TABLE 104-2 VACCINATION OF CANCER PATIENTS RECEIVING CHEMOTHERAPY[a]

Vaccine	Use in Indicated Patients		
	Intensive Chemotherapy	Hodgkin's Disease	Hematopoietic Stem Cell Transplantation
Diphtheria-tetanus[b]	Primary series and boosters as necessary	No special recommendation	3 doses given 6–12 months after transplantation
Poliomyelitis[c]	Complete primary series and boosters	No special recommendation	3 doses given 6–12 months after transplantation
Haemophilus influenzae type b conjugate	Primary series and booster for children	Single dose for adults	3 doses given 6–12 months after transplantation (separated by 1 month)
Human papillomavirus (HPV)	Quadrivalent HPV vaccine is approved for males and females 9–26 years of age. Check Centers for Disease Control and Prevention (CDC) website *(www.cdc.gov/vaccines)* for updated recommendations.	Quadrivalent HPV vaccine is approved for males and females 9–26 years of age. Check CDC website *(www.cdc.gov/vaccines)* for updated recommendations.	Quadrivalent HPV vaccine is approved for males and females 9–26 years of age. Check CDC website *(www.cdc.gov/vaccines)* for updated recommendations.
Hepatitis A	As indicated for normal hosts on the basis of occupation and lifestyle	As indicated for normal hosts on the basis of occupation and lifestyle	As indicated for normal hosts on the basis of occupation and lifestyle
Hepatitis B	Same as for normal hosts	As indicated for normal hosts on the basis of occupation and lifestyle	3 doses given 6–12 months after transplantation
Pneumococcal conjugate vaccine (PCV13) Pneumococcal polysaccharide vaccine (PPSV23)[d]	Finish series prior to chemotherapy if possible	Patients with splenectomy should receive PPSV23.	Three doses of PCV13, beginning 3–6 months after transplantation, are followed by a dose of PPSV23 at least 8 weeks later. A second PPSV23 dose can be given 5 years later.
Quadrivalent meningococcal vaccine[e]	Should be administered to splenectomized patients and to patients living in endemic areas, including college students in dormitories	Should be administered to splenectomized patients and to patients living in endemic areas, including college students in dormitories. An additional dose can be given after 5 years.	Should be administered to splenectomized patients and to patients living in endemic areas, including college students in dormitories. An additional dose can be given after 5 years.
Influenza	Seasonal immunization	Seasonal immunization	Seasonal immunization (A seasonal dose is recommended and can be given as early as 4 months after transplantation; if given <6 months after transplantation, an additional dose is recommended.)
Measles/mumps/rubella	Contraindicated	Contraindicated during chemotherapy	After 24 months in patients without graft-versus-host disease
Varicella-zoster virus[f]	Contraindicated[g]	Contraindicated	Contraindicated (CDC recommends use on a case-by-case basis following reevaluation.)

[a]The latest recommendations by the Advisory Committee on Immunization Practices and the CDC guidelines can be found at *http://www.cdc.gov/vaccines.* [b]A single dose of TDaP (tetanus–diphtheria–acellular pertussis), followed by a booster dose of Td (tetanus-diphtheria) every 10 years, is recommended for adults. [c]Live-virus vaccine is contraindicated; inactivated vaccine should be used. [d]Two types of vaccine are used to prevent pneumococcal disease. A conjugate vaccine active against 13 serotypes (13-valent pneumococcal conjugate vaccine, or PCV13) is currently administered in three separate doses to all children. A polysaccharide vaccine active against 23 serotypes (23-valent pneumococcal polysaccharide vaccine, or PPSV23) elicits titers of antibody lower than those achieved with the conjugate vaccine, and immunity may wane more rapidly. Because the ablative chemotherapy given to recipients of hematopoietic stem cell transplants (HSCTs) eradicates immunologic memory, revaccination is recommended for all such patients. Vaccination is much more effective once immunologic reconstitution has occurred; however, because of the need to prevent serious disease, pneumococcal vaccine should be administered 6–12 months after transplantation in most cases. Because PPSV23 includes serotypes not present in PCV13, HSCT recipients should receive a dose of PPSV23 at least 8 weeks after the last dose of PCV13. Although antibody titers from PPSV23 clearly decay, experience with multiple doses of PPSV23 is limited, as are data on the safety, toxicity, or efficacy of such a regimen. For this reason, the CDC currently recommends the administration of one additional dose of PPSV23 at least 5 years after the last dose to immunocompromised patients, including transplant recipients, as well as patients with Hodgkin's disease, multiple myeloma, lymphoma, or generalized malignancies. Beyond this single additional dose, further doses are not recommended at this time. [e]Meningococcal conjugate vaccine MenACWY is recommended for adults ≤55 years old, and meningococcal polysaccharide vaccine (MPSV4) is recommended for those ≥56 years old. [f]Includes both varicella vaccine for children and zoster vaccine for adults. [g]Contact the manufacturer for more information on use in children with acute lymphocytic leukemia.

The level of suspicion of infections with certain organisms should depend on the type of cancer diagnosed (Table 104-3). Diagnosis of multiple myeloma or CLL should alert the clinician to the possibility of hypogammaglobulinemia. While immunoglobulin replacement therapy can be effective, in most cases prophylactic antibiotics are a cheaper, more convenient method of eliminating bacterial infections in CLL patients with hypogammaglobulinemia. Patients with acute lymphocytic leukemia (ALL), patients with non-Hodgkin's lymphoma, and all cancer patients treated with high-dose glucocorticoids (or glucocorticoid-containing chemotherapy regimens) should receive antibiotic prophylaxis for *Pneumocystis* infection (Table 104-3) for the duration of their chemotherapy. In addition to exhibiting susceptibility to certain infectious organisms, patients with cancer are likely to manifest their infections in characteristic ways. For example, fever—generally a sign of infection in normal hosts—continues to be a reliable indicator in neutropenic patients. In contrast, patients receiving glucocorticoids and agents that impair T cell function and cytokine secretion may have serious infections in the absence of fever. Similarly, neutropenic patients commonly present with cellulitis without purulence and with pneumonia without sputum or even x-ray findings (see below).

The use of monoclonal antibodies that target B and T cells as well as drugs that interfere with lymphocyte signal transduction events is associated with reactivation of latent infections. The use of rituximab, the antibody to CD20 (a B cell surface protein), is associated with the development of reactivation tuberculosis as well as other latent viral infections, including hepatitis B and cytomegalovirus (CMV) infection. Like organ transplant recipients (Chap. 169), patients with latent bacterial disease (like tuberculosis) and latent viral disease (like herpes simplex or zoster) should be carefully monitored for reactivation disease.

SYSTEM-SPECIFIC SYNDROMES

SKIN-SPECIFIC SYNDROMES

Skin lesions are common in cancer patients, and the appearance of these lesions may permit the diagnosis of systemic bacterial or fungal infection. While cellulitis caused by skin organisms such as