All current VISs are available on the Internet at two websites: the CDC's Vaccines & Immunizations site *(www.cdc.gov/vaccines/hcp/vis/)* and the Immunization Action Coalition's site *(www.immunize.org/vis/)*. (The latter site also includes translations of the VISs.) VISs from these sites can be downloaded and printed.

STORAGE AND HANDLING

Injectable vaccines are packaged in multidose vials, single-dose vials, or manufacturer-filled single-dose syringes. The live attenuated nasal-spray influenza vaccine is packaged in single-dose sprayers. Oral typhoid vaccine is packaged in capsules. Some vaccines, such as MMR, varicella, zoster, and meningococcal polysaccharide vaccines, come as lyophilized (freeze-dried) powders that must be reconstituted (i.e., mixed with a liquid diluent) before use. The lyophilized powder and the diluent come in separate vials. Diluents are not interchangeable but rather are specifically formulated for each type of vaccine; only the specific diluent provided by the manufacturer for each type of vaccine should be used. Once lyophilized vaccines have been reconstituted, their shelf-life is limited and they must be stored under appropriate temperature and light conditions. For example, varicella and zoster vaccines must be protected from light and administered within 30 min of reconstitution; MMR vaccine likewise must be protected from light but can be used up to 8 h after reconstitution. Single-dose vials of meningococcal polysaccharide vaccine must be used within 30 min of reconstitution, while multidose vials must be used within 35 days.

Vaccines are stored either at refrigerator temperature (2–8°C) or at freezer temperature (–15°C or colder). In general, inactivated vaccines (e.g., inactivated influenza, pneumococcal polysaccharide, and meningococcal conjugate vaccines) are stored at refrigerator temperature, while vials of lyophilized-powder live-virus vaccines (e.g., varicella, zoster, and MMR vaccines) are stored at freezer temperature. Diluents for lyophilized vaccines may be stored at refrigerator or room temperature. Live attenuated influenza vaccine—a live-virus liquid formulation administered by nasal spray—is stored at refrigerator temperature.

Vaccine storage and handling errors can result in the loss of vaccines worth millions of dollars, and administration of improperly stored vaccines may elicit inadequate immune responses in patients. To improve the standard of vaccine storage and handling practices, the CDC has published detailed guidance (available at *www.cdc.gov/vaccines/recs/storage/toolkit/storage-handling-toolkit.pdf*). For vaccine storage, the CDC recommends stand-alone units—i.e., self-contained units that either refrigerate or freeze but do not do both—as these units maintain the required temperatures better than combination refrigerator/freezer units. Dormitory-style combined refrigerator/freezer units should never be used for vaccine storage.

The temperature of refrigerators and freezers used for vaccine storage must be monitored and the temperature recorded at least twice each workday. Ideally, continuous thermometers that measure and record temperature all day and all night are used, and minimum and maximum temperatures are read and documented each workday. The CDC recommends the use of calibrated digital thermometers with a probe in a glycol-filled bottle; more detailed information on specifications of storage units and temperature-monitoring devices is provided at the link given above.

ADMINISTRATION OF VACCINES

Most parenteral vaccines recommended for routine administration to adults in the United States are given by either the IM or the SC route; one influenza vaccine formulation approved for use in adults 18–64 years of age is given intradermally. Live-virus vaccines such as varicella, zoster, and MMR are given SC. Most inactivated vaccines are given IM, except for meningococcal polysaccharide vaccine, which is given SC. The 23-valent pneumococcal polysaccharide vaccine may be given either IM or SC, but IM administration is preferred because it is associated with a lower risk of injection-site reactions.

Vaccines given to adults by the SC route are administered with a 5/8-inch needle into the upper outer-triceps area. Vaccines administered to adults by the IM route are injected into the deltoid muscle

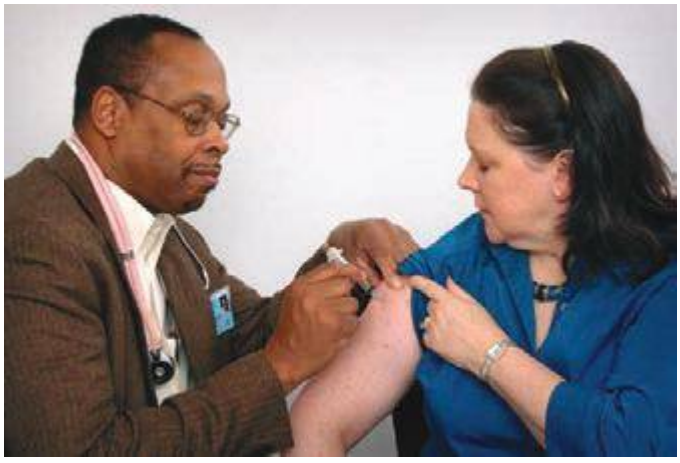

FIGURE 148-2 Technique for IM administration of vaccine. *(Photo credit: James Gathany, Centers for Disease Control and Prevention; accessible at Public Health Image Library, www.cdc.gov. PHIL ID#9420.)*

(Fig. 148-2) with a needle whose length should be selected on the basis of the recipient's sex and weight to ensure adequate penetration into the muscle. Current guidelines indicate that, for men and women weighing <152 lbs (<70 kg), a 1-inch needle is sufficient; for women weighing 152–200 lbs (70–90 kg) and men weighing 152–260 lbs (70–118 kg), a 1- to 1.5-inch needle is needed; and for women weighing >200 lbs (>90 kg) and men weighing >260 lbs (>118 kg), a 1.5-inch needle is required. Additional illustrations of vaccine injection locations and techniques may be found at *www.immunize.org/catg.d/p2020a.pdf*.

Aspiration, the process of pulling back on the plunger of the syringe after skin penetration but prior to injection, is not necessary because no large blood vessels are present at the recommended vaccine injection sites.

Multiple vaccines can be administered at the same visit; indeed, administration of all needed vaccines at one visit is encouraged. Studies have shown that vaccines are as effective when administered simultaneously as they are individually, and simultaneous administration of multiple vaccines is not associated with an increased risk of adverse effects. If more than one vaccine must be administered in the same limb, the injection sites should be separated by 1–2 inches so that any local reactions can be differentiated. If a vaccine and an immune globulin preparation are administered simultaneously (e.g., Td vaccine and tetanus immune globulin), a separate anatomic site should be used for each injection.

For certain vaccines (e.g., HPV vaccine and hepatitis B vaccine), multiple doses are required for an adequate and persistent antibody response. The recommended vaccination schedule specifies the interval between doses. Many adults who receive the first dose in a multiple-dose vaccine series do not complete the series or do not receive subsequent doses within the recommended interval. For example, at least one-third of adults who receive the first dose of hepatitis B vaccine in the three-dose series do not complete the series. In these circumstances, vaccine efficacy and/or the duration of protection may be compromised. Providers should implement recall systems that will prompt patients to return for subsequent doses in a vaccination series at the appropriate intervals. With the exception of oral typhoid vaccination, an interruption in the schedule does not require restarting of the entire series or the addition of extra doses.

Syncope may follow vaccination, especially in adolescents and young adults. Serious injuries, including skull fracture and cerebral hemorrhage, have occurred. Adolescents and adults should be seated or lying down during vaccination. The majority of reported syncope episodes after vaccination occur within 15 min. The ACIP recommends that vaccine providers strongly consider observing patients, particularly adolescents, with patients seated or lying down for 15 min after vaccination. If syncope develops, patients should be observed until the symptoms resolve.