MINISTRY OF NATIONAL GUARD HEALTH AFFAIRS
INFECTION PREVENTION AND CONTROL PROGRAM

Adult Immunization Guidelines

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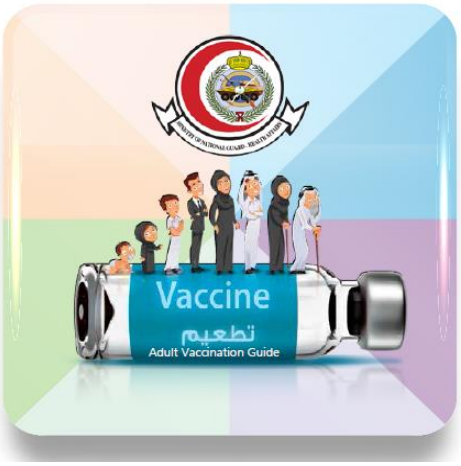

Adult Immunization Guidelines 2018

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1. STATEMENT OF PURPOSE

1.1 To provide guidelines for healthcare providers on adult immunizations.

2. APPLICABILITY

These guidelines are applicable to all adult patients and healthy individuals.

3. RELATED REFERENCE(S)

3.1 Centers for Disease Control and Prevention (CDC). Advisory Committee on Immunization Practices Recommended Immunization Schedule for Adults Aged 19 Years or Older — United States, 2018. MMWR Morb Mortal Weekly / February 9, 2018/ 67(5); 158–160.

3.2 Staples JE, Gershman M, Fischer M, Centers for Disease Control and Prevention (CDC). Yellow fever vaccine: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Recomm Rep 2010; 59:1.

3.3 Freedman D, Leder K, Weller PF, Baron EL. Immunization for travel. UpToDate May 2016.

3.4 Chi C, Patel P, Pilishvili T, Moore M, Murphy M, Strikas R. Guidelines for Vaccinating Dialysis Patients and Patients with Chronic Kidney Disease summarized from Recommendations of the Advisory Committee on Immunization Practices (ACIP), CDC December 2012.

3.5 Tomblyn M, Chiller T, Einsele H, et al. Guidelines for preventing infectious complications among hematopoietic cell transplantation recipients: a global perspective. Biol Blood Marrow Transplant 2009; 15:1143.

3.6 Rubin LG, Levin MJ, Ljungman P, et al. 2013 IDSA clinical practice guideline for vaccination of the immunocompromised host. Clin Infect Dis 2014; 58:e44.

3.7 http://www.immunize.org

4. DEFINITIONS

4.1 **Healthcare providers** in this document refer to physicians and nurses.

4.2 **Standing orders** are written protocols approved by the healthcare institution that allow qualified health care professionals (such as registered nurses) to assess the need for vaccination and prescribe and administer vaccines to individuals meeting certain criteria.

4.3 **Contraindications**: A condition in a recipient that increases the chance of a serious adverse reaction. Therefore, a vaccine should not be administered when a contraindication is present.

4.4 **Precautions**: Events or conditions listed as precautions should be reviewed carefully. Benefits of and risks for administering a specific vaccine to a person under these circumstances should be considered.

5. POLICY

5.1 Adult immunizations are essential for the prevention and control of vaccine preventable diseases.

5.2 Adult immunizations differ according to age, occupation and underlying health conditions.

5.3 Healthcare providers should consider each hospital visit as an opportunity to assess the need for immunization.

5.4 Prescription of vaccines must be done by the treating physician, unless there is available standing order for vaccine prescription and administration.

5.5 These guidelines will be reviewed on a yearly basis for updates or practice changes.

6. PROCEDURES

The following sections include specific guidelines on the following:

a) Vaccines that might be indicated for adults (6.1)
b) Travel Immunizations (6.2)
c) Immunizations for adult kidney dialysis patients and adult patients with chronic kidney disease (6.3)
d) Immunizations for hematopoietic cell transplant candidates and recipients (6.4)
e) Immunizations for patients with cancer (6.5)
f) Summaries of recommendations on specific conditions:
   - Immunizations for adult patients with HIV (7.1)
   - Immunizations for adult patients with Diabetes Mellitus (7.2)
   - Immunizations for adult patients with Heart Disease (7.3)
   - Immunizations for adult patients with Liver Disease (7.4)
   - Immunizations for elderly patients ≥65 years old (7.5)
   - Immunizations during pregnancy (7.6)

6.1 Vaccines that might be indicated for adults

6.1.1 Influenza vaccination

- Annual vaccination with inactivated influenza vaccine (IIV) is recommended for all persons aged ≥6 months including pregnant women.
- Yearly guidelines (during Influenza season campaign) apply.

6.1.2 Tetanus, diphtheria, and acellular pertussis (Td/Tdap) vaccination

6.1.2.1 *Indications*:

- One dose of Tdap is routinely given at age 11 or 12.
- People who did not get Tdap at that age should get it as soon as possible followed by tetanus and diphtheria toxoids Td booster every 10 years.
- Pregnant women should get a dose of Tdap during every pregnancy. (Review 7.6 for details)

6.1.2.2 *Dosing and administration:*

- Td should be administered as a booster every 10 years.
- Adults who have not received tetanus and diphtheria toxoids and acellular pertussis vaccine (Tdap) or for whom pertussis vaccination status is unknown should receive 1 dose of Tdap followed by a tetanus and diphtheria toxoids (Td) booster every 10 years.
- Tdap should be administered regardless of when a tetanus or diphtheria toxoid-containing vaccine was last received.
- Adults with an unknown or incomplete history of a 3-dose primary series with tetanus and diphtheria toxoid-containing vaccines should complete the primary series that includes 1 dose of Tdap.
- Unvaccinated adults should receive the first 2 doses at least 4 weeks apart and the third dose 6–12 months after the second dose.
- One dose of Tdap should be administered during each pregnancy at 27 to 36 weeks gestation, irrespective of the patient's prior history of receiving Tdap.

6.1.2.3 *Efficacy & effectiveness:*

Immune responses to tetanus and diphtheria antigens were compared between Tdap and Td groups; The seroprotective rate for tetanus was 100% for Tdap and 99.8% in the Td group. The seroprotective rate for diphtheria was 94.1% in the Tdap group and 95.1% in the Td group. In contrast to tetanus and diphtheria, no well-accepted serologic or laboratory correlate of protection for pertussis exists.

6.1.2.4 *Contraindications:*

- Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component.

- For pertussis-containing vaccines: encephalopathy.

6.1.2.5 *Precautions:*

- Moderate or severe acute illness with or without fever.
- Guillain-Barré syndrome (GBS) within 6 weeks after a previous dose of tetanus toxoid-containing vaccine.
- History of Arthus-type hypersensitivity reactions after a previous dose of tetanus or diphtheria toxoid-containing vaccine (including MenACWY); defer vaccination until at least 10 years have elapsed since the last tetanus-toxoid containing vaccine.
- For pertussis-containing vaccines: progressive or unstable neurologic disorder.

6.1.3 Varicella vaccination

6.1.3.1 *Indications:*

All adults without evidence of immunity to varicella (as defined below, item 6.1.3.6) should receive two doses of single-antigen varicella vaccine or a second dose if they have received only one dose. Vaccination is especially important for

- Healthcare professionals
- People who care for or are around immunocompromised people
- Teachers
- Child care workers
- Residents and staff in nursing homes and residential settings
- College students
- Inmates and staff of correctional institutions
- Military personnel
- Women of childbearing age who are not pregnant (women should not get pregnant for 1 month after being vaccinated)
- Adolescents and adults living with children
- International travelers

6.1.3.2 *Dosing and administration:*

- Adults should receive 2 doses of single antigen varicella vaccine (Varivax) subcutaneously 4-8 weeks apart.
- If it has been more than 8 weeks since the first dose, the second dose may be given without restarting the schedule.
- Women who do not have evidence of immunity should receive the first dose of varicella vaccine upon completion or termination of pregnancy and before discharge from the healthcare facility.

6.1.3.3 *Efficacy & effectiveness:*

- One dose is 85% effective at preventing any form of varicella.
- Two doses are 98% effective.
- It is not known how long a vaccinated person is protected against varicella but several studies have shown that people vaccinated against varicella had antibodies for at least 10 to 20 years after vaccination.

6.1.3.4 *Contraindications:*

- has a history of anaphylactic/anaphylactoid reaction to gelatin, neomycin, or any other component of the vaccine.
- has blood dyscrasias, leukemia, lymphomas, or malignant neoplasms affecting bone marrow or lymphatic system..
- is receiving prolonged, high-dose systemic immunosuppressive therapy (≥2 weeks), including large doses of oral steroids (≥2mg/kg of body weight or a total of 20mg/day of prednisone or its equivalent for people who weigh >10kg).
- has a moderate or severe concurrent illness.
- has received blood products (such as whole blood, plasma, or immune globulin) during the previous 3 to 11 months, depending on dosage.
- has a family history (first degree relatives) of congenital hereditary immunodeficiency, unless the person is immunocompetent.

- is or may be pregnant.

6.1.3.5 *Precautions:*

- People with Acute Illness
- People who have recently received (within 3 to 11 months depending on dosage) blood, plasma, or immune globulin products should not be vaccinated. And those who have received varicella vaccine should not receive blood products for 14 days after being vaccinated.
- People should avoid using salicylates for 6 weeks after getting varicella vaccine because of the association between aspirin use and Reye syndrome following varicella

6.1.3.6 *Evidence of immunity to varicella* in adults includes any of the following:

a) Documentation of two doses of varicella vaccine at least 4 weeks apart;
b) History of varicella based on diagnosis or verification of varicella disease by a healthcare provider;
c) History of herpes zoster based on diagnosis or verification of herpes zoster disease by a healthcare provider; or
d) Laboratory evidence of immunity or laboratory confirmation of disease.

6.1.4 Zoster vaccination

- Shingrix® (recombinant zoster vaccine, RZV) is preferred over Zostavax® (zoster vaccine live, ZVL) for the prevention of herpes zoster (shingles) and related complications.
- Studies showed that RZV estimates of efficacy against herpes zoster were higher than ZVL estimates in all age categories.
- Shingrix is administered for the prevention of herpes zoster in immunocompetent adults aged ≥50 years. The vaccine consists of 2 doses (0.5 mL each), administered intramuscularly, 2–6 months apart irrespective of prior receipt of varicella vaccine or ZVL, and does not require screening for a history of chickenpox (varicella). However, RZV should not be given <2 months after receipt of ZVL.
- Zostavax (Zoster vaccine live, ZVL) is administered subcutaneously in a single dose for immunocompetent adults over 60 years. It has similar safety profile as the Varicella vaccine. Refer to Varicella vaccine **(6.1.3.4 & 6.1.3.5)** for contraindications & precautions. It is not routinely recommended for adults aged 50 through 59 years. Persons aged ≥60 years with chronic medical conditions may be vaccinated unless their condition constitutes a contraindication, such as severe immunodeficiency.

6.1.5 Measles-mumps-rubella (MMR) vaccination

6.1.5.1 *Indications:*

All adults with no evidence of immunity **(6.1.5.2)** to measles, mumps or rubella should receive the vaccine. The following groups of adults are at increased risk of exposure to or morbidity from measles, mumps, and rubella or may place others at risk:

- Women who could become pregnant
- College and university students
- Healthcare workers
- International travelers
- Military personnel
- Household and close contacts of immunocompromised persons
- HIV-infected individuals who do not have current evidence of severe immunosuppression

6.1.5.2 These high-risk adults need full immunity to all three diseases, which is provided by any of the following:

- Documentation of the administration of two doses of the MMR vaccine administered at least 28 days apart

- Laboratory evidence of immunity to all three diseases
- Laboratory confirmation of disease

6.1.5.3 *Dosage and administration:*

- All adults with no immunity against measles and mumps should receive one dose of MMR vaccine. Those at high risk should receive two doses.
- Adults with no immunity against rubella should receive one dose.
- During mumps outbreak, those who already received two doses of mumps-virus containing vaccine should receive a third dose to improve protection against mumps.
- The minimum interval between 2 doses of MMR or MMR & MMRV (contains MMR & Varicella; not for use in adults) is 28 days. Minimum interval between 2 doses of MMRV is 3 months.
- Post-exposure management is occasionally needed for susceptible healthy adults exposed to measles; vaccine should be administered unless there is a contraindication. Adults vaccinated within 72 hours of exposure are considered protected against measles.

6.1.5.4 *Efficacy & effectiveness:*

- Measles component: vaccine effectiveness is 93% & 97% after 1 and 2 doses respectively.
- Rubella: vaccine effectiveness is 97% after one dose.
- Mumps: : vaccine effectiveness is 78% & 88% after 1 and 2 doses respectively

6.1.5.5 *Contraindications:*

- Pregnancy current or planned within 28 days
- Immunocompromised
- Anaphylaxis after previous dose or to a vaccine component or neomycin

6.1.5.6 *Precautions:*

- Recent (≤11 months) receipt of antibody-containing blood product.
- Moderate or severe illness with or without fever.
- History of thrombocytopenia or thrombocytopenic purpura.
- Personal or family history of seizures of any etiology.
- Tuberculin testing; MMR vaccine might interfere with the response to a tuberculin skin test. if a tuberculin skin test is to be performed, it should be administered either any time before, simultaneously with, or at least 4–6 weeks after MMR or MMRV vaccine.

6.1.6 Pneumococcal (13-valent pneumococcal conjugate vaccine [PCV13] and 23-valent pneumococcal polysaccharide vaccine [PPSV23]) vaccination

6.1.6.1 *Indications:*

Pneumococcal vaccination is recommended for all adults 65 years and older. It is also recommended for adults with specific medical conditions and certain situations that are discussed below (see dosing & administration **6.1.6.3**)

6.1.6.2 There are two types of pneumococcal vaccines: Pneumococcal conjugate vaccine (PCV13) and Pneumococcal polysaccharide vaccine (PPSV23).

- **PCV13** includes purified capsular polysaccharide of 13 serotypes of Streptococcus pneumoniae (1, 3, 4, 5, 6A, 6B, 7F, 9V, 14, 19A, 19F, 18C, and 23F) conjugated to a nontoxic variant of diphtheria toxin and is administered Intramuscularly .
- **PPSV23** contains polysaccharide antigen from 23 types of pneumococcal bacteria and can be administered Intramuscularly or subcutaneously. Schedule of administration differs by condition as discussed below.

6.1.6.3 *Dosing and Administration:*

Individuals who have an indication to receive both PCV13 and PPSV23 should be vaccinated according to the following schedule:

6.1.6.3.1 For adults 65 Years or Older:

- Give 1 dose of PCV13 to all adults 65 years or older who have not previously received a dose followed by 1 dose of PPSV23 at least 1 year later.
- Those who received PPSV23 before age of 65, a minimum interval of 1 year should separate last dose of PPSV23 and PCV13 and at least 5 years between PPSV23 doses.

6.1.6.3.2 For persons with any of the conditions listed below who has not previously received the recommended pneumococcal vaccines:

- Cerebrospinal fluid leaks
- Cochlear implant(s)

Give 1 dose of PCV13 and 1 dose of PPSV23. Administer PCV13 first, then give the PPSV23 dose at least 8 weeks later.

6.1.6.3.3 For persons with any of the conditions listed below who has not previously received the recommended pneumococcal vaccines:

- Sickle cell disease or other hemoglobinopathies
- Congenital or acquired asplenia
- Congenital or acquired immunodeficiency
- HIV infection
- Chronic renal failure or nephrotic syndrome
- Leukemia or lymphoma
- Hodgkin's disease
- Generalized malignancy
- Iatrogenic immunosuppression (diseases requiring treatment with immunosuppressive drugs, including long-term systemic corticosteroids and radiation therapy)
- Solid organ transplantation
- Multiple myeloma

Give 1 dose of PCV13 and 2 doses of PPSV23. Administer PCV13 first, then give the first PPSV23 dose at least 8 weeks later. Give the second dose of PPSV23 at least 5 years after the first.

6.1.6.3.4 For persons with any of the conditions listed below who has not previously received the recommended pneumococcal vaccine:

- Smokers
- Alcoholism
- Chronic heart disease
- Chronic liver disease
- Chronic lung disease
- Diabetes mellitus

Give 1 dose of PPSV23

6.1.6.4 *Efficacy & effectiveness:*

- Results from a randomized placebo-controlled trial (CAPiTA trial) in the Netherlands evaluating the clinical benefit of PCV13 among approximately 85,000 adults 65 years or older demonstrated:
  - 45.6% efficacy of PCV13 against vaccine-type pneumococcal pneumonia
  - 45.0% efficacy against vaccine-type non-bacteremic pneumococcal pneumonia
  - 75.0% efficacy of PCV13 against vaccine-type invasive pneumococcal disease (IPD)
- More than 80% of healthy adults who receive PPSV23 develop antibodies against the serotypes contained in the vaccine. This immune response usually occurs within 2 to 3 weeks after vaccination. Elevated antibody levels persist for at least 5 years in healthy adults but decline more quickly in persons with certain underlying illnesses.

6.1.6.5 *Contraindications and precautions:*

- Previous severe allergic reaction to the vaccine or vaccine component, including (for PCV13) to any diphtheria toxoid containing vaccine.

- Moderate or severe acute illness.

6.1.7 Hepatitis A vaccination

6.1.7.1 *Indications:*

Vaccinate any person seeking protection from hepatitis A virus (HAV) infection and persons with any of the following indications:

a) All individuals with no evidence of immunity especially those traveling to or working in countries with high or intermediate rates of hepatitis A
b) Persons with chronic liver disease
c) Individuals with clotting factor disorders
d) Men who have sex with men
e) Illicit drug users (injection and non-injection)
f) Individuals with recent exposure for post-exposure prophylaxis

6.1.7.2 *Dosing and administration:*

Two single antigen vaccines (Havrix & Vaqta) and one combined vaccine (TWINRIX® containing both HAV and HBV antigens) are available; all are inactivated and administered intramuscularly.

Single-antigen vaccine formulations should be administered in a 2-dose schedule at either 0 and 6 to 12 months (Havrix), or 0 and 6 to 18 months (Vaqta).

6.1.7.3 *Efficacy & effectiveness:*

Protective antibody levels were identified in 94-100% of adults 1 month after receiving one dose. After the second dose, all persons had protective levels of antibody. Protective levels can last for >25 years.

6.1.7.4 *Contraindications and precautions:*

- History of hypersensitivity to any vaccine component, including neomycin.
- Pregnancy: The safety of hepatitis A vaccine for pregnant women has not been determined.

6.1.8 Hepatitis B vaccination

6.1.8.1 *Indications:*

Vaccinate any person seeking protection from hepatitis B virus (HBV) infection and persons with any of the following indications:

a) Household contacts of patients with hepatitis B —Household contacts, especially sexual contacts of individuals with chronic HBV infection should be tested and those who are seronegative, should be vaccinated.
b) Healthcare personnel and public safety workers who are potentially exposed to blood or other infectious body fluids.
c) Patients with diabetes — The ACIP recommends that HBV vaccination be given to unvaccinated adults with diabetes mellitus who are aged 19 to 59. For older patients with diabetes, vaccination can be administered at the discretion of the treating clinician based on the risk of acquiring HBV and the likelihood of an adequate immune response to vaccination.
d) Patients on chronic hemodialysis and patients requiring repeated blood or blood product transfusion should also be vaccinated. Anti-HBs titers should be checked annually and booster doses administered as needed (*see below, Immunizations for adult kidney dialysis patients and adult patients with chronic kidney disease (CKD), item 6.3*).
e) Patients with chronic liver disease — Vaccination should be administered as early as possible because response rates to HepB vaccine are low in patients with decompensated cirrhosis
f) Injection drug users.

6.1.8.2 *Dosing and administration*:

- Recombinant HepB vaccines contain yeast-derived HBsAg purified by biochemical and biophysical separation techniques and are formulated to contain 10–40 µg of HBsAg protein/mL. Two single antigen vaccines (Engerix-B and Recombivax

HB) and one combined (Twinrix: recombinant HBsAg and inactivated hepatitis A virus) are recommended for use in adults.

- Primary vaccination consists of three intramuscular doses administered on a 0-, 1-, and 6-month schedule. A second series of vaccination is indicated if no response (AntiHbs <10) 1-2 months after the third dose.
- Twinrix can be given at accelerated schedule for travelling or potential exposure at 0, 7, 21-30 days with a fourth booster dose at 12 months.
- When the HepB vaccine schedule is interrupted, the vaccine series does not need to be restarted; and the next dose should be administered as soon as possible with a minimum separation interval as follows:
  The final dose of vaccine must be administered at least 8 weeks after the second dose and should follow the first dose by at least 16 weeks; the minimum interval between the first and second doses is 4 weeks.

6.1.8.3 *Efficacy & effectiveness:*

The presence of anti-HBs typically indicates immunity against HBV infection. Adults who have vaccine-induced anti-HBs levels of ≥10 mIU/mL 1–2 months after having received a complete HepB vaccine series are considered seroprotected and deemed vaccine responders.

The 3-dose HepB vaccine series produces a protective antibody response (anti-HBs ≥10 mIU/mL) in >90% of healthy adults aged <40 years. Response decreases with age, and seroprotection is achieved in 75% of persons aged 60 years. In patients on chronic hemodialysis, the response rate to recombinant vaccines is 50 to 60 percent.

Anti-HBs levels wane over time following vaccination related in part to the age at vaccination. Among those who responded to the initial vaccine series, protection has been estimated to persist for up to 30 years. Protection from clinical disease is felt to occur even in the setting of declining or undetectable anti-HBs levels, due to the priming of memory cells, which are capable of eliciting an anamnestic response when challenged, and long-lasting cellular immunity.

6.1.8.4 *Contraindications and Precautions:*

Severe allergic reaction after receiving a previous dose of the vaccine or to any vaccine component.

6.1.8.5 Adult patients receiving hemodialysis or with other immunocompromising conditions should receive 2 doses of 20 mcg/mL (Engerix-B) administered simultaneously on a 4-dose schedule at 0, 1, 2, and 6 months (*see below, Immunizations for adult kidney dialysis patients and adult patients with chronic kidney disease (CKD), item 6.3*).

6.1.9 Meningococcal vaccination

6.1.9.1 Available meningococcal vaccine formulations to protect against Neisseria meningitidis include: (1) quadrivalent meningococcal polysaccharide conjugate vaccine-diphtheria toxoid carrier (MenACWY-D, Menactra); (2) quadrivalent meningococcal polysaccharide conjugate vaccine-diphtheria toxoid carrier, CRM197 (MenACWY-CRM, Menveo); (3) Meningococcal serogroup B.

Vaccination against meningococcal infection is recommended in certain situations that are discussed below for each vaccine type.

6.1.9.2 **MenACWY** is conjugate vaccines that provide protection against 4 serogroups (A, C, Y, and W135). Formulated as capsular polysaccharide conjugated to protein.

- Administer 2 doses of MenACWY intramuscularly at least 8 weeks apart and revaccinate with 1 dose of MenACWY every 5 years, if the risk remains, to adults with the following indications:
  - Anatomical or functional asplenia (including sickle cell disease and other hemoglobinopathies)
  - HIV infection
  - Persistent complement component deficiency
  - Eculizumab use

- Administer 1 dose of MenACWY and revaccinate with 1 dose of MenACWY every 5 years, if the risk remains, to adults with the following indications:
  - Travel to or live in countries where meningococcal disease is hyperendemic or epidemic, including countries in the African meningitis belt or during the Hajj.
  - At risk from a meningococcal disease outbreak attributed to serogroup A, C, W, or Y.
  - Microbiologists routinely exposed to Neisseria meningitidis.
  - Military recruits.
  - First-year college students who live in residential housing (if they did not receive MenACWY at age 16 years or older).

6.1.9.3 Serogroup B Meningococcal Two vaccines are available [MenB-4C (Bexsero) & MenB-FHbp (Trumenba)] both are recombinant protein vaccines but are not interchangeable i.e. cannot substitute a dose with the other. Both MenB vaccines are FDA approved for use in individuals 10 to 25 years. The ACIP supports use of MenB vaccine in individuals ≥10 years who are at increased risk for serogroup B meningococcal disease.

- May administer, based on individual clinical decision, to young adults and adolescents aged 16–23 years (preferred age is 16–18 years) who are not at increased risk 2-dose series of MenB-4C (Bexsero) at least 1 month apart or 2-dose series of MenB-FHbp (Trumenba) at least 6 months apart.
- Administer 2-dose series of MenB-4C at least 1 month apart or 3-dose series of MenB-FHbp at 0, 1–2, and 6 months to adults with the following indications:
  - Anatomical or functional asplenia (including sickle cell disease)
  - Persistent complement component deficiency
  - Eculizumab use
  - At risk from a meningococcal disease outbreak attributed to serogroup B
  - Microbiologists routinely exposed to Neisseria meningitidis
- Bexsero or Trumenba may be given concomitantly with quadrivalent meningococcal conjugate vaccines but at different anatomic sites if feasible.
- Use of either meningococcal serogroup B vaccine in persons younger than age 10 years is off-label in the U.S. However, Bexsero brand meningococcal B vaccine is approved for infants by the European Medicines Agency (the European version of the U.S. Food and Drug Administration). It is routinely recommended for infants in the United Kingdom.

6.1.9.4 *Contraindications and precautions:*

- A person who has ever had a severe allergic reaction (e.g., anaphylaxis) after a previous dose.
- A person who has a severe allergy to any vaccine component.
- Meningococcal conjugate vaccines may be given to pregnant women who are at increased risk for serogroup A, C, W, or Y meningococcal disease.
- Serogroup B meningococcal vaccines should only be given to pregnant or breastfeeding women who are at increased risk for serogroup B meningococcal disease who decide, after talking with a doctor, that the benefits of receiving the vaccine outweigh the risk.

6.1.10 Haemophilus influenzae type b (Hib) vaccination

6.1.10.1 One dose of Hib vaccine should be administered to persons who have anatomical or functional asplenia or sickle cell disease or are undergoing elective splenectomy if they have not previously received Hib vaccine. Hib vaccination 14 or more days before splenectomy is suggested.

6.1.10.2 Recipients of a hematopoietic stem cell transplant (HSCT) should be vaccinated with a 3-dose regimen 6 to 12 months after a successful transplant, regardless of vaccination history; at least 4 weeks should separate doses.

6.1.10.3 Hib vaccine is not recommended for adults with HIV infection since their risk for Hib infection is low.

6.1.11 Human papillomavirus (HPV) vaccination

6.1.11.1 *Indications:*

Vaccination against human papillomavirus (HPV) is recommended to prevent HPV infections and HPV-associated diseases, including cancers.
HPV vaccine is routinely recommended for adolescents at age 11 or 12 years.
Vaccination is also recommended for females ages 13 through 26 years and males ages 13 through 21 years who were not adequately vaccinated when they were younger. Males 22-26 years of age may receive the vaccine (e.g., immunocompromised as a result of infection (including HIV), disease, or medication or based on clinical decision).

6.1.11.2 *Dosing and administration:*

Three vaccine are licensed for females; bivalent (types 16, 18), quadrivalent (types 6, 11, 16, and 18) and 9-valent (types 6, 11, 16, 18, 31, 33, 45, 52, and 58). The quadrivalent and 9-valent are also licensed for males.
For persons initiating vaccination before age of 15, the recommended immunization schedule is 2 doses of HPV vaccine at 0, 6-12 months.
For persons initiating vaccination at or after age of 15, the recommended immunization schedule is 3 doses of HPV vaccine. The second dose should be administered 1–2 months after the first dose, and the third dose should be administered 6 months after the first dose (0, 1–2, 6 months).

6.1.11.3 *Efficacy & effectiveness:*

HPV vaccines work extremely well with similar efficacy against infection for those who received two and 3 doses. However, HPV vaccination doesn't eliminate the need for cervical cancer screening as per recommendations.

6.1.11.4 *Contraindications and precautions:*

- Patients with a history of allergies to any vaccine component. Quadrivalent vaccine (4vHPV) and nine-valent vaccine (9vHPV) are not recommended for people with immediate hypersensitivity to yeast. Bivalent vaccine (2vHPV) is not recommended for people with anaphylaxis caused by latex.
- Patients with moderate or severe acute illnesses. Patients should wait until the illness improves before getting vaccinated.
- Pregnant women. However, HPV vaccines have not been shown to cause any adverse pregnancy outcomes or adverse events for the mother or her developing fetus.

6.1.12 Rabies vaccination

6.1.12.1 Pre-exposure vaccination

Pre-exposure vaccination should be offered to people at high risk of exposure to rabies, such as laboratory staff working with rabies virus, veterinarians, animal handlers, and other individuals living in or travelling to countries or areas at risk.
Pre-exposure rabies vaccination consists of three full intramuscular (i.m.) doses given on days 0, 7 and 21 or 28 (a few days' variation in the timing is not important).
Periodic booster injections are not recommended for general travelers.

6.1.12.2 Post-exposure prophylaxis (PEP)

Refer to INFECTION CONTROL MANUAL; ICM– IV-07 RABIES EXPOSURE MANAGEMENT

- **Category I – touching or feeding animals, licks on intact skin**
  None

- **Category II – nibbling of uncovered skin, minor scratches or abrasions without bleeding**
  Immediate vaccination and local treatment of the wound
- **Category III – single or multiple transdermal bites or scratches, licks on broken skin; contamination of mucous membrane with saliva from licks, contacts with bats**
  Immediate vaccination and administration of rabies immunoglobulin; local treatment of the wound

Rabies vaccine is part of rabies post-exposure management along with wound care and passive immunization with Immunoglobulins. Administration is as follows:

IF NOT previously vaccinated

Active immunization
Cell-culture- or embryonated-egg-based rabies vaccines should always be used for post-exposure prophylaxis.

- For healthy, fully immunocompetent exposed people who receive wound care plus high-quality rabies immunoglobulin plus WHO-prequalified rabies vaccines consists of four doses administered i.m. on days 0, 3, 7 and 14.
- For persons with immunosuppression, rabies PEP should be administered using all 5 doses of vaccine on days 0, 3, 7, 14, and 28.
- The deltoid area is the only acceptable site of vaccination for adults and older children. For younger children, the outer aspect of the thigh may be used. Vaccine should never be administered in the gluteal area.

Passive immunization

- Should be administered just before or shortly after administration of the first dose of vaccine given in the post-exposure prophylaxis regimen. If it is not immediately available, passive immunization can be administered up until the seventh day after initiation of the primary series of post-exposure prophylaxis.
- The dose for HRIG is 20 IU/kg body weight. The full dose of rabies immunoglobulin, or as much as is anatomically feasible, should be administered into and around the wound site. Any remainder should be injected i.m. at a site distant from the site of active vaccine administration. Multiple needle injections into the wound should be avoided. If the correct dose of rabies immunoglobulin is too small to infiltrate all wounds, as might be true of a severely bitten individual, it can be diluted in physiological buffered saline to ensure greater wound coverage.

IF previously vaccinated

In the event of exposure through the bite or scratch of an animal known or suspected to be rabid, individuals who have previously received a complete series of pre- or post-exposure rabies vaccine should receive two booster doses of vaccine. Ideally, the first dose should be administered on the day of exposure and the second 3 days later. This should be combined with thorough wound treatment. Rabies immunoglobulin is not required for patients who have previously received a complete vaccination series. (Source: http://www.who.int/ith/vaccines/rabies/en/)

(Table 1). Vaccines that might be indicated for adults based on medical and other indications

Vaccine	Pregnancy	Immuno-compromising conditions (excluding HIV infection)	HIV infection CD4 count (cell/uL)		Kidney failure, end-stage renal dis, on hemodialysis	Heart dis, chronic lung dis	Asplenia and persistent complement component deficiency	Ch liver dis	DM	HCWs
			<200	≥200						
Influenza	1 dose annually									
Td/Tdap	1 dose of Tdap each pregnancy	Substitute Tdap for Td once, then Td booster every 10 years								
Varicella	Contraindicated			2 doses						
(HPV), female		3 doses through age 26 years			2 or 3 doses through age 26 years					
(HPV), male		3 doses through age 26 years			2 or 3 doses through age 21 years					
Zoster RZV					2 dose for adults aged ≥50 years					
Zoster ZVL	Contraindicated				1 dose for adults aged ≥60 years					
MMR	Contraindicated			1 or 2 doses depending on indication						
(PCV13)		1 dose								
(PPSV23)		1, 2 or 3 doses								
Hepatitis A	2 doses									
Hepatitis B	3 doses									
Meningococcal conjugate	1 or 2 doses and booster depending on indication									
MenB							2 or 3 doses			
Hemophilus influenza type b (Hib)		3 doses post-HSCT recipients only					1 dose			

Recommended for all persons who meet age requirement	Recommended for persons with risk factors	No recommendations	Contraindicated

(Source: http://www.cdc.gov/vaccines/schedules/hcp/adult.html). See guidelines above with specific information on each vaccine.

6.2 Travel Immunizations

The pre-travel visit provides an opportunity to ensure that routine immunizations are current. Specific travel immunizations available include yellow fever vaccine, meningococcal vaccine, hepatitis A vaccine and hepatitis B vaccine. The indications, contraindications, precautions, dosing, and administration of these vaccines are discussed in the following sections.

6.2.1 Yellow fever vaccine

6.2.1.1 YF vaccination is legally required for entrance into specific countries.

6.2.1.1.1 The vaccination certificate for YF is valid beginning 10 days after administration of YF vaccine. The YF vaccination certificate for international travel is valid for 10 years.

6.2.1.1.2 Yellow fever vaccination may be effective for lifelong protection, however, patients with YF exposure risk should continue to receive a booster every 10 years.

6.2.1.2 Indications — Travelers aged ≥9 months who are traveling to or living in areas at risk for YF transmission in South America and Africa should be vaccinated. In addition, the International Health Regulations allow countries to require proof of YF vaccination as a condition of entry for travelers arriving from certain countries to prevent importation and indigenous transmission of YF virus.

6.2.1.3 Contraindications and precautions — Because the YF is a live attenuated vaccine, it should not be given to individuals with primary immunodeficiencies, transplant recipients, patients on immunosuppressive and immunomodulatory therapies, or patients with HIV whose CD4 count is <200/mL. Other contraindications include age <6 months, allergy to a vaccine component, and thymic disorders. Precaution should be taken in infants aged six to eight months and in individuals ≥60 years of age. For travelers >60 years, the risk of severe illness and death due to yellow fever infection should be balanced against the risk of serious vaccine effects. Pregnancy is a precaution for yellow fever vaccine administration (in contrast with most other live vaccines that are contraindicated in pregnancy). If travel is unavoidable and the risks for yellow fever virus exposure are felt to outweigh the vaccination risks, a pregnant woman should be vaccinated. If the risks for vaccination are felt to outweigh the risks for yellow fever virus exposure, pregnant women should be issued a medical waiver to fulfill health regulations.

6.2.1.4 Major adverse events — Three well-characterized serious adverse events occur following YF vaccine administration:

6.2.1.4.1 Immediate hypersensitivity or anaphylactic reactions: These are uncommon and principally occur among persons with histories of allergies to egg or other substances.

6.2.1.4.2 YF vaccine-associated neurologic disease (YEL-AND): YEL-AND is a serious but rarely fatal adverse event. YEL-AND manifests as several distinct clinical syndromes, including meningoencephalitis, Guillain-Barré syndrome (GBS), acute disseminated encephalomyelitis (ADEM), and bulbar palsy.

6.2.1.4.3 YF vaccine-associated viscerotropic disease (YEL-AVD): YEL-AVD mimics naturally acquired YF disease, with proliferation and dissemination of the vaccine virus throughout the host tissues. The median time from vaccination to symptom onset is three days (range: one to eight days); death has occurred in 65 percent of cases.

6.2.2 Meningococcal vaccine for travelers

6.2.2.1 Indications — Epidemics of meningococcal disease are frequent in the area of sub-Saharan Africa extending from Senegal in the west to Ethiopia in the east. Meningococcal vaccine is recommended for travelers to this meningitis belt in Africa, especially during the dry season from December through June. Travelers to Saudi Arabia

during the Hajj are required to have a certificate of vaccination with quadrivalent (A,C,Y,W-135) meningococcal vaccine before entering.

6.2.3 Hepatitis A vaccine for travelers

6.2.3.1 Indications — Vaccination is warranted for travelers to countries with intermediate to high endemicity of hepatitis A. The list includes all developing countries.

6.2.3.2 One dose of single-antigen hepatitis A vaccine administered at any time prior to departure provides adequate initial protection for healthy individuals ≤40 years. A second dose of vaccine 6 to 12 months after the initial dose is recommended and provides longer-term protection. If the immunization schedule is interrupted, the second dose can be given without restarting the series. No additional booster doses are recommended. A vaccination series started with one brand of vaccine may be completed with the same or other brand of hepatitis A vaccine.

6.2.3.3 Older adults, immunocompromised patients, and individuals with chronic liver disease planning to depart for an area endemic for hepatitis A within ≤2 weeks should receive the initial dose of the vaccine as well as immunoglobulin (IG; 0.02 mL/kg) at a separate anatomic injection site. If IG is unavailable or patients elect not to receive it, hepatitis A vaccine alone should still be given.

6.2.3.4 Travelers who choose not to receive the vaccination, are aged <12 months, or are allergic to a vaccine component should receive a single dose of IG. IG provides protection for about three months; administration must be repeated if the travel period is >5 months.

6.2.4 Hepatitis B vaccine for travelers

6.2.4.1 Indications — Vaccination is warranted for travelers to countries with intermediate to high endemicity of HBV (ie, with hepatitis B surface antigen [HBsAg] prevalence ≥2 percent); a list of countries is available on the CDC website. Risk groups include healthcare workers, adventure travelers, Peace Corps volunteers, missionaries, military personnel, and medical tourists. Hepatitis B immunization should also be considered for any traveler with potential contact with blood or bodily secretions, potential sexual contact, or potential need for medical or dental procedures while traveling.

6.2.4.2 Dosing and administration

Hepatitis B vaccine is administered in three intramuscular doses: the initial dose is followed by repeat doses at one and six months after the first dose. Immunization should begin six months prior to travel. If this schedule is not feasible, some protection is afforded by one or two doses administered before travel. An accelerated regimen (with doses given on days 0, 7, and 21) can be administered to travelers who cannot complete the full series prior to departure. Travelers who receive the accelerated regimen should receive a booster at least six months later to optimize long-term immunity.

6.2.5 Typhoid vaccine for travelers

6.2.5.1 Travelers to areas where there is a recognized risk for exposure to Salmonella serotype Typhi. Risk is greatest for travelers who have prolonged exposure to possibly contaminated foods and beverages, although short-term travelers are also at risk. Travelers should be cautioned that typhoid vaccination is not a substitute for careful selection of food and beverages. Typhoid vaccines are not 100% effective, and vaccine-induced protection can be overwhelmed by large inocula of Salmonella serotype Typhi.

6.2.5.2 Parenteral Vi polysaccharide and oral Ty21a are both acceptable forms of typhoid vaccine.

The **Vi polysaccharide vaccine** is administered as a single injection and is approved for adults and children aged ≥2 years. Primary vaccination with Vi polysaccharide consists of one 0.5-mL (25-µg) dose administered intramuscularly. This vaccine should be given at least 2 weeks before potential exposure.

The **oral Ty21a vaccine** is administered in 4 doses on alternating days over 1 week and is approved for adults and children aged ≥6 years. Immunocompromised persons should not use Ty21a because it is a live-attenuated vaccine. Because antibacterial drugs might

be active against the vaccine strain and reduce immunogenicity, the Ty21a vaccine should not be administered to persons taking these medications.

Primary vaccination with live-attenuated Ty21a vaccine consists of one enteric-coated capsule taken on alternate days (day 0, 2, 4, and 6), for a total of four capsules. The capsules must be kept refrigerated (not frozen). Each capsule should be taken with cool water no warmer than 37.0°C, approximately 1 hour before a meal. All doses should be completed at least 1 week before potential exposure.

6.2.5.3 Repeat Doses

If continued or repeated exposure to Salmonella serotype Typhi is expected, repeat doses of typhoid vaccine are needed to maintain immunity. An optimal revaccination schedule for the Vi polysaccharide vaccine has not been established; however, the manufacturer recommends a repeat dose every 2 years after the primary dose if continued or renewed exposure is expected. The manufacturer of Ty21a recommends revaccination with the entire 4-dose series every 5 years if continued or renewed exposure to Salmonella serotype Typhi is expected.

6.2.5.4 No data have been reported on the use of either typhoid vaccine in pregnant women. In general, live vaccines like Ty21a are contraindicated in pregnancy. Vi polysaccharide vaccine should be given to pregnant women only if clearly needed. (Source: https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6411a4.htm).

6.3 Immunizations for adult kidney dialysis patients and adult patients with chronic kidney disease (CKD)

6.3.1 Hepatitis B vaccine

Despite the availability of the hepatitis B vaccine, the most important factor in preventing the spread of hepatitis B in a hemodialysis unit is the maintenance of universal precautions.

6.3.1.1 HBsAg +ve

6.3.1.1.1 Proper isolation, management (The CDC recommends isolating antigen-positive patients and prohibiting the use of shared medications (eg, common heparin vials) among dialysis patients)

6.3.1.1.2 Contact tracing for Hepatitis B infection (household, sexual, or needle-sharing contacts should be identified and vaccinated)

6.3.1.2 HBsAg –ve

6.3.1.2.1 Anti-HBs ≥10 mIU/mL

I. Screen annually

6.3.1.2.2 Anti-HBs < 10 mIU/mL

I. **Consider susceptible**

II. **Give Hepatitis B vaccine according to the following Dosage and Schedule:**

i. Available formulation of hepatitis B vaccine (Engerix-B, 20ug) is administered at a double standard dosage in a 4 dose schedule (0, 1, 2, and 6 months) for hemodialysis patients and other immunocompromised adult (age ≥20 years) patients (two Engerix-B, 20 ug [1.0 mL doses] administered in 1 or 2 injections).

ii. If an adult patient begins the vaccine series with a standard dose before beginning hemodialysis treatment, then moves to hemodialysis treatment before completing the series, complete the series using the higher dose recommended for hemodialysis patients.

iii. If a lower than recommended vaccine dose is administered to either adults or children, the dose should be repeated.

III. **Check anti-HBs 1-2 months after administration of the last dose of the vaccine series** (protective level of anti-HBs is ≥10 mIU/mL).
(Note: Testing HBsAg should be avoided within three weeks of vaccination)

IV. **If no response after the primary (1st) vaccine series,** re-vaccinate with three dose series one to two months after completion of the first series

V. **If no response after 1-2 months following the 2nd vaccine series,** test for HBsAg and if negative, consider susceptible (counsel about precautions to prevent HBV infection and the need to obtain HBIG post-exposure prophylaxis for any known or likely parenteral exposure to HBsAg positive blood)

VI. **Screen monthly for HBsAg**

VII. **For hemodialysis patients, the need for booster doses should be assessed by annual testing for antibody to hepatitis B surface antigen (anti-HBs).** A booster dose should be administered when anti-HBs levels decline to <10 mIU/mL.

6.3.2 Seasonal influenza

6.3.2.1 Inactivated Influenza Vaccine (IIV) should be given annually

6.3.2.2 Preferred before the winter season as soon as the vaccine is available. However, it should be offered throughout the influenza season

6.3.2.3 Recommended for all persons ≥6 months

6.3.3 Pneumococcal vaccine

Follow the schedule of dual vaccination of (13-valent pneumococcal conjugate vaccine [PCV13] and 23-valent pneumococcal polysaccharide vaccine [PPSV23]) vaccination as follow:

6.3.3.1 Schedule for dual vaccination - Individuals who have an indication to receive both PCV13 and PPSV23 should be vaccinated according to the following schedule:

6.3.3.1.1 A single dose of PCV13 followed by a dose of PPSV23 **≥8 weeks** later should be given for adults with advanced kidney disease who are at any age (including those ≥65 years of age) and who have not previously received either PCV13 or PPSV23.

6.3.3.1.2 For patients who have previously received one or more doses of PPSV23, a single dose of PCV13 should be given **≥1 year** after the last PPSV23 dose was received.

6.3.3.2 Revaccination —

Only one single revaccination with PPSV23 **≥5 years** after the first dose is recommended for:

a) Immunocompromised patients who are <65 years of age.

b) All adults aged ≥65 years even if they were vaccinated when they were <65 years of age; however, a minimum interval of five years between PPSV23 doses should be maintained.

c) At the present time, revaccination of adults with PCV13 is **not** recommended.

(Table 2). List of vaccines and their use for dialysis or CKD patients

Vaccine	Recommended for dialysis or CKD patients	May use if otherwise indicated*
Tdap/Td		**X**
Hib		**X**
Hepatitis A		**X**
Hepatitis B	**X**	
Human papilloma virus		**X**
Inactivated Influenza (IIV)	**X**	
MMR		**X**
Meningococcal		**X**
Pneumococcal	**X**	
Inactivated Polio (IPV)		**X**
Rabies		**X**
Rotavirus		**X**
Typhoid		**X**
Varicella		**X**
Yellow fever		**X**
Zoster		**X**

* No specific ACIP recommendation for this vaccine exists for dialysis patients or patients with chronic kidney disease. Follow the same guidelines in Table (1).

(Table 3). Summary of recommendations on immunizations for patients with chronic kidney diseases

Vaccine name and route	For whom vaccination is recommended	Schedule for vaccination administration	Contraindications & Precautions
Inactivated Influenza (IIV) IM	All persons ≥6 months	One dose every year, preferred before the winter season	Previous severe allergic reaction Moderate or severe acute illness with or without fever
Hepatitis B (HepB) IM	All persons with end-stage renal disease, including patients receiving hemodialysis	Adult patients receiving hemodialysis or with other immunocompromising conditions should receive 2 doses of 20 mcg/mL (Engerix-B) administered simultaneously on a 4-dose schedule at 0, 1, 2, and 6 months	Previous severe allergic reaction Moderate or severe acute illness
Pneumococcal conjugate (PCV13) IM	Chronic renal failure and nephrotic syndrome, 65 yeas and above, Functional or anatomic asplenia, HIV infection, Leukemia, Lymphoma, generalized malignancy, Immunosupression	**Schedule for dual vaccination** - A single dose of PCV13 followed by a dose of PPSV23 ≥8 weeks later should be given for adults with advanced kidney disease who are at any age (including those ≥65 years of age) and who have not previously received either PCV13 or PPSV23. For patients who have previously received one or more doses of PPSV23, a single dose of PCV13 should be given ≥1 year after the last PPSV23 dose was received. Revaccination with PPSV23 >5 year in immunocompromised and at 65 years old.	Previous severe allergic reaction to this vaccine, including (for PCV13) to any diphtheria toxoid-containing vaccine, or to any of its components Moderate or severe acute illness
Pneumococcal polysaccharide (PPSV23) IM or SC	All chronic kidney diseases patients		
Hepatitis A (HepA) IM	All adults seeking protection from (HAV) infection and persons with other risk factors	2 dose schedule with a minimum of 6 month interval	Previous severe allergic reaction Moderate or severe acute illness
Tetanus, diphtheria, acellular pertussis (Td/Tdap) IM	All people who lack written documentation of a primary series consisting of at least 3 doses of tetanus- and diphtheria-toxoid-containing vaccine	Substitute 1-time dose of Tdap for Td booster; then boost with Td every 10 yrs	Previous severe allergic reaction For Tdap only, history of encephalopathy not attributable to an identifiable cause, within 7d following DTP/DTaP, or Tdap

Measles, mumps, rubella (MMR) SC	Individuals at higher risk of either exposure or morbidity e.g., Healthcare personnel, college students, Military personnel, international travelers, Household and close contacts of immunocompromised persons, HIV-infected individuals who do not have current evidence of severe immunosuppression	Individuals at high risk should have two doses separated by at least one month or serologic evidence of immunity. Adults with no evidence of immunity should get 1 dose of MMR unless the adult is in a high risk group.	Previous severe allergic reaction Pregnancy or possibility of pregnancy within 4wks Immunocompromising conditions Severe immunodeficiency History of thrombocytopenia or thrombocytopenic purpura
Zoster (shingles)	Shingrix (RZV) for adults ≥50 years (IM) (Preferred) Zostavax (ZVL) for adults ≥60 years (SC). Whether patients have a history of varicella or herpes zoster.	Shingrix (RZV) 2 doses, 2-6 months apart. Zostavax (ZVL), 1 dose.	Shingrix (RZV) Patients with a known allergy to components of the vaccine. Zostavax (ZVL) Previous severe allergic reaction Primary cellular or acquired immunodeficiency Pregnancy Receipt of specific antivirals 24hrs before vaccination Moderate or severe acute illness
Varicella (chickenpox) SC	All adults without evidence of immunity to varicella	2 doses Dose #2 is given 4—8wks after dose #1. If dose #2 is delayed, do not repeat dose #1, just give dose #2.	Previous severe allergic reaction (e.g. anaphylaxis) - - Pregnancy Long-term immunosuppressive therapy or immunocompromised pts Receipt of specific antivirals Moderate or severe acute illness

6.4 Immunizations in hematopoietic cell transplant candidates and recipients

6.4.1 Pre-transplant:

6.4.1.1 Prior to hematopoietic cell transplant (HCT), HCT **candidates** who are not already immunocompromised should receive the vaccines that are indicated for immunocompetent individuals based upon age, vaccination history, and exposure history.

6.4.1.2 HCT **candidates** should receive live virus vaccines ≥4 weeks prior to the initiation of the conditioning regimen and inactivated vaccines ≥2 weeks prior to the initiation of the conditioning regimen.

6.4.2 Post-transplant:

The approach to immunization is summarized in Table (4). Specific recommendations for each vaccine are presented below.

6.4.2.1 Haemophilus influenza type b (Hib): HCT recipients should receive three doses of Haemophilus influenzae type b (Hib) conjugate vaccine starting 6 to 12 months following transplantation; at least four weeks should separate doses.

6.4.2.2 Poliovirus: Three-dose series should be initiated 6 to 12 months following transplantation. The doses can be administered one to three months apart. **The live oral poliovirus vaccine should not** be given to HCT recipients, their household contacts, or their healthcare providers.

6.4.2.3 Hepatitis B: A three-dose series of hepatitis B vaccine 6 to 12 months following HCT is recommended. Serologic testing to assess the response to hepatitis B vaccination is recommended ≥1 month following the third dose. A second three-dose series is recommended in non-responders (ie, those with anti-HBs concentrations <10 mIU/mL). Among those receiving a second series, a high dose of the vaccine should be given to adolescents and adults, whereas either the standard dose or the high dose can be given to children. In those with an obvious reason for a poor response, such as chronic graft-versus-host disease, it is preferable to wait until the underlying issue has improved. For HCT recipients who are positive for hepatitis B core antibody (HBcAb), hepatitis B vaccination is particularly important because vaccination may reduce the risk of hepatitis B reactivation.

6.4.2.4 Diphtheria, Tetanus, acellular Pertussis: A three-dose series of DTaP should be considered for initial vaccination following HCT regardless of patient age. Doses should be spaced one to three months apart. After the post-transplant series, tetanus and diphtheria booster vaccines can be administered according to routine recommendations for adults and children.

6.4.2.5 Meningococcus: HCT recipients who are at increased risk of meningococcal disease (eg, asplenic individuals, individuals aged 11 to 18 years, college students living in dormitories, travelers to endemic regions) should be vaccinated. When indicated, the meningococcal conjugate vaccine should be administered as a two-dose series 6 to 12 months following transplantation; the two doses should be given 8 to 12 weeks apart.

6.4.2.6 Pneumococcus: Inducing immunity against pneumococcus is challenging in HCT recipients because the 23-valent polysaccharide vaccine (PPSV23) is poorly immunogenic in this population, whereas conjugate pneumococcal vaccines are more immunogenic but cover fewer serotypes. HCT recipients should receive three doses of the pneumococcal conjugate vaccine (eg, the 13-valent pneumococcal conjugate vaccine, PCV13) starting 3 to 6 months following transplantation. At 15 months following HCT, a single dose of PPSV23 should be given to patients who do not have chronic graft-versus-host disease (GVHD) in an attempt to broaden the immune response. For patients with GVHD, a fourth dose of pneumococcal conjugate vaccine (PCV13) should be given instead of PPSV23 since such patients respond particularly poorly to polysaccharide antigens.

6.4.2.7 Influenza: Lifelong annual administration of the inactivated formulation of the influenza vaccine is recommended for all HCT candidates and recipients ≥6 months of

age; vaccination should be given beginning 6 months following transplantation and beginning 4 months following transplantation if there is a community influenza outbreak. In those who are vaccinated less than 6 months following transplantation, a second dose should be considered. Individuals <9 years of age who have not previously been vaccinated against influenza should receive two doses of the influenza vaccine, approximately one month apart. **The live attenuated (intranasal) formulation should not** be given to HCT recipients. Adjunctive strategies for protection of HCT recipients involve immunizing close contacts and hospital staff as well as chemoprophylaxis of HCT recipients in some cases.

6.4.2.8 Measles, mumps, and rubella: A two-dose series of the measles, mumps, and rubella vaccine (MMR) should be administered to all measles-seronegative pediatric and adult HCT recipients; the first dose should be given beginning 24 months following transplantation in patients who do not have active graft-versus-host disease (GVHD) and are not receiving immunosuppression. MMR should be given 8 to 11 months (or earlier if there is a measles outbreak) after the last dose of intravenous immunoglobulin.

6.4.2.9 Varicella: There are two live vaccines to protect against infections caused by varicella-zoster virus. One is the varicella vaccine that prevents chickenpox, and the other is the zoster vaccine that prevents herpes zoster (shingles). The varicella vaccine can be used in HCT recipients with indications for varicella vaccination. In contrast, the zoster vaccine is not recommended. Two doses of the varicella vaccine be administered to varicella-seronegative HCT recipients who do not have active graft-versus-host disease and are not receiving immunosuppression; the vaccine should be given ≥24 months following transplantation and 8 to 11 months after the last dose of intravenous immunoglobulin (IVIG). The recommended minimum interval between the first dose and the "catch-up" second dose is three months for children aged <12 years and four weeks for persons aged >13 years.

6.4.2.10 Hepatitis A: There are no data on the use of the hepatitis A vaccine in HCT recipients. Hepatitis A vaccination should be given according to the recommendations for the general population. Patients with chronic liver disease (eg, graft-versus-host disease, concurrent infection with other hepatitis viruses) may benefit from hepatitis A vaccine. If indicated, a two-dose series should be given 6 months apart, 6 to 12 months following HCT.

6.4.3 CONTRAINDICATED VACCINES: Some vaccines are contraindicated in hematopoietic cell transplant (HCT) due to safety concerns, particularly live virus vaccines and/or those that lack efficacy data. The following vaccines are contraindicated in HCT recipients: Bacillus Calmette-Guérin (BCG), oral poliovirus vaccine, intranasal influenza vaccine, cholera vaccine, oral typhoid vaccine, zoster vaccine, and rotavirus vaccine. The live virus vaccines that are indicated following HCT (eg, measles, mumps, and rubella; varicella) must be given only to those who meet specific criteria for timing and/or immune function.

6.4.4 SEROLOGIC TESTING: Serologic testing is recommended prior to measles and varicella vaccination in HCT recipients, and vaccination against these viruses should only be performed in individuals who are seronegative. Serologic testing following vaccination is recommended after hepatitis B vaccination to document an adequate response. Periodic testing is also recommended in HCT recipients to assess for the maintenance of antibody responses. Testing should be repeated approximately every four to five years to assess immunity to hepatitis B, measles, tetanus, diphtheria, and poliovirus. Testing for immunity to pneumococcus should also be considered every two years for the first four years after transplantation.

6.4.5 HOUSEHOLD CONTACTS: Household contacts should receive recommended routine vaccinations including annual influenza vaccination which is recommended for all family members and close or household contacts ≥6 months of age. Household contacts with an indication for live vaccines should ideally receive them before the hematopoietic cell transplant (HCT) candidate undergoes transplantation provided there are no contraindications.

6.4.6 The following precautions should be followed for preventing possible transmission of the attenuated vaccine virus to the HCT recipient:

6.4.6.1 Poliovirus vaccine – All household contacts with an indication for poliovirus vaccination should receive the inactivated poliovirus vaccine rather than the oral formulation, which is a live attenuated vaccine. If a household member inadvertently receives the oral formulation, close contact between the household member and the HCT recipient should be avoided for four to six weeks. If avoidance of close contact is not possible, then the HCT recipient should practice stringent hand hygiene after contact with the feces of the vaccinee (eg, after changing a diaper) and avoid contact with saliva from the vaccinee, including not sharing food or eating utensils. Infants and children who have recently received the oral poliovirus vaccine should not visit the HCT unit for four to six weeks after receipt of the vaccine.

6.4.6.2 Rotavirus vaccine – Two formulations of rotavirus vaccine, RV1 and RV5, are available. Both are live attenuated vaccines and are used in infants. Rotavirus vaccine should be given to infants who are household contacts of HCT recipients according to age-based recommendations. Although no cases of transmission of the attenuated vaccine virus have been reported, HCT recipients should avoid handling diapers of vaccinees for four weeks following vaccination. When this is not possible, HCT recipients should adhere to strict hand hygiene practices after contact with the vaccinee's feces. Some HCT units prohibit infants who have received the rotavirus vaccine within the previous two to four weeks from visiting the HCT unit.

6.4.6.3 Zoster vaccine – The herpes zoster vaccine(ZVL) is recommended for adults ≥60 years of age. Although no cases of transmission of the attenuated vaccine virus has been reported, HCT centers should prohibit visitors who develop a varicella- or zoster-like rash following vaccination from visiting. If a household member develops such a rash after vaccination against herpes zoster, he or she should avoid close contact with the HCT recipient and should keep the rash covered.

6.4.6.4 Varicella vaccine – Transmission of the live attenuated varicella vaccine virus has been reported very rarely. Household members who have not had varicella infection should receive the varicella vaccine to protect the HCT recipient from potential exposure to wild-type virus. Household contacts are recommended to be vaccinated before HCT has occurred when feasible. Individuals who develop a varicella-like rash within one month of vaccination should be prohibited from visiting the HCT unit and should avoid close contact with the HCT recipient in the home setting.

6.4.6.5 Measles, mumps, rubella vaccine – Household members should receive the measles, mumps, rubella (MMR) vaccine as indicated by age. Individuals who develop a fever and/or rash following vaccination should be prohibited from visiting the HCT until signs and symptoms have resolved and should avoid close contact with the HCT recipient in the home setting.

(Table 4). Schedule of immunizations for hematopoietic cell transplant candidates

Vaccine	**Month 6** after HSCT	**Month 9** after HSCT	**Month 12** after HSCT	**Month 15** after HSCT	**Month 24** after HSCT	**Year 5** after HSCT
Haemophilus influenzae type b (Hib) conjugate 0.5 ml IM	X	X	X			
Inactivated Polio 0.5 ml IM	X	X	X			
Hepatitis B 0.5 ml IM	X	X	X			
Diphtheria Tetanus acellular Pertussis (DTaP) 0.5 ml IM	X	X	X			
Meningococcal Conjugate 0.5 ml IM	X	X				X
Pneumococcal Conjugate (PCV) 0.5 ml IM	X	X	X	X Only in cGVHD patients		
Pneumococcal Polysaccharide (PPSV23) 0.5 ml IM				X in patients without cGVHD		X in patients without cGVHD
Inactivated Influenza Vaccine 0.5 ml IM	X (annually thereafter for the life of the patient)					
MMR 0.5 ml SC (avoid if patient is still on immunosuppression)					X in patients who do **not** have active graft-versus-host disease (GVHD) and are **not** receiving immunosuppression.	
Varicella 0.5 ml SC (avoid if patient is still on immunosuppression)					X in patients who do **not** have active graft-versus-host disease (GVHD) and are **not** receiving immunosuppression.	

6.5 Immunizations for patients with cancer

Patients with cancer receiving chemotherapy should **not** receive live virus vaccines, although patients with leukemia, lymphoma, or other malignancies whose disease is in remission and whose chemotherapy has been terminated for at least three months may receive live virus vaccines such as the vaccines for varicella; measles, mumps, rubella; and zoster according to age-specific recommendations.

All indicated vaccines should be given to cancer patients before initiation of chemotherapy, before therapy with other immunosuppressive drugs, and before radiation or splenectomy, when feasible.

If inactivated vaccines are given during chemotherapy, they should not be considered valid doses unless protective antibodies are documented. In such patients, vaccines should be re-administered after the recovery of immune competence.
Revaccination of individuals after chemotherapy or radiation is generally unnecessary if the prior vaccination occurred before chemotherapy, with the exception of hematopoietic cell transplant recipients.

Three months after the completion of chemotherapy, cancer patients who haven't received anti–B cell antibodies (eg, rituximab, alemtuzumab) should be vaccinated with inactivated vaccines and the live vaccines for varicella; measles, mumps, rubella; or measles, mumps, rubella, and varicella. In patients who have received anti–B cell antibodies, vaccine administration should be delayed for at least six months.

6.5.1 Tetanus toxoid, diphtheria toxoid, and pertussis vaccines: Tetanus and diphtheria booster immunizations should be considered for all patients with cancer. In addition, adults who have not been vaccinated with the acellular pertussis vaccine should receive the vaccine containing tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis (Tdap). Td or Tdap should ideally be given before starting treatment and preferably not during cycles of intensive chemotherapy.

6.5.2 Polio vaccine: The inactivated polio vaccine is the only poliovirus vaccine recommended for immunodeficient individuals and their household contacts. However, a protective immune response cannot be assured in patients who are immunodeficient at the time of vaccination.

6.5.3 Pneumococcal vaccine: Adults with cancer are recommended to receive PCV13 in addition to PPSV23 as follows:

6.5.3.1 For patients who have not previously received either PCV13 or PPSV23, a single dose of PCV13 should be given, followed by a dose of PPSV23 at least eight weeks later.

6.5.3.2 For patients who have previously received one or more doses of PPSV23, a single dose of PCV13 should be given one or more years after the last PPSV23 dose was received.

6.5.3.3 For patients who require additional doses of PPSV23, the first such dose should be given no sooner than eight weeks after PCV13 and at least five years after the most recent dose of PPSV23.

6.5.3.4 Children with cancer should also receive both the pneumococcal conjugate vaccine and the pneumococcal polysaccharide vaccine.

6.5.4 Haemophilus influenzae vaccine: The Hib conjugate vaccine is indicated for children with cancer as early as possible in the course of their disease, but poor vaccine response is observed and booster doses are ineffective. Hib immunization is not routinely recommended for adult oncology patients unless they undergo HCT.

6.5.5 Meningococcal vaccine: Meningococcal vaccination is recommended for individuals at increased risk for meningococcal infection, such as children between 11 and 18 years of age and certain other groups (college freshmen living in dormitories, individuals traveling to countries where Neisseria meningitidis is hyperendemic or epidemic, patients with terminal complement component deficiencies or anatomic or functional asplenia, and others). There are no specific recommendations for patients with cancer, but any cancer patient >2 months of age who has another indication for meningococcal vaccination should be vaccinated.

6.5.6 Influenza vaccine: Patients ≥6 months of age with cancer should receive an inactivated influenza vaccine annually. An exception is patients who are receiving anti–B cell antibodies (eg, rituximab, alemtuzumab) since immunogenicity is so poor; vaccine administration should be delayed for at least six months in such patients. Although inactivated vaccines are generally avoided in patients receiving intensive chemotherapy (eg, induction or consolidation chemotherapy for acute leukemia), inactivated influenza vaccine is recommended to such patients given the need for annual administration to protect against circulating seasonal strains of influenza.

Immunization of family members and hospital staff is also strongly recommended.

6.5.7 Hepatitis B vaccine: A three-dose series of hepatitis B vaccine is recommended. The second dose should be administered at least 1 month after the first dose; the third dose should be administered at least 2 months after the second dose (and at least 4 months after the first dose). The preferred schedule is 0, 1 and 6 months. Serologic testing to assess the response to hepatitis B vaccination is recommended ≥1 month following the third dose. A second three-dose series is recommended in non-responders (ie, those with anti-HBs concentrations <10 mIU/mL). Hepatitis B and hepatitis A vaccine may be co-administered to cancer patients.

6.5.8 Hepatitis A Vaccine: Cancer patients who have any risk factors for developing hepatitis A should receive the hepatitis A vaccine, probably in combination with the hepatitis B vaccine since many of the risk factors for hepatitis A and B overlap. Single-antigen vaccine formulations should be administered in a 2-dose schedule at either 0 and 6 to 12 months (Havrix), or 0 and 6 to 18 months (Vaqta). If the combined hepatitis A and hepatitis B vaccine (Twinrix) is used, administer 3 doses at 0, 1, and 6 months.

6.5.9 Measles, mumps, and rubella vaccines: These live vaccines should not be administered unless the vaccine is otherwise indicated AND the patient is not immunosuppressed AND there will be an interval of ≥4 weeks prior to initiation of chemotherapy. Measles-mumps-rubella (MMR) vaccine should not be administered to cancer patients receiving chemotherapy. However, those with leukemia, lymphoma, or other malignancies whose disease is in remission and whose chemotherapy has been terminated for at least three months may receive live virus vaccines such as MMR.

The 2013 Advisory Committee on Immunization Practices (ACIP) recommendations state that severely immunocompromised patients who have been exposed to measles should receive 400 mg/kg of intravenous immune globulin, regardless of vaccination or immunologic status. Severely immunocompromised cancer patients include those receiving treatment for acute lymphoblastic leukemia until at least six months after completing therapy.

6.5.10 Varicella vaccine: Those with leukemia, lymphoma, or other malignancies whose disease is in remission and whose chemotherapy has been terminated for at least three months may receive live virus vaccines, including varicella. The varicella vaccine may be administered to susceptible household and other close contacts of cancer patients because transmission of varicella vaccine is rare. If the household contact develops a rash after vaccination, the household contact should avoid direct contact with the immunocompromised cancer patient.

6.5.11 Zoster vaccine: The live zoster vaccine (ZVL) is contraindicated in cancer patients receiving chemotherapy, although the ACIP states that patients whose leukemia is in remission and who have not received chemotherapy or radiation for at least three months may receive the zoster vaccine. There are no contraindications to administering (non-live recombinant vaccine, RZV) in immunocompromised hosts who have an underlying immunodeficiency or are receiving moderate- to high-dose immunosuppressive therapy, but there are insufficient data at this time to recommend routine vaccination with RZV.

(Table 5). Immunizations for patients with cancer

Vaccine	Starting ≥3 months Post-chemotherapy and ≥6 months post anti-B cell antibodies for inactivated vaccines	**Revaccination Year 5**
Inactivated Polio 0.5 ml IM	X	
Hepatitis B 0.5 ml IM	X 3-dose series	
Hepatitis A 0.5 ml IM	X 2-dose series	
Tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis (Tdap) 0.5 ml IM	X (then Td booster every 10 years)	
Meningococcal Conjugate 0.5 ml IM	X	X
Pneumococcal Conjugate (PCV) 0.5 ml IM	X (Check guidelines item 6.5.3 for specific protocol)	
Pneumococcal Polysaccharide (PPSV23) 0.5 ml IM	X (Check guidelines item 6.5.3 for specific protocol)	X
Inactivated Influenza Vaccine 0.5 ml IM	X (annually thereafter for the life of the patient)	
MMR 0.5 ml SC (avoid if patient is still on immunosuppression)	X	
Varicella 0.5 ml SC (avoid if patient is still on immunosuppression)	X	

7. Summaries of recommendations on specific health conditions

7.1 Summary of recommendations of immunizations for adult patients with HIV

Vaccine name and route	For whom vaccination is recommended	Schedule for vaccination administration	Contraindications & Precautions
Inactivated Influenza (IIV) IM	Recommended for all adults with HIV	One **IIV** dose every year in the fall or winter	Previous severe allergic reaction Moderate or severe acute illness with or without fever
Tetanus, diphtheria, pertussis (Td/Tdap) IM	All people who lack written documentation of a primary series consisting of at least 3 doses of tetanus- and diphtheria-toxoid-containing vaccine	Substitute 1-time dose of Tdap for Td booster; then boost with Td every 10 yrs	Previous severe allergic reaction For Tdap only, history of encephalopathy not attributable to an identifiable cause, within 7d following DTP/DTaP or Tdap
Pneumococcal conjugate (PCV13) IM	- Incidence of invasive pneumococcal disease (meningitis, sepsis) **is 35 times** higher in HIV-infected adults than in non-infected **- As soon as possible** to adults who are newly diagnosed with asymptomatic or symptomatic HIV infection	HIV patients should first be given PCV13, followed by PPSV23 at least 8 weeks later. If they are younger than age 65 years, they will need a second dose of PPSV23 at least 5 years after their initial dose and a third dose once they become age 65 years. If they are age 65 years or older when first diagnosed, they will need only one dose	Previous severe allergic reaction to this vaccine, including (for PCV13) to any diphtheria toxoid-containing vaccine, or to any of its components Moderate or severe acute illness
Pneumococcal polysaccharide (PPSV23) IM or SC			
Hepatitis A (HepA) IM	Adults seeking protection from (HAV) infection and persons with other risk factors (e.g., traveling to countries with high or intermediate rates, have ch. Liver dis or clotting factor disorders, illicit drug users, post exposure prophylaxis)	2 dose schedule with a minimum of 6 month interval	Previous severe allergic reaction Moderate or severe acute illness

Hepatitis B (HepB) IM	For all HIV positive persons	3-dose series at 0, 1 and 6 month intervals (the 2nd should be at least 4 wks after the 1st and the 3rd should be at least 8 wks after the 2nd and at least 16 wks after the 1st)	
Humanpapilloma virus (HPV) IM	For unvaccinated females, 13 through age 26yrs: Complete a 3-dose series of HPV2 or HPV4 For unvaccinated males, 13 through age 21yrs: Complete a 3-dose series of HPV4 Males 22-26yrs may be vaccinated	3 doses on a 0, 1–2, 6m schedule. Use either HPV2 or HPV4 for women, and only HPV4 for men Must be at least 4wks between doses #1 and #2 and at least 12wks between doses #2 and #3	Previous severe allergic reaction Moderate or severe acute illness Pregnancy
MMR (Measles, mumps, rubella) SC	HIV patients who were born in 1957 or later & not severely immunocompromised (CD4+ T-lymphocyte counts are ≥ 200 cells/μL) if they have no laboratory evidence of immunity to each of the 3 diseases Contraindicated for HIV patients who are severely immunocompromised (CD4+ T-lymphocyte counts are < 200 cells/μL)	2 doses dose #2 should be given at lease 4weeks after dose #1	Previous severe allergic reaction Pregnancy or possibility of pregnancy within 4wks Severe immunodeficiency History of thrombocytopenia or thrombocytopenic purpura
Varicella (chickenpox) SC	- HIV patients who are not severely immunocompromised (CD4+ T-lymphocyte counts are ≥ to 200 cells/μL) without evidence of immunity to varicella* Contraindicated for HIV patients who are severely immunocompromised (CD4+ T-lymphocyte counts are < to 200 cells/μL)	- 2 doses - Dose #2 is given 4—8wks after dose #1. - If dose #2 is delayed, do not repeat dose #1. Just give dose #2.	Previous severe allergic reaction (e.g. anaphylaxis) Pregnancy Long-term immunosuppressive therapy or immunocompromised because of malignancy Receipt of specific antivirals Moderate or severe acute illness

7.2 Summary of recommendations for immunizations for adult patients with Diabetes Mellitus

Vaccine name and route	For whom vaccination is recommended	Schedule for vaccination administration	Contraindications & Precautions
Inactivated Influenza (IIV) IM	Recommended for all diabetic adults **because influenza can raise blood glucose to dangerously high levels**	One **IIV** dose every year in the fall or winter	Previous severe allergic reaction Moderate or severe acute illness with or without fever
Pneumococcal conjugate (PCV13) IM	All diabetic adults if some other risk factor is present: Age ≥65 years, Cerebrospinal fluid leak, Cochlear implant, Functional or anatomic asplenia, hemoglobinopathies, HIV infection, Chronic renal failure and Nephrotic syndrome, Leukemia, Lymphoma, generalized malignancy, immunosuppression	**Schedule for dual vaccination** - A single dose of PCV13 followed by a dose of PPSV23 ≥8 weeks later should be given for adults with diabetes mellitus who are ≥65 years or have any of the risk factors (mentioned before) and who have not previously received either PCV13 or PPSV23. For patients who have previously received one or more doses of PPSV23, a single dose of PCV13 should be given ≥1 year after the last PPSV23 dose was received. Revaccination with single dose of PPSV23 >5 year in immunocompromised and at 65 years old.	Previous severe allergic reaction to this vaccine, including (for PCV13) to any diphtheria toxoid-containing vaccine, or to any of its components Moderate or severe acute illness
Pneumococcal polysaccharide (PPSV23) IM or SC	All diabetic adults at any age		
Hepatitis B (HepB) IM	For all unvaccinated diabetics who are <60 yrs, and based on risk of exposure for older patients.	3-dose series at 0, 1 and 6 month intervals (the 2nd should be at least 4wks after the 1st and the 3rd should be at least 8wks after the 2nd and at least 16wks after the 1st)	Previous severe allergic reaction Moderate or severe acute illness
Hepatitis A (HepA) IM	All adults seeking protection from (HAV) infection and persons with other risk factors (e.g., traveling to countries with high or intermediate rates, have ch. Liver dis or clotting factor disorders, illicit drug users, with recent exposure as post exposure prophylaxis)	2 dose schedule with a minimum of 6 month interval	Previous severe allergic reaction Moderate or severe acute illness

Tetanus, diphtheria, pertussis (Td/Tdap) IM Do not use tetanus toxoid (TT) in place of Tdap or Td	All people who lack written documentation of a primary series consisting of at least 3 doses of tetanus- and diphtheria-toxoid-containing vaccine	Substitute 1-time dose of Tdap for Td booster; then boost with Td every 10 yrs	Previous severe allergic reaction For Tdap only, history of encephalopathy not attributable to an identifiable cause, within 7d following DTP/DTaP, or Tdap
Zoster (shingles)	Adults aged 60 years or older (ZVL) or 50 years or older (RZV) regardless of whether they report a prior episode of herpes zoster or varicella.	1 dose of ZVL 2 doses 2-6 months apart for RZV	ZVL: Previous severe allergic reaction Primary cellular or acquired immunodeficiency Pregnancy Receipt of specific antivirals 24hrs before vaccination Moderate or severe acute illness RZV: allergic reaction to vaccine or vaccine component
Measles, mumps, rubella (MMR) SC	Individuals at higher risk of either exposure or morbidity e.g., Healthcare personnel, college students, Military personnel, international travelers, Household and close contacts of immunocompromised persons, HIV-infected individuals who do not have current evidence of severe immunosuppression	- Adults with no evidence of immunity should get 1 dose of MMR unless the adult is in a high risk group. - Individuals at high risk should have two doses separated by at least one month or serologic evidence of immunity.	Previous severe allergic reaction Pregnancy or possibility of pregnancy within wks Immuno-compromising conditions Severe immunodeficiency History of thrombocytopenia or thrombocytopenic purpura
Varicella (chickenpox) SC	All adults without evidence of immunity to varicella	- 2 doses - Dose #2 is given 4—8 wks after dose #1. - If dose #2 is delayed, do not repeat dose #1, just give dose #2.	Previous severe allergic reaction (e.g. anaphylaxis) Pregnancy Long-term immunosuppressive therapy or immunocompromised pts Receipt of specific antivirals Moderate or severe acute illness

7.3 Summary of recommendations for immunizations for adult patients with Heart Disease

Vaccine name and route	For whom vaccination is recommended	Schedule for vaccination administration	Contraindications & Precautions
Inactivated Influenza (IIV) IM	Recommended for all adults	One **IIV** dose every year in the fall or winter	Previous severe allergic reaction Moderate or severe acute illness with or without fever
Tetanus, diphtheria, pertussis (Td/Tdap) IM Do not use tetanus toxoid (TT) in place of Tdap or Td	All people who lack written documentation of a primary series consisting of at least 3 doses of tetanus- and diphtheria-toxoid-containing vaccine	Substitute 1-time dose of Tdap for Td booster; then boost with Td every 10 yrs	Previous severe allergic reaction For Tdap only, history of encephalopathy not attributable to an identifiable cause, within 7d following DTP/DTaP, or Tdap
Pneumococcal conjugate (PCV13) IM	For all adults with chronic heart and lung diseases if some other risk factor is present: Age ≥65 years, Cerebrospinal fluid leak, Cochlear implant, Functional or anatomic asplenia, hemoglobinopathies, HIV infection, Chronic renal failure and Nephrotic syndrome, Leukemia, Lymphoma, generalized malignancy, immunosuppression	**Schedule for dual vaccination** - A single dose of PCV13 followed by a dose of PPSV23 ≥8 weeks later should be given for adults with heart disease who are ≥65 years or have any of the risk factors (mentioned before) and who have not previously received either PCV13 or PPSV23. For patients who have previously received one or more doses of PPSV23, a single dose of PCV13 should be given ≥1 year after the last PPSV23 dose was received. Revaccination with single dose of PPSV23 >5 year in immunocompromised and at 65 years old.	Previous severe allergic reaction to this vaccine, including (for PCV13) to any diphtheria toxoid-containing vaccine, or to any of its components Moderate or severe acute illness

Pneumococcal polysaccharide (PPSV23) IM or SC	Chronic heart disease, including heart failure and cardiomyopathy Chronic lung disease, including asthma and COPD	2 doses for adults aged 19 through 64 years with chronic heart disease (including congestive heart failure and cardiomyopathies, excluding hypertension), 5 years apart.	
Hepatitis B (HepB) IM	Recommended if some other risk factor is present (e.g., on the basis of medical, occupational, lifestyle, or other indications)	3-dose series at 0, 1 and 6 month intervals (the 2nd should be at least 4wks after the 1st and the 3rd should be at least 8wks after the 2nd and at least 16wks after the 1st)	Previous severe allergic reaction Moderate or severe acute illness
Hepatitis A (HepA) IM	All adults seeking protection from (HAV) infection and persons with other risk factors (e.g., traveling to countries with high or intermediate rates, have ch. Liver dis or clotting factor disorders, illicit drug users, with recent exposure as post exposure prophylaxis)	2 dose schedule with a minimum of 6 month interval	Previous severe allergic reaction Moderate or severe acute illness
Humanpapilloma virus (HPV) IM	For unvaccinated females, 13 through age 26yrs: Complete a 3-dose series of HPV2 or HPV4 For unvaccinated males, 13 through age 21yrs: Complete a 3-dose series of HPV4 Males 22-26yrs may be vaccinated	3 doses on a 0, 1–2, 6m schedule. Use either HPV2 or HPV4 for women, and only HPV4 for men Must be at least 4wks between doses #1 and #2 and at least 12wks between doses #2 and #3	Previous severe allergic reaction Moderate or severe acute illness Pregnancy
Zoster (shingles)	Adults aged 60 years or older (ZVL) or 50 years or older (RZV) regardless of whether they report a prior episode of herpes zoster	1 dose of ZVL 2 doses 2-6 months apart for RZV	ZVL: Previous severe allergic reaction Primary cellular or acquired immunodeficiency Pregnancy Receipt of specific antivirals 24hrs before vaccination Moderate or severe acute illness RZV: allergic reaction to vaccine or vaccine component

MMR (Measles, mumps, rubella) SC	Individuals at higher risk of either exposure or morbidity e.g., Healthcare personnel, college students, Military personnel, international travelers, Household and close contacts of immunocompromised persons, HIV-infected individuals who do not have current evidence of severe immunosuppression	Adults with no evidence of immunity should get 1 dose of MMR unless the adult is in a high risk group Individuals at high risk should have two doses separated by at least one month or serologic evidence of immunity	Previous severe allergic reaction Pregnancy or possibility of pregnancy within 4wks Immuno-compromising conditions Severe immunodeficiency History of thrombocytopenia or thrombocytopenic purpura
Varicella (chickenpox) SC	All adults without evidence of immunity to varicella	2 doses Dose #2 is given 4—8wks after dose #1. If dose #2 is delayed, do not repeat dose #1. Just give dose #2.	Previous severe allergic reaction (e.g. anaphylaxis) Pregnancy Long-term immunosuppressive therapy or immunocompromised pts Receipt of specific antivirals Moderate or severe acute illness

7.4 Summary of recommendations for immunizations for adult patients with Liver Disease

Vaccine name and route	For whom vaccination is recommended	Schedule for vaccination administration	Contraindications & Precautions
Inactivated Influenza (IIV) IM	Recommended for all adults	One **IIV** dose every year in the fall or winter	Previous severe allergic reaction Moderate or severe acute illness with or without fever
Tetanus, diphtheria, pertussis (Td/Tdap) IM	All people who lack written documentation of a primary series consisting of at least 3 doses of tetanus- and diphtheria-toxoid-containing vaccine	Substitute 1-time dose of Tdap for Td booster; then boost with Td every 10 yrs	Previous severe allergic reaction For Tdap only, history of encephalopathy not attributable to an identifiable cause, within 7d following DTP/DTaP, or Tdap
Pneumococcal conjugate (PCV13) IM	For all adults with chronic liver diseases if some other risk factor is present: Age ≥65 years, Cerebrospinal fluid leak, Cochlear implant, Functional or anatomic asplenia, hemoglobinopathies, HIV infection, Chronic renal failure and Nephrotic syndrome, Leukemia, Lymphoma, generalized malignancy, immunosuppression	**Schedule for dual vaccination** - A single dose of PCV13 followed by a dose of PPSV23 ≥8 weeks later should be given for adults with liver disease who are ≥65 years or have any of the risk factors (mentioned before) and who have not previously received either PCV13 or PPSV23. For patients who have previously received one or more doses of PPSV23, a single dose of PCV13 should be given ≥1 year after the last PPSV23 dose was received. Revaccination with single dose of PPSV23 >5 year in immunocompromised and at 65 years old.	Previous severe allergic reaction to this vaccine, including (for PCV13) to any diphtheria toxoid-containing vaccine, or to any of its components Moderate or severe acute illness
Pneumococcal polysaccharide (PPSV23) IM or SC	All chronic liver diseases patients because they have an increased risk of death from pneumococcal bacteremia & pulmonary complications	2 doses for adults aged 19 through 64 years, 5yrs apart For age 65yrs they need a 2nd dose, at least 5 years since previous dose if 1st dose was given prior to age 65	

Hepatitis A (HepA) IM	Adults who want to be protected from (HAV) infection For chronic liver diseases patients & for persons who receive clotting factor concentrates	2-dose series with a minimum of 6 month interval	Previous severe allergic reaction Moderate or severe acute illness
Hepatitis B (HepB) IM	All persons with chronic liver disease including, HCV infection, cirrhosis, fatty liver disease	3-dose series at 0, 1 and 6 month intervals	
MMR (Measles, mumps, rubella) SC	Individuals at higher risk of either exposure or morbidity e.g., Healthcare personnel, college students, Military personnel, international travelers, Household and close contacts of immunocompromised persons, HIV-infected individuals who do not have current evidence of severe immunosuppression	Adults with no evidence of immunity should get 1 dose of MMR unless the adult is in a high risk group - Individuals at high risk should have two doses separated by at least one month or serologic evidence of immunity	Previous severe allergic reaction Pregnancy or possibility of pregnancy within 4wks Immuno-compromising conditions Severe immunodeficiency History of thrombocytopenia or thrombocytopenic purpura
Zoster (shingles)	Adults aged 60 years or older (ZVL) or 50 years or older (RZV) regardless of whether they report a prior episode of herpes zoster	1 dose of ZVL 2 doses 2-6 months apart for RZV	ZVL: Previous severe allergic reaction Primary cellular or acquired immunodeficiency Pregnancy Receipt of specific antivirals 24hrs before vaccination Moderate or severe acute illness RZV: allergic reaction to vaccine or vaccine component
Varicella (chickenpox) SC	All adults without evidence of immunity to varicella	2 doses Dose #2 is given 4—8wks after dose #1. If dose #2 is delayed, do not repeat dose #1. Just give dose #2.	Previous severe allergic reaction (e.g. anaphylaxis) Pregnancy Long-term immunosuppressive therapy or immunocompromised pts Receipt of specific antivirals Moderate or severe acute illness

Human papillomavirus (HPV) IM	For unvaccinated females through age 26yrs: Complete a 3-dose series of HPV2 or HPV4 For unvaccinated males through age 21yrs: Complete a 3-dose series of HPV4	3 doses on a 0, 1–2, 6m schedule. Use either HPV2 or HPV4 for women, and only HPV4 for men Must be at least 4wks between doses #1 and #2 and at least 12wks between doses #2 and #3	Previous severe allergic reaction Moderate or severe acute illness Pregnancy

7.5 Summary of recommendations for immunizations for elderly patients ≥65 years old

Vaccine name and route	For whom vaccination is recommended	Schedule for vaccination administration	Contraindications & Precautions
Inactivated Influenza (IIV) IM	All adults who are ≥ 65 yrs.	One **IIV** dose every year in the fall or winter	Previous severe allergic reaction Moderate or severe acute illness with or without fever
Tetanus, diphtheria, pertussis (Td/Tdap) IM	All people who lack written documentation of a primary series consisting of at least 3 doses of tetanus- and diphtheria-toxoid-containing vaccine	Substitute 1-time dose of Tdap for Td booster; then boost with Td every 10 yrs	Previous severe allergic reaction For Tdap only, history of encephalopathy not attributable to an identifiable cause, within 7d following DTP/DTaP, or Tdap
Pneumococcal conjugate (PCV13) IM Pneumococcal polysaccharide (PPSV23) IM or SC	All people ≥ 65 yrs. Should receive 1-time dose of PCV13 (if previously unvaccinated) and 1 dose of PPSV23 No additional dose of PPSV23 is indicated for adults vaccinated with PPSV23 at or after age 65 years	Adults aged ≥ 65 who: Have not received PCV13 or PPSV23: Administer PCV13 followed by PPSV23 one year later unless the patient has a high-risk medical condition (such immunocompromised or splenia), then the first PPSV23 dose can follow the PCV13 by 8 wks	Previous severe allergic reaction to this vaccine, including (for PCV13) to any diphtheria toxoid-containing vaccine, or to any of its components Moderate or severe acute illness
Hepatitis A (HepA) IM	All adults ≥ 65 yrs. who want to be protected from (HAV) infection if some other risk factor is present	2 dose schedule with a minimum of 6 month interval	Previous severe allergic reaction Moderate or severe acute illness
Hepatitis B (HepB) IM	Recommended if some other risk factor is present	3 dose series at 0, 1 and 6 month intervals (the 2nd should be at least 4 wks after the 1st and the 3rd should be at least 8 wks after the 2nd and at least 16 wks after the 1st)	
Zoster (shingles)	Adults aged 60 years or older (ZVL) or 50 years or older (RZV) regardless of whether they report a prior episode of herpes zoster	1 dose of ZVL 2 doses 2-6 months apart for RZV	ZVL: Previous severe allergic reaction Primary cellular or acquired immunodeficiency Pregnancy Receipt of specific antivirals 24hrs before vaccination

			Moderate or severe acute illness RZV: allergic reaction to vaccine or vaccine componentModerate or severe acute illness
Measles, mumps, rubella (MMR) SC	Individuals at higher risk of either exposure or morbidity e.g., Healthcare personnel, international travelers, Household and close contacts of immunocompromised persons, HIV-infected individuals who do not have current evidence of severe immunosuppression	Adults with no evidence of immunity should get 1 dose of MMR unless the adult is in a high risk group. Individuals at high risk should have two doses separated by at least one month or serologic evidence of immunity	Previous severe allergic reaction Pregnancy or possibility of pregnancy within 4wks Immuno-compromising conditions Severe immunodeficiency History of thrombocytopenia or thrombocytopenic purpura
Varicella (chickenpox) SC	A person age 60 years or older who has no medical contraindications, is eligible for zoster vaccine regardless of their memory of having had chickenpox. However, if an adult age 60 years or older is tested for varicella immunity for whatever reason, and the test is negative, he/she should be given 2 doses of varicella vaccine at least 4 weeks apart, not zoster vaccine.	2 doses Dose #2 is given 4—8 wks after dose #1 If dose #2 is delayed, do not repeat dose #1, just give dose #2	Previous severe allergic reaction (e.g. anaphylaxis) Pregnancy Long-term immunosuppressive therapy or immunocompromised pts Receipt of specific antivirals Moderate or severe acute illness

7.6 Summary of recommendations for immunizations during pregnancy

Vaccine		Recommendation	More information
Routine	Hepatitis A	Base decision on risk vs. benefit.	The safety of hepatitis A vaccination during pregnancy has not been determined; however, because hepatitis A vaccine is produced from inactivated HAV, the theoretic risk to the developing fetus is expected to be low. The risk associated with vaccination should be weighed against the risk for hepatitis A in pregnant women who might be at high risk for exposure to HAV
	Hepatitis B	Recommended in some circumstances	Pregnancy is not a contraindication to vaccination. Limited data suggest that developing fetuses are not at risk for adverse events when hepatitis B vaccine is administered to pregnant women. Available vaccines contain noninfectious HBsAg and should cause no risk of infection to the fetus. Pregnant women who are identified as being at risk for HBV infection during pregnancy (e.g. been evaluated or treated for an STD, recent or current injection drug use, or having had an HBsAg-positive sex partner) should be vaccinated.
	Human Papillomavirus (HPV)	Not recommended	HPV vaccines are not recommended for use in pregnant women. If a woman is found to be pregnant after initiating the vaccination series, the remainder of the 3-dose series should be delayed until completion of pregnancy. Pregnancy testing is not needed before vaccination. If a vaccine dose has been administered during pregnancy, no intervention is needed.
	Influenza (Inactivated IIV)	Recommended.	Pregnant and postpartum women are at higher risk for severe illness and complications from influenza than women who are not pregnant because of changes in the immune system, heart, and lungs during pregnancy.... Influenza vaccination can be administered at any time during pregnancy, before and during the influenza season. Women who are or will be pregnant during influenza season should receive IIV.
	Measles, Mumps, Rubella (MMR)	Contraindicated	**MMR vaccines should not be administered to women known to be pregnant or attempting to become pregnant**. Because of the theoretical risk to the fetus when the mother receives a live virus vaccine, women should be counseled to avoid becoming pregnant for 28 days after receipt of MMR vaccine. If the vaccine is inadvertently administered to a pregnant woman or a pregnancy occurs within 28 days of vaccination, she should be counseled about the theoretical risk to the fetus. Routine pregnancy testing of women of childbearing age before administering a live-virus vaccine is not recommended. MMR or varicella vaccination during pregnancy should not be considered a reason to terminate pregnancy. Rubella-susceptible women who are not vaccinated because they state they are or may be pregnant should be counseled about the potential risk for CRS and the importance of being vaccinated as soon as they are no longer pregnant.
	Meningococcal (MenACWY	May be used if otherwise indicated	**Pregnancy should not preclude vaccination with MenACWY, if indicated**.
	Pneumococcal Conjugate (PCV13)	No recommendation	ACIP has not published pregnancy recommendations for PCV13 at this time.
	Pneumococcal Polysaccharide	Inadequate data for specific	The safety of pneumococcal polysaccharide vaccine during the first trimester of pregnancy has not been evaluated, although no

	(PPSV23)	recommendation.	adverse consequences have been reported among newborns whose mothers were inadvertently vaccinated during pregnancy
	Inactivated Polio (IPV)	May be used if needed	Although no adverse effects of IPV have been documented among pregnant women or their fetuses, vaccination of pregnant women should be avoided on theoretical grounds. However, if a pregnant woman is at increased risk for infection and requires immediate protection against polio, IPV can be administered in accordance with the recommended schedules for adults
	Tetanus, Diphtheria, and Pertussis (Tdap); & Tetanus and Diphtheria (Td)	Should be used if otherwise indicated (Tdap preferred).	**Health-care personnel should administer a dose of Tdap during each pregnancy irrespective of the patient's prior history of receiving Tdap**. To maximize the maternal antibody response and passive antibody transfer to the infant, optimal timing for Tdap administration is between 27 and 36 weeks of gestation although Tdap may be given at any time during pregnancy. Currently available data suggest that vaccinating earlier in the 27 through 36–week period will maximize passive antibody transfer to the infant. For women not previously vaccinated with Tdap, if Tdap is not administered during pregnancy, Tdap should be administered immediately postpartum. *Wound Management:* If a Td booster is indicated for a pregnant woman, health-care providers should administer Tdap. *Unknown or Incomplete Tetanus Vaccination:* To ensure protection against maternal and neonatal tetanus, pregnant women who never have been vaccinated against tetanus should receive three vaccinations containing tetanus and reduced diphtheria toxoids. The recommended schedule is 0, 4 weeks and 6 through 12 months. Tdap should replace 1 dose of Td, preferably between 27 and 36 weeks gestation.
	Varicella	Contraindicated	Nonpregnant women who are vaccinated should avoid becoming pregnant for 1 month after each injection. For persons without evidence of immunity, having a pregnant household member is not a contraindication for vaccination. Routine pregnancy testing of women of childbearing age before administering a live-virus vaccine is not recommended. If a pregnant woman is inadvertently vaccinated or becomes pregnant within 4 weeks after MMR or varicella vaccination, she should be counseled about the theoretical basis of concern for the fetus; however, MMR or varicella vaccination during pregnancy should not be considered a reason to terminate pregnancy.
Travel or other	BCG	Contraindicated	**BCG vaccination should not be given during pregnancy**. Even though no harmful effects of BCG vaccination on the fetus have been observed, further studies are needed to prove its safety
	Rabies	May be used if otherwise indicated.	Because of the potential consequences of inadequately managed rabies exposure, **pregnancy is not considered a contraindication to post-exposure prophylaxis**. Certain studies have indicated no increased incidence of abortion, premature births, or fetal abnormalities associated with rabies vaccination. **If the risk of exposure to rabies is substantial, pre-exposure prophylaxis also might be indicated during pregnancy**.
	Typhoid	Inadequate data. Give Vi polysaccharide if needed.	No data have been reported on the use of either typhoid vaccine in pregnant women. In general, live vaccines like Ty21a are contraindicated in pregnancy. Vi polysaccharide vaccine should be given to pregnant women only if clearly needed

	Yellow Fever	May be used if benefit outweighs risk	**Pregnancy is a precaution for YF vaccine administration**, compared with most other live vaccines, which are contraindicated in pregnancy. If travel is unavoidable, and the risks for YFV exposure are felt to outweigh the vaccination risks, a pregnant woman should be vaccinated. If the risks for vaccination are felt to outweigh the risks for YFV exposure, pregnant women should be issued a medical waiver to fulfill health regulations. Although no specific data are available, a woman should wait 4 weeks after receiving YF vaccine before conceiving.

Prenatal Screening
Pregnant women should be evaluated for immunity to rubella and varicella and be tested for the presence of HBsAg during every pregnancy.
Women susceptible to rubella and varicella should be vaccinated immediately after delivery.
A woman found to be HBsAg positive should be monitored carefully to ensure that the infant receives HBIG and begins the hepatitis B vaccine series no later than 12 hours after birth and that the infant completes the recommended hepatitis B vaccine series on schedule.

Passive Immunization during Pregnancy
No known risk exists for the fetus from passive immunization of pregnant women with immune globulin preparations.

Breastfeeding and Vaccination
Neither inactivated nor live-virus vaccines administered to a lactating woman affect the safety of breastfeeding for women or their infants.
Although live viruses in vaccines can replicate in vaccine recipients (i.e., the mother), the majority of live viruses in vaccines have been demonstrated not to be excreted in human milk.
Varicella vaccine virus has not been found in human milk. Although rubella vaccine virus might be excreted in human milk, the virus usually does not infect the infant. If infection does occur, it is well tolerated because the virus is attenuated.
Inactivated, recombinant, subunit, polysaccharide, and conjugate vaccines, as well as toxoids, pose no risk for mothers who are breastfeeding or for their infants."
Yellow fever vaccine should be avoided in breastfeeding women. However, when nursing mothers cannot avoid or postpone travel to areas endemic for yellow fever in which risk for acquisition is high, these women should be vaccinated.
(Source: Guidelines for Vaccinating Pregnant Women.
https://www.cdc.gov/vaccines/pregnancy/hcp/guidelines.html. August 2016)

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FOR FURTHER INFORMATION
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