Immunizations for Preventable Diseases in Children and Adolescents With HIV

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Immunizations are an extremely effective primary prevention tool, and vaccines that help protect against 19 diseases are recommended for routine use in children and adolescents in the United States. In addition, select immunizations may be recommended for children and adolescents with HIV in special circumstances (e.g., yellow fever vaccine [YFV] and cholera vaccine for international travelers). Immunization schedules for children from birth through 18 years of age are published annually by the Centers for Disease Control and Prevention (CDC). For more information see the following:

- Child and Adolescent Immunization Schedule by Age
- Child and Adolescent Immunization Schedule by Medical Indication
- ACIP Altered Immunocompetence Guidelines for Immunizations
- ACIP Vaccine Recommendations and Guidelines
- Interim Clinical Considerations for Use of COVID-19 Vaccines

These schedules are compiled from approved immunization-specific policy recommendations that are standardized in collaboration with the major immunization policy-setting and immunization-delivery organizations (i.e., the Advisory Committee on Immunization Practices [ACIP], American Academy of Pediatrics, American Academy of Family Physicians, American College of Obstetricians and Gynecologists, American College of Nurse Midwives, American College of Physicians, American Academy of Physician Associates, and National Association of Pediatric Nurse Practitioners). See the ACIP Recommendations webpage for recent updates.

It is critical that children and adolescents with HIV be vaccinated, as they are particularly vulnerable to severe complications from vaccine-preventable diseases. Most immunizations recommended for routine use can be administered safely to children with or exposed to HIV. The recommended immunization schedule for children aged 0 to 18 years with or exposed to HIV corresponds to the ACIP-approved schedule for all children and adolescents and includes ACIP-approved additions specific to children and adolescents with HIV that are summarized in Table 1 below. For more information, see Figure 1. Recommended Immunization Schedule for Children With HIV Infection Aged 0 Through 18 Years and CDC's Child and Adolescent Immunization Schedule by Medical Indication.

Table 1. Immunizations and Possible Variations for Children and Adolescents With HIV (Additional Vaccines Are Discussed in the Full Text)

Recommendation	Immunizing Agents
Immunization given according to routine schedule	Hepatitis B vaccine (HepB) Diphtheria, tetanus, acellular pertussis vaccine (DTaP) Tetanus, reduced diphtheria, reduced acellular pertussis vaccine (Tdap) Inactivated poliovaccine (IPV) Inactivated influenza vaccine (IIV) Hepatitis A vaccine (HepA) Nirsevimab
Precaution—immunization may be indicated when benefit of protection outweighs the risk	Rotavirus vaccine (RV) Dengue vaccine (DEN4CYD) *(only if CD4% ≥15% and total CD4 count of ≥200/mm^3)*
Immunization given according to routine schedule; additional doses may be needed	Haemophilus *influenzae* type b (Hib) Pneumococcal conjugate vaccine (PCV) Human papillomavirus vaccine (HPV) Meningococcal ACWY vaccine (MenACWY) Pneumococcal polysaccharide vaccine (PPSV) Monovalent COVID-19 vaccine (1vCOV-mRNA or 1vCOV-aPS)
Immunization given to individuals with an additional risk factor for which the vaccine would be indicated	Serogroup B meningococcal vaccine (MenB) Respiratory syncytial virus vaccine (RSVpreF) Mpox vaccine (Jynneos) Recombinant zoster vaccine (RZV)
Not recommended	Live attenuated influenza vaccine (LAIV) Oral typhoid vaccine (TY21A)
Not recommended if CD4% <15% and/or total CD4 count is <200 cells/mm^3	Measles-mumps-rubella vaccine (MMR) Varicella vaccine (VAR) Dengue vaccine (DEN4CYD)

Non-Live Vaccines

All non-live vaccines—whether killed, whole organism, or fractional vaccine—can be administered safely to individuals with altered immunocompetence. For children and adolescents without HIV, some non-live vaccines, such as pneumococcal conjugate vaccine (PCV) and *Haemophilus influenzae* type b conjugate vaccine (Hib), are not routinely recommended after certain ages, even if the recommended series was not completed. However, because children and adolescents with HIV have a risk of increased disease severity, these vaccines remain recommended beyond the routinely recommended ages for children and adolescents without HIV. For children and adolescents with HIV, some non-live vaccines are recommended as additional vaccine doses outside of the routine recommendation; for instance, an additional dose of mRNA COVID-19 vaccine can be administered to any person aged ≥6 months who has received a primary series and/or booster dose, as long as 2 months have elapsed since the most recent dose. Another example of additional vaccine doses is for children and adolescents with HIV who have received a complete primary series with PCV15 or PCV20 before 6 years of age. They can receive either one dose of PCV20 or one dose of pneumococcal polysaccharide vaccine (PPSV23), followed by either a second dose of PCV20 (after 8 weeks) or another dose of PPSV23 (after 5 years) if they are aged 2 years or older. Other non-live vaccines might be recommended outside the routine age window, such as quadrivalent meningococcal conjugate (MenACWY-CRM) vaccine beginning at age 2 months for children with HIV. Children with HIV aged 2 to 5 years who were partially vaccinated with a primary series of PCV13, 15, or 20 prior to their second birthday are recommended for catch-up doses of PCV15 or PCV20.

Live Vaccines

Certain live vaccines, such as live attenuated influenza vaccine (LAIV), are **contraindicated** for children and adolescents with HIV because of the potential risk of uninhibited vaccine microbe replication leading to adverse reactions. Annual age-appropriate influenza vaccination with non-live influenza vaccine is recommended for children and adolescents with HIV as part of routine prevention for influenza.[1] The effectiveness of any vaccine may be suboptimal in an individual with an immunocompromising condition.[2-4]

Compared with children and adolescents who are immunocompetent, children and adolescents with HIV are at higher risk for complications of some diseases for which only live vaccines are available. Two doses of measles, mumps, and rubella (MMR) vaccine are recommended for all individuals with HIV aged ≥12 months who do not have evidence of current severe immunosuppression.[5] Based on limited safety, immunogenicity, and efficacy data in children and adolescents with HIV, single-antigen varicella vaccine should be considered for children and adolescents with HIV and CD4 T lymphocyte (CD4) cell count percentages ≥15% of total lymphocytes (see Child and Adolescent Immunization Schedule by Medical Indication). Eligible children should receive two doses 3 months apart, with the first dose administered as soon as possible after the child's first birthday. In contrast, the measles, mumps, rubella, and varicella (MMRV) vaccine **should not be administered** to a child or adolescent with HIV, regardless of CD4 parameters.

Limited data are available from clinical trials on the safety of rotavirus vaccines in infants known to have HIV and who were clinically asymptomatic or mildly symptomatic when vaccinated.[6] The data available do not suggest that the safety profile of rotavirus vaccines in infants with clinically asymptomatic or mildly symptomatic HIV is different from that in infants who do not have HIV.[7,8] Two other considerations support rotavirus vaccination of infants with or exposed to HIV: first, the

diagnosis of perinatal HIV may not be established in infants born to mothers with HIV before the oldest age at which the rotavirus vaccine series can be administered[9]; and second, vaccine strains of rotavirus are attenuated, suggesting that if vaccine-induced disease occurred, it would be milder than natural disease. Consultation with an immunologist or pediatric infectious disease specialist is advised before the rotavirus vaccine is administered to infants with known or suspected altered immunocompetence, such as infants with HIV with low CD4 counts (CD4 <200 cells/mm^3) or low CD4 percentages of total lymphocytes (CD4% <15%).

Oral typhoid vaccine **should not be administered** to children and adolescents with HIV. Intramuscular (IM) typhoid vaccine can be administered as an alternative. Ideally, travel vaccines should be administered 2 weeks prior to exposure or travel but should still be administered even if this window is shortened. Adequate prevention of typhoid disease requires, in addition to vaccination, education on food handling and other foodborne illness prevention.

The U.S. Food and Drug Administration has approved the cholera vaccine (Vaxchora–CVD 103-HgR) for children aged ≥2 years, adolescents, and adults. No safety or efficacy data exist regarding use of the current formulation of cholera vaccine in adults with HIV or people with severe immunosuppression. Limited data from an older formulation of the cholera vaccine suggest no association between the vaccine and serious or systemic adverse events, as well as slightly lower immunogenicity of the vaccine in adults with or without HIV. HIV infection is neither a contraindication nor a precaution to Vaxchora.[10]

If recommended, YFV can be administered to children aged 9 months to <6 years with CD4 percentages >24% of total lymphocytes or to children aged ≥6 years with a CD4 count of ≥500 cells/mm^3. Providers should ensure that patients do not have AIDS or other clinical manifestations of HIV, which are contraindications.

YFV is **contraindicated** for all children aged <6 months. YFV is also **contraindicated** for all children with symptomatic HIV or CD4 values <200 cells/mm^3 or <15% of total lymphocytes for children younger than 6 years. If a person with severe immunosuppression based on CD4 counts (<200 cells/mm^3 or <15% total), AIDS diagnosis, or symptomatic HIV cannot avoid traveling to an area in which yellow fever is endemic, a medical waiver for YFV should be provided, and counseling on protective measures against mosquito bites should be emphasized.

Precautions in administering YFV should be followed, and administering YFV may be considered for people with HIV who are aged ≥6 years with CD4 counts of 200 to 499 cells/mm^3 or children aged 6 months to 6 years with CD4 percentages of 15% to 24% of total lymphocytes. If international travel requirements, rather than an increased risk for acquiring yellow fever, are the only reason to vaccinate someone with a precaution, the person should be excused from vaccination and issued a medical waiver to fulfill health regulations. As with other travel vaccines, it is optimal to administer YFV 14 days before expected exposure.

At the time of the initial dose of YFV, people with HIV should receive a booster dose every 10 years if they continue to travel or live in areas that put them at risk for yellow fever. (See the CDC Yellow Book and Yellow Fever ACIP Vaccination Recommendations for details on precautions and contraindications for YFV.) Of note, the YFV is only available at specialized centers, which can be found at CDC's Traveler's Health page.

Other Considerations

For certain vaccines (e.g., hepatitis A vaccine [HepA]), the response to vaccination may be greater with immune reconstitution following antiretroviral therapy (ART),[11] or immunogenicity may vary based on viral load (e.g., improved immune response with lower HIV viral load), such as with YFV.[12] Postvaccination serology is recommended for patients with HIV following HepA, and, if lower than 10 mIU/mL, revaccination with a series of HepA can be considered. After the second series, another serology can be performed, and if negative, no further doses are recommended, but counseling should be provided regarding the risks of hepatitis A and the need for immune globulin postexposure (see Prevention of Hepatitis A Virus Infection in the United States: Recommendations of the Advisory Committee on Immunization Practices, 2020.) For the hepatitis B vaccine, postvaccination serology is recommended for people with certain risk factors, including HIV, and revaccination is recommended if levels are lower than 10 mIU/mL.

For some additional vaccines, ACIP recommends performing postvaccination serology to ensure immune response. For most vaccines, people with higher CD4 counts have improved immune response, which also means that response (e.g., to vaccination for influenza, MMR, or yellow fever) likely would be improved after ART is initiated.[1,12-14] Concern about the lack of protection from vaccines administered before a child begins ART has prompted debate about the need for routine revaccination once a child is on effective ART.[12,15] Currently, the only vaccine for which there is a recommendation for revaccination is MMR, for which ACIP made specific recommendations for routine revaccination after initiation of ART.[5] This recommendation was based on the low rates of measles seroprotection in children with HIV who received the MMR vaccine before starting ART, as well as the safety and high rates of measles seroprotection associated with MMR revaccination after the children were receiving ART.[16] Individuals with perinatally acquired HIV who were vaccinated prior to establishment of effective ART should receive two appropriately spaced doses of MMR vaccine after effective ART has been established, unless they are severely immunosuppressed or have other acceptable current evidence of measles immunity.[5]

Household contacts of children and adolescents with HIV can be vaccinated with live vaccines because vaccination protects both the vaccine recipient and the child or adolescent by preventing transmission. Children and adolescents living in a household with an adult or child with HIV can receive the MMR vaccine because the viruses in this vaccine are not transmitted from person to person. All members of a household who are aged >6 months can receive yearly influenza vaccines. Likewise, household contacts of children and adolescents with HIV can receive the LAIV or the inactivated influenza vaccine (IIV); there is no preference between LAIV and IIV for household contacts of children and adolescents with HIV. Immunization against varicella is encouraged for all household contacts of children and adolescents with HIV without evidence of immunity to varicella.[16] Transmission of varicella vaccine virus from an immunized, immunocompetent individual to a household contact is rare. Household contacts of children and adolescents with HIV need special counseling if there is a need for live, replicating smallpox vaccine (ACAM2000), because contact between these children and adolescents should be avoided.

Although human papillomavirus (HPV) vaccines may be given on a two-dose schedule (0, >6 months) for immunocompetent individuals who initiate their HPV vaccinations between 9 and 14 years of age , a three-dose schedule (0, 1 to 2 months, >6 months) is recommended for all children and adolescents who are immunocompromised, including those with HIV.

Consult the specific ACIP statements (see ACIP Vaccine Recommendations and Guidelines) for more details regarding recommendations, precautions, and contraindications for use of specific vaccines (see CDC's MMWR, ACIP Updates: Recommendations for Use of 20-Valent Pneumococcal Conjugate Vaccine in Children — United States, 2023 **and** Use of 15-Valent Pneumococcal Conjugate Vaccine Among U.S. Children: Updated Recommendations of the Advisory Committee on Immunization Practices — United States, 2022 **and** Use of a 2-Dose Schedule for Human Papillomavirus Vaccination).[11,13,16-28]

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