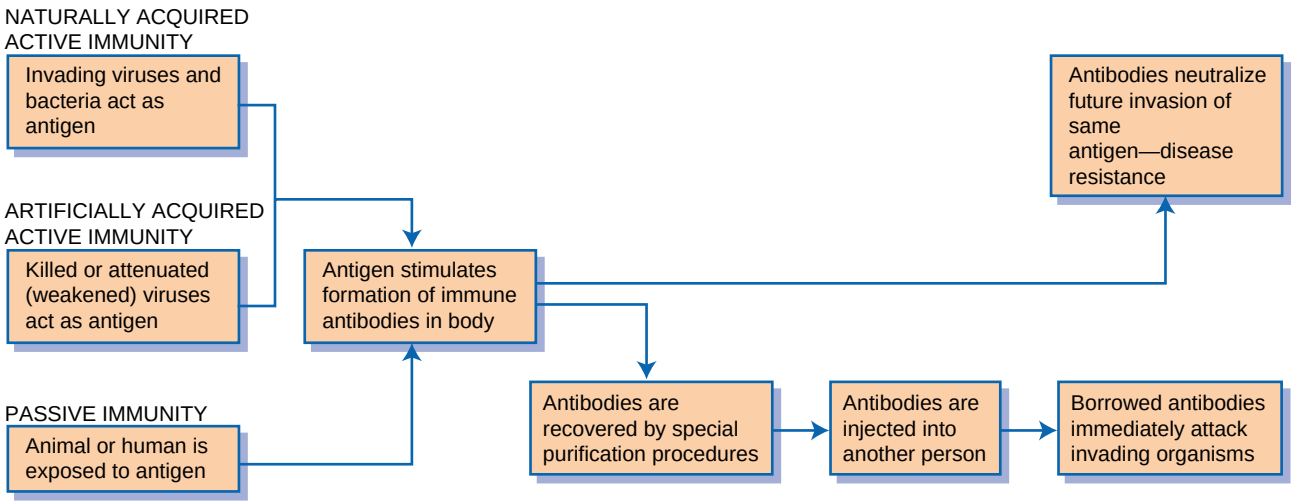


FIGURE 54-1. Active and passive immunity.

Artificially acquired immunity against some diseases may require periodic booster injections to keep an adequate antibody level (or antibody titer) circulating in the blood. A **booster** injection is the administration of an additional dose of the vaccine to "boost" the production of antibodies to a level that will maintain the desired immunity. The booster is given months or years after the initial vaccine and may be needed because the life of some antibodies is short.

The measles vaccine is considered an immunization. Immunization is a form of artificial active immunity and an important method of controlling some of the infectious diseases that are capable of causing serious and sometimes fatal consequences. The immunization schedule for children is given in Figure 54-2. Currently, many infectious diseases may be prevented by **vaccine** (artificial active immunity). Examples of some of these diseases can be found in Display 54-3.

PASSIVE IMMUNITY

Passive immunity is obtained from the administration of immune globulins or antivenins. This type of immunity provides the individual with ready-made antibodies from another human or an animal (see Fig. 54-1). Passive immunity provides immediate immunity to the invading antigen, but lasts for only a short time. The Summary Drug Table: Agents for Passive Immunity identifies agents for passive immunizations. Display 54-4 provides an example of passive immunity.

DISPLAY 54-3 ● Examples of Diseases Preventable by Vaccination

- cholera
- diphtheria
- *Haemophilus influenzae* type B
- hepatitis A
- hepatitis B
- influenza
- Japanese encephalitis
- Lyme disease
- mumps
- measles
- pertussis
- pneumococcal disease
- poliomyelitis
- rubella
- tetanus
- typhoid
- varicella
- yellow fever

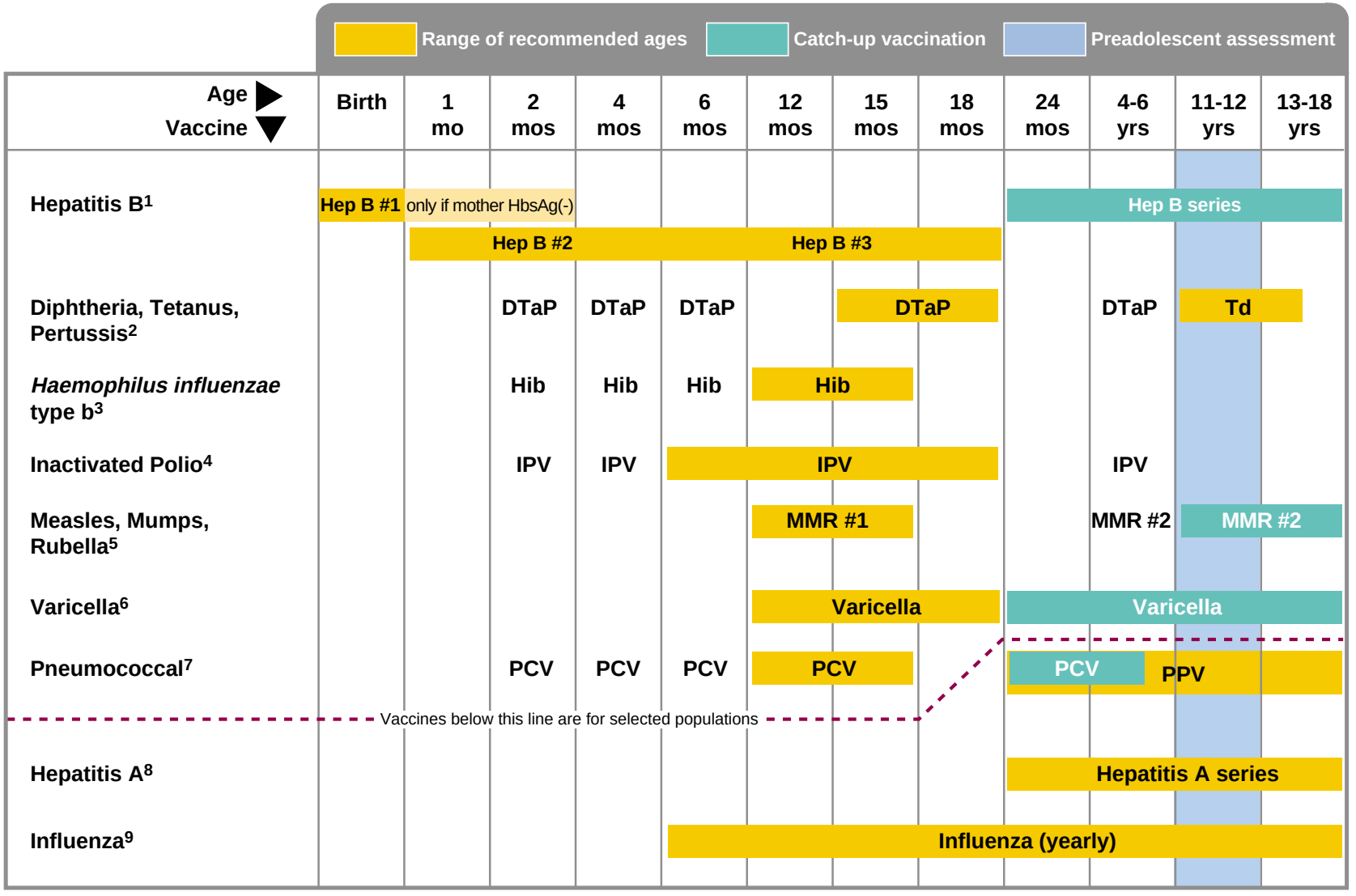
Herbal Alert: Echinacea

Echinacea, a frequently used herb, is taken to stimulate the immune system function by increasing the number and activity of immune cells and to stimulate phagocytosis (ingestion and destruction of bacteria and other harmful substances). It appears to shorten the duration of colds and influenza. The recommended dosage is:

- *500–1000 mg three times a day*
- *15–30 drops of tincture two to five times a day*

Most herbalists recommend that echinacea should be taken at the initial signs of infection, when symptoms first become apparent. Small repeated doses throughout the day may be better than taking larger doses less frequently. Because it is an immunosuppressant, the herb should not be taken for more than eight consecutive weeks. Seven to fourteen days of treatment is usually sufficient.

Although rare, side effects such as nausea and other mild gastrointestinal effects may occur. Individuals with allergies to daisy-type plants are more susceptible to reactions.



This schedule indicates the recommended ages for routine administration of currently licensed childhood vaccines, as of December 1, 2001, for children through age 18 years. Any dose not given at the recommended age should be given at any subsequent visit when indicated and feasible. Indicates age groups that warrant special effort to administer those vaccines not previously given. Additional vaccines may be licensed and recommended during the year. Licensed combination vaccines may be used whenever any components of the combination are indicated and the vaccine's other components are not contraindicated. Providers should consult the manufacturer's package inserts for detailed recommendations. Approved by the Advisory Committee on Immunization Practices (www.cdc.gov/nip/acip), the American Academy of Pediatrics (www.aap.org), and the American Academy of Family Physicians (www.aafp.org).

1. **Hepatitis B vaccine (Hep B).** All infants should receive the first dose of hepatitis B vaccine soon after birth and before hospital discharge; the first dose may also be given by age 2 months if the infant's mother is HBsAg-negative. Only monovalent hepatitis B vaccine can be used for the birth dose. Monovalent or combination vaccine containing Hep B may be used to complete the series; four doses of vaccine may be administered if combination vaccine is used. The second dose should be given at least 4 weeks after the first dose, except for Hib-containing vaccine which cannot be administered before age 6 weeks. The third dose should be given at least 16 weeks after the first dose and at least 8 weeks after the second dose. The last dose in the vaccination series (third or fourth dose) should not be administered before age 6 months.

   Infants born to HBsAg-positive mothers should receive hepatitis B vaccine and 0.5 mL hepatitis B immune globulin (HBIG) within 12 hours of birth at separate sites. The second dose is recommended at age 1–2 months and the vaccination series should be completed (third or fourth dose) at age 6 months.

   Infants born to mothers whose HBsAg status is unknown should receive the first dose of the hepatitis B vaccine series within 12 hours of birth. Maternal blood should be drawn at the time of delivery to determine the mother's HBsAg status; if the HBsAg test is positive, the infant should receive HBIG as soon as possible (no later than age 1 week).

2. **Diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP).** The fourth dose of DTaP may be administered as early as age 12 months, provided 6 months have elapsed since the third dose and the child is unlikely to return at age 15–18 months,. **Tetanus and diphtheria toxoids (Td)** is recommended at age 11–12 years if at least 5 years have elapsed since the last dose of tetanus and diphtheria toxoid-containing vaccine. Subsequent routine Td boosters are recommended every 10 years.

3. ***Haemophilus influenzae* type b (Hib) conjugate vaccine.** Three Hib conjugate vaccines are licensed for infant use. If PRP-OMP (PedvaxHIB or ComVax) is administered at ages 2 and 4 months, a dose at age 6 months is not required. DTaP/Hib combination products should not be used for primary immunization in infants at ages 2, 4 or 6 months, but can be used as boosters following any Hib vaccine.

4. **Inactivated polio vaccine (IPV).** An all-IPV schedule is recommended for routine childhood polio vaccination in the United States. All children should receive four doses of IPV at ages 2 months, 4 months, 6–18 months, and 4–6 years.

5. **Measles, mumps, and rubella vaccine (MMR).** The second dose of MMR is recommended routinely at age 4–6 years but may be administered during any visit, provided at least 4 weeks have elapsed since the first dose and that both doses are administered beginning at or after age 12 months. Those who have not previously received the second dose should complete the schedule by the 11–12-year-old visit.

6. **Varicella vaccine.** Varicella vaccine is recommended at any visit at or after age 12 months for susceptible children, ie, those who lack a reliable history of chickenpox. Susceptible persons aged >13 years should receive two doses, given at least 4 weeks apart.

7. **Pneumococcal vaccine.** The heptavalent **pneumococcal conjugate vaccine (PCV)** is recommended for all children age 2–23 months. It is also recommended for certain children age 24–59 months. **Pneumococcal polysaccharide vaccine (PPV)** is recommended in addition to PCV for certain high-risk groups. See *MMWR.* 2000;49(RR-9):1–35.

8. **Hepatitis A vaccine.** Hepatitis A vaccine is recommended for use in selected states and regions, and for certain high-risk groups; consult your local public health authority. See *MMWR.* 1999;48(RR-12):1–37.

9. **Influenza vaccine.** Influenza vaccine is recommended annually for children age > 6 months with certain risk factors (including but not limited to asthma, cardiac disease, sickle cell disease, HIV, diabetes; see *MMWR.* 2001;50(RR-4):1–44), and can be administered to all others wishing to obtain immunity. Children aged ≤12 years should receive vaccine in a dosage appropriate for their age (0.25 mL if age 6–35 months or 0.5 mL if age ≥3 years). Children aged ≤8 years who are receiving influenza vaccine for the first time should receive two doses separated by at least 4 weeks.

For additional information about vaccines, vaccine supply, and contraindications for immunization, please visit the National Immunization Program Web site at www.cdc.gov/nip or call the National Immunization Hotline at (800) 232-2522 (English) or (800) 232-0233 (Spanish).

FIGURE 54-2. Recommended childhood immunization schedule, United States, 2002.

SUMMARY DRUG TABLE AGENTS FOR PASSIVE IMMUNITY

GENERIC NAME	TRADE NAME*	USES	ADVERSE REACTIONS	DOSAGE RANGES
Immune Globulins				
cytomegalovirus immune globulin intravenous, human (CMV-IGIV) *sy-toe'-meg-a-lo-vi'-rus em-une'-glob'-u-lin*	CytoGam	Prophylaxis of CMV associated with organ transplant (kidney)	Flushing, chills, muscle cramps, back pain, fever, nausea, vomiting, wheezing, decrease in blood pressure	15 mg/kg IV over 30 min, increase to 30 mg/kg for 30 min, then 60 mg/kg to a maximum of 150 mg/kg
hepatitis B immune globulin (human) (HBIG) *hep-ah-ti'-tus-em-une'-glob'-u-lin*	BayHep B, Nabi-HB	Postexposure prophylaxis to blood containing HBsAg, peronatal exposure of infants born to HBsAg-positive mothers, sexual exposure to an HBsAg-positive person, household exposure to people with acute HBV infections	Local tenderness, pain, muscle stiffness at injection site, urticaria, angioedema, malaise, nausea, diarrhea, headache, chills, and fever	0.06 mL/kg (3–5 mL) IM
immune globulin (human) (IG; IGIM; gamma globulin; IgG) *em-une'-glob'-u-lin*	BayGam	Prophylaxis after exposure to hepatitis A, prevention or modification of measles in one who has not been vaccinated or has not had measles previously, immunoglobulin deficiency, passive immunity against varicella, and rubella	Same as HBIG	0.02 mL/kg (0.1 mL/lb)–1.2 mL/kg IM
immune globulin intravenous (IGIV) *em-une'-glob'-u-lin*	Gamimune N, Gammagard S/D, Gammar-P I.V., Iveegam, Polygam S/D, Sandoglobulin, Venoglobulin	Immunodeficiency syndrome, idiopathic thrombocytopenic purpura, B-cell chronic lymphocytic leukemia (Gammagard S/D, Polygam SID), bone marrow transplantation (Gamimune N only), pediatric HIV (Gamimune N only)	Same as HBIG	100–400 mg/kg IV; dosage varies, see package insert
lymphocyte immune globulin, antithymocyte globulin (equine) *lymph'-o-site-em-une'-glob'-u-lin*	Atgam	Renal transplantation, aplastic anemia	Same as HBIG	Adults: 10–30 mg/kg/d Children: 5–25 mg/kg/d IV
rabies immune globulin, human (RIG) *ray'-bees-em-une'-glob'-u-lin*	Bay Bab, Imogam	Immunization for those suspected of exposure to rabies	Same as HBIG	20 IU/kg IM
Rh (D) immune globulin (RH [D] IGIM) *R-h-d-em-une' glob'-u-lin*	Gamulin Rh, RhoGAM	Prevention of Rh hemolytic disease	Same as HBIG	300 mcg (1 vial) IM within 72 h of delivery

SUMMARY DRUG TABLE AGENTS FOR PASSIVE IMMUNITY (*Continued*)

GENERIC NAME	TRADE NAME*	USES	ADVERSE REACTIONS	DOSAGE RANGES
Rh (D) immune globulin IV (human) (Rh [D] IGIV) *R-h-d-em-une'-glob'-u-lin*	WinRho SDF	Suppression of Rh isoimmunization in nonsensitized Rh (D)-negative women, immune thrombocytopenic purpura, transfusion to suppress Rh isoimmunization in Rh (D)-negative female children and female adults in their childbearing years	Same as HBIG	300–1200 mcg IM or IV
Rh (D) immune globulin micro-dose (Rh [D] IG) *r-h-d-em-une'-glob'-u-lin*	BayRho-D Mini Dose, MICRhoGAM	Prevent isoimmunization of Rh (D)-negative women at the time of spontaneous or induced abortion	Local tenderness, pain, muscle stiffness at injection site, urticaria	50 mcg (1 vial) IM
Respiratory syncytial virus immune globulin IV (human) (RSV-IGIV) *sin-sish'-al-vi'-rus em-une'-glob'-u-lin*	RespiGam	Respiratory syncytial virus (RSV)	Same as HBIG	1.5–6 mL/kg/h IV to a total monthly infusion of 750 mg/kg
tetanus immune globulin (human) (TIG) *tet'-ah-nus-em-une'-glob'-u-lin*	BayTet	Tetanus prophylaxis after injury in patients whose immunization is incomplete or uncertain	Same as HBIG	250 units IM
varicella-zoster immune globulin (human) (VZIG) *var'-i-sel-a-zos-ter'-em-une'-glob'-u-lin*	*Generic*	Passive immunization of exposed, susceptible individuals who are at greater risk of complications from varicella than are healthy individuals	Same as HBIG	125–625 units IM (dosage varies depending on weight). See package insert for exact dosage.
Antivenins				
Crotalidae polyvalent immune Fab (ovine origin) *kro-tal'-i-day pol-ee-va-lent em-une'-fab*	CroFab	For treatment of mild to moderate North American rattlesnake bites	Same as HBIG	4–6 vials, depending on severity of symptoms, dilute each vial with 10 mL sterile water, then with 250 mL 0.9% sodium chloride; give each 250 mL over 60 min
Antivenin *(micrurus fulvius)* *an-tee'-ven-in*	*Generic*	Passive transient protection for toxic effects of venoms of coral snake in U.S.	Same as HBIG	30–50 mL slow IV injection; flush with IV fluids after antivenin has been infused; may require up to 100 mL

*The term *generic* indicates the drug is available in generic form.

Herbal Alert: Shiitake

The shiitake mushroom is an edible variety of mushroom and is not associated with severe adverse reactions. Mild side effects such as skin rashes or gastrointestinal upsets have been reported. The recommended dosage for general health maintenance:

- *3–4 fresh shiitake mushrooms*
- *1–5 capsules/day*
- *1 dropper two to three times a day*

Lentinan, a derivative of the shiitake mushroom, is proving to be valuable in boosting the body's immune system and may prolong the survival time of patients with cancer by supporting immunity. In Japan, lentinan is commonly used to treat cancer. Additional possible benefits of this herb are to lower cholesterol levels by increasing the rate at which cholesterol is excreted from the body. Under no circumstances should shiitake or lentinan be used for cancer or any serious illness without consulting a primary health care provider.

IMMUNOLOGIC AGENTS

Some immunologic agents capitalize on the body's natural defenses by stimulating the immune response, thereby creating within the body protection to a specific disease. Other immunologic agents supply ready-made antibodies to provide passive immunity. Examples of immunologic agents include vaccines, toxoids, and immune globulins.

ACTIONS AND USES

Vaccines and Toxoids

Antibody-producing tissues cannot distinguish between an antigen that is capable of causing disease (a live antigen), an attenuated antigen, or a killed antigen. Because of this phenomenon, vaccines, which contain either an attenuated or a killed antigen, have been developed to create immunity to certain diseases. The live antigens are either killed or weakened during the manufacturing process. Although the vaccine contains weakened or killed antigens, they do not have sufficient strength to cause disease. Although rare, vaccination with any vaccine may not result in a protective antibody response in all individuals given the vaccine.

A **toxin** is a poisonous substance produced by some bacteria, such as *Clostridium tetani*, the bacteria that cause tetanus. A toxin is capable of stimulating the body to produce antitoxins, which are substances that act in the same manner as antibodies. Toxins are powerful substances, and like other antigens, they can be attenuated. A toxin that is attenuated (or weakened) but still capable of stimulating the formation of antitoxins is called a **toxoid.**

Both vaccines and toxoids are administered to stimulate the immune response within the body to specific antigens or toxins. These agents must be administered before exposure to the pathogenic organism. The initiation of the immune response, in turn, produces resistance to a specific infectious disease. The immunity produced in this manner is active immunity. Display 54-5 gives examples of indications for use of toxoids and vaccines.

Immune Globulins and Antivenins

Globulins are proteins present in blood serum or plasma, which contain antibodies. **Immune globulins** are solutions obtained from human blood containing antibodies that have been formed by the body to specific antigens. Because they contain ready-made antibodies, they are given for passive immunity against disease. The immune globulins are administered to provide passive immunization to one or more infectious diseases. Those receiving immune globulins receive antibodies only to the diseases to which the donor blood is immune. The onset of protection is rapid but of short duration (1–3 months).

Antivenins are used for passive, transient protection from the toxic effects of bites by spiders (black widow and similar spiders) and snakes (rattlesnakes, copperhead and cottonmouth, and coral). The most effective response is obtained when the drug is administered within 4 hours after exposure.

DISPLAY 54-4 ● Example of Passive Immunity

An example of passive immunity is the administration of immune globulins (see Summary Drug Table: Agents for Passive Immunity), such as hepatitis B immune globulin. Administration of this vaccine is an attempt to prevent hepatitis B after the individual has been exposed to the virus.

DISPLAY 54-5 ● Uses of Vaccines and Toxoids

- Routine immunization of infants and children (see Fig. 54-1)
- Immunization of adults against tetanus
- Adults at high risk for certain diseases (eg, pneumococcal and influenza vaccines for individuals with serious respiratory disorders)
- Children or adults at risk for exposure to a particular disease (eg, hepatitis B for health care workers)
- Immunization of prepubertal girls or nonpregnant women of childbearing age against rubella

ADVERSE REACTIONS

Vaccines and Toxoids

Adverse reactions from the administration of vaccines or toxoids are usually mild. Chills, fever, muscular aches and pains, rash, and lethargy may be present. Pain and tenderness at the injection site may also occur. Although rare, a hypersensitivity reaction may occur. The Summary Drug Table: Agents for Active Immunization provides a listing of the more rare, but serious, adverse reactions.

Immune Globulins and Antivenins

Adverse reactions to immune globulins are rare. However, local tenderness and pain at the injection site may occur. The most common adverse reactions include urticaria, angioedema, erythema, malaise, nausea, diarrhea, headache, chills, and fever. Adverse reactions, if they occur, usually last for several hours. Systemic reactions are extremely rare.

The antivenins may cause various reactions, with hypersensitivity being the most severe. Some antivenins are prepared from horse serum, and if a patient is sensitive to horse serum, serious reactions and death may result. The immediate reactions usually occur within 30 minutes after administration of the antivenin. Symptoms include apprehension; flushing; itching; urticaria; edema of the face, tongue, and throat; cough; dyspnea; vomiting; cyanosis; and collapse. Other adverse reactions are included in the Summary Drug Table: Agents for Passive Immunity.

CONTRAINDICATIONS AND PRECAUTIONS

Vaccines and Toxoids

Immunologic agents are contraindicated in patients with known hypersensitivity to the agent or any component of it. The measles, mumps, rubella, and varicella vaccines are contraindicated in patients who have ever had an allergic reaction to gelatin, neomycin, or a previous dose of one of the vaccines. The measles, mumps, rubella, and varicella vaccines are contraindicated during pregnancy, especially during the first trimester, because of the danger of birth defects. Women are instructed to wait at least 3 months before getting pregnant after receiving these vaccines. Vaccines and toxoids are contraindicated during acute febrile illnesses, leukemia, lymphoma, immunosuppressive illness or drug therapy, and nonlocalized cancer. See Display 54-6 for additional information on the contraindications for immunologic agents.

DISPLAY 54-6 ● Contraindications for Immunization

- Moderate or severe illness, with or without fever
- Anaphylactoid reactions (eg, hives, swelling of the mouth and throat, difficulty breathing [dyspnea], hypotension, and shock)
- Known allergy to vaccine or vaccine constituents, particularly gelatin, eggs, or neomycin
- Individuals with an immunologic deficiency should not receive a vaccine (virus is transmissible to the immunocompromised individual).
- Immunizations are postponed during the administration of steroids, radiation therapy, and antineoplastic (anticancer) drug therapy.
- Virus vaccines against measles, rubella, and mumps should not be given to pregnant women.
- Patients who experience severe systemic or neurologic reactions after a previous dose of the vaccine should not be given any additional doses.

The immunologic agents are used with extreme caution in individuals with a history of allergies. Sensitivity testing may be performed in individuals with a history of allergies. No adequate studies have been conducted in pregnant women, and it is not known whether these agents are excreted in breast milk. Thus, the immunologic agents (Pregnancy Category C) are used with caution in pregnant women and during lactation.

Immune Globulins and Antivenins

The immune globulins are contraindicated in patients with a history of allergic reactions after administration of human immunoglobulin preparations and individuals with isolated immunoglobulin A (IgA) deficiency (individuals could have an anaphylactic reaction to subsequent administration of blood products that contain IgA).

Nursing Alert

Human immune globulin intravenous (IGIV) products have been associated with renal impairment, acute renal failure, osmotic nephrosis, and death. Individuals with a predisposition to acute renal failure, such as those with preexisting renal disease, diabetes mellitus, individuals older than 65 years, or patients receiving nephrotoxic drugs should not be given human IGIV products.

The antivenins are contraindicated in patients with hypersensitivity to horse serum or any other component of the serum.

The immune globulins and antivenins are administered cautiously during pregnancy (Pregnancy Category C) and lactation and in children.

INTERACTIONS

Vaccines and Toxoids

Vaccinations containing live organisms are not administered within 3 months of immune globulin administration because antibodies in the globulin preparation may interfere with the immune response to the vaccination. Corticosteroids, antineoplastic drugs, and radiation therapy depress the immune system to such a degree that insufficient numbers of antibodies are produced to prevent the disease. When the salicylates are administered with the varicella vaccination, there is an increased risk of Reye's syndrome developing.

Immune Globulins and Antivenins

Antibodies in the immune globulin preparations may interfere with the immune response to live virus vaccines, particularly measles, but also others, such as mumps and rubella. It is recommended that the live virus vaccines be administered 14 to 30 days before or 6 to 12 weeks after administration of immune globulins. No known interactions have been reported with antivenins.

NURSING PROCESS

The Patient Receiving an Immunologic Agent

ASSESSMENT

Preadministration Assessment

Before the administration of any vaccine, the nurse obtains an allergy history. If the individual is known or thought to have allergies of any kind, the nurse tells the primary health care provider before the vaccine is given. Some vaccines contain antibodies obtained from animals, whereas other vaccines may contain proteins or preservatives to which the individual may be allergic. A highly allergic person may have an allergic reaction that could be serious and even fatal. If the patient has an allergy history, the primary health care provider may decide to perform skin tests for allergy to one or more of the components or proteins in the vaccine. The nurse also determines whether the patient has any conditions that contraindicate the administration of the agent (eg, cancer, leukemia, lymphoma, immunosuppressive drug therapy).

Ongoing Assessment

The patient is usually not hospitalized after administration of an immunologic agent. However, the patient may be asked to stay in the clinic or office for observation for about 30 minutes after the injection to observe for any signs of hypersensitivity (eg, laryngeal edema, hives, pruritus, angioneurotic edema, and severe dyspnea [see Chap. 2 for additional information]). Emergency resuscitation equipment is kept available to be used in the event of a severe hypersensitivity reaction.

Nursing Diagnoses Checklist

- ✓ **Risk of Injury** related to the development of infectious disease, hypersensitivity to the immunologic agent
- ✓ **Risk for Imbalanced Body Temperature** related to adverse reaction of vaccination
- ✓ **Pain** related to adverse reactions (pain and discomfort at the injection site, muscular aches and pain)

NURSING DIAGNOSES

Drug-specific nursing diagnoses are highlighted in the Nursing Diagnoses Checklist. Other nursing diagnoses applicable to these drugs are discussed in depth in Chapter 4.

PLANNING

The expected outcomes of the patient may include an optimal response to the immunologic agent, management of common adverse drug effects, and an understanding of and compliance with the prescribed immunization schedule.

IMPLEMENTATION

Promoting an Optimal Response to Therapy

If a vaccine is not in liquid form and must be reconstituted, the nurse must read the directions enclosed with the vaccine. It is important to follow the enclosed directions carefully. Package inserts also contain information regarding dosage, adverse reactions, method of administration, administration sites (when appropriate), and, when needed, recommended booster schedules.

On occasion, it may be necessary to postpone the regular immunization schedule, particularly for children. This is of special concern to parents. The decision to delay immunization because of illness or for other reasons must be discussed with the primary health care provider. However, the decision to administer or delay vaccination because of febrile illness (illness causing an elevated temperature) depends on the severity of the symptoms and the specific disorder. In general, all vaccines can be administered to those with minor illness, such as a cold virus and to those with a low-grade fever. However, moderate or severe febrile illness is a contraindication. In instances of moderate or severe febrile illness, vaccination is done as soon as the acute phase of

the illness is over. Display 54-6 lists general contraindications for immunizations. Specific contraindications and precautions may be found in the package insert that comes with the drug.

The nurse documents the following information in the patient's chart or form provided by the institution:

- Date of vaccination
- Route and site, vaccine type, manufacturer
- Lot number and expiration date
- Name, address, and title of individual administering vaccine

Monitoring and Managing Adverse Reactions

Minor adverse reactions, such as fever, rashes, and aching of the joints, are possible with the administration of a vaccine. In most cases, these reactions subside within 48 hours.

Nursing Alert

In most cases, the risk of serious adverse reactions from an immunization is much smaller than the risk of contracting the disease for which the immunizing agent is given.

General interventions, such as increasing the fluids in the diet, allowing for adequate rest, and keeping the atmosphere quiet and nonstimulating, may be beneficial. The primary health care provider may prescribe acetaminophen, every 4 hours, to control these reactions. Local irritation at the injection site may be treated with warm or cool compresses, depending on the patient's preference. A lump may be palpated at the injection site after a diphtheria, pertussis, tetanus (DPT) injection or other immunization. This is not abnormal and will resolve itself within several days to several months.

Vaccine Adverse Event Reporting System

The Vaccine Adverse Event Reporting System (VAERS) is a national vaccine safety surveillance program co-sponsored by the Centers for Disease Control and Prevention (CDC) and the Food and Drug Administration (FDA). VAERS collects and analyzes information from reports of adverse reactions after immunization. Anyone can report to VAERS, and reports are sent in by vaccine manufacturers, health care providers, and vaccine recipients and their parents or guardians. An example of the VAERS and instructions for completing the form are found in Appendix F. Any clinically significant adverse event that occurs after the administration of any vaccine should be reported. Individuals are encouraged to provide the information on the form even if the individual is uncertain if the event was related to the immunization. A copy of the form can be obtained by calling 1-800-822-7967 or by downloading it from the Internet at http://www.vaers.org.

Educating the Patient and Family

Because of the effectiveness of various types of vaccines in the prevention of disease, nurses must inform the public about the advantages of immunization. Parents are encouraged to have infants and young children receive the immunizations suggested by the primary health care provider.

The nurse advises those traveling to a foreign country to contact their primary health care provider or local health department well in advance of their departure date for information about the immunizations that will be needed. Immunizations should be given well in advance of departure because it may take several weeks to produce adequate immunity.

When an adult or child is receiving a vaccine for immunization, the nurse explains to the patient or a family member the possible reactions that may occur, for example, soreness at the injection site or fever.

Serious viral infections of the central nervous system and fatalities have been associated with the use of vaccines. Although the number of these incidents is small, a risk factor still remains when some vaccines are given. It is also important for the parents to understand that a risk is also associated with not receiving immunization against some infectious diseases. That risk may be higher and just as serious as the risk associated with the use of vaccines. It must also be remembered that when a large segment of the population is immunized, the small number of those not immunized are less likely to be exposed to and be infected with the disease-producing microorganism. However, when large numbers of the population are not immunized, there is a great increase in the chances of exposure to the infectious disease and a significant increase in the probability that the individual will experience the disease.

The nurse encourages the parents or guardians to report any adverse reactions or serious adverse events occurring after administration of a vaccine. It may be necessary to report the event to VAERS.

The following summarizes the information to be included when educating the parents of a child receiving a vaccination.

- Discuss briefly the risks of contracting vaccine-preventable diseases and the benefits of immunization.
- Instruct the parents to bring immunization records to all visits.
- Provide the date for return for the next vaccination.
- Discuss common adverse reactions (eg, fever, soreness at the injection site) and methods to combat these reactions (eg, acetaminophen, warm compresses).

- Instruct the parents to report any unusual or severe adverse reactions after the administration of a vaccination.

EVALUATION

- The therapeutic effect is achieved and the disease for which immunization is given does not present itself.
- Adverse drug reactions are managed successfully.
- The patient or parents/guardians comply with the immunization schedule.
- The patient and family express an understanding of the need for immunizations.

Critical Thinking Exercises

1. *Ms. Wilson has brought her 2-month-old daughter, Michelle, to the clinic for the first of the series of three DPT and oral polio vaccine (OPV) immunizations. Ms. Wilson asks you to explain how a vaccination will keep her daughter from getting sick and why she has to have three injections. Discuss how you would address these topics with Ms. Wilson.*
2. *Jimmy, age 4 months, has a slight cold with a "runny nose" when he comes for his regular well-baby checkup. His mother tells the nurse that because Jimmy is sick, she does not think he needs his DPT injection at this time. She says that she will bring him in next month for this immunization. Analyze the situation to determine the best response to Jimmy's mother. Discuss any assessments that you think would be important to make before giving your response.*

Review Questions

1. When discussing the possibility of adverse reactions after receiving a vaccine, the nurse tells the parents of a young child that _____.
   - **A.** adverse reactions may be severe, and the child should be monitored closely for 24 hours
   - **B.** adverse reactions are usually mild
   - **C.** the child will likely experience a hypersensitivity reaction
   - **D.** the most common adverse reaction is a severe headache
2. Which of the following statements made by the patient would alert the nurse to a possibility of an allergy to the measles vaccine? My daughter is allergic to _____.
   - **A.** Jell-O
   - **B.** peanut butter
   - **C.** sugar
   - **D.** corn
3. What type of immunity does an antivenin produce?
   - **A.** Artificially acquired active immunity
   - **B.** Naturally acquired active immunity
   - **C.** Passive immunity
   - **D.** Cell-mediated immunity
4. What type of immunity will be produced by the hepatitis B vaccine recombinant?
   - **A.** Artificially acquired active immunity
   - **B.** Naturally acquired active immunity
   - **C.** Passive immunity
   - **D.** Cell-mediated immunity