Florida/Caribbean AIDS Education and Training Center
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Update on Immunizations in HIV-Infected and Exposed Children and Adolescents

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The immunization schedule recommended for HIV-infected and exposed children and adolescents has been revised in 2008 (http://aidsinfo.nih.gov/contentfiles/Pediatric_OI.pdf) and new vaccines have been added to the preventive armamentarium. Yearly, the routine pediatric immunization schedules are reviewed by the Advisory Committee on Immunization Practices (ACIP) of the Centers for Disease Control and Prevention (CDC) and updated schedules can be accessed online (http://www.cdc.gov/vaccines/recs/schedules/default.htm). These guidelines include immunization schedules for ages 0-7 years, and 7-18 years and a catch up schema.

HIV-infected infants and children can safely receive most childhood vaccines, although effective response depends on the degree of immunosuppression. The use of highly active antiretroviral therapy, followed by immune restoration and controlled viremia, had been shown to correlate with an overall improvement in the immunogenicity and efficacy of many recommended vaccines. CD4% at time of vaccination and level of HIV replication are independent factors that may impact vaccine response and long-term immunity. This update will outline current vaccine schedules including recent revised recommendations.

LIVE ATTENUATED VACCINES

Rotavirus vaccine (Rota)

- No safety or efficacy data are available for the administration of attenuated rotavirus vaccine to infants who are potentially immunocompromised, including those who are HIV-positive. As HIV diagnosis may not be established in infants born to HIV positive mothers before the age of the first rotavirus vaccine dose, and only 1.5%–3% of HIV-exposed infants in the US will eventually test HIV positive, guidelines support vaccination of HIV-exposed or infected infants.
- Schedule: Rotateq®, 2, 4, and 6 months; Rotarix®, 2 and 4 months. First dose should be administered at age 6–14 weeks. Final dose should not be administered later than age 32 weeks.

Varicella vaccine

- Single antigen varicella (VZV) primary vaccination may be considered in HIV-infected, VZV-seronegative persons aged >8 years with CD4 cell counts >200 cells/mm^3 and in HIV-infected children aged 1–8 years with CD4 cell percentages ≥ 15%.
- Limited data are available on safety and immunogenicity of VZV vaccine in HIV-infected children however, weighing the risk for severe disease from wild VZV and the potential benefit of vaccination, experts agree to consider vaccination unless severely immunocompromised (CD4% <15).
- Schedule: 2 doses 3 months apart; first dose at 12 months
- Combined MMR and varicella vaccine (MMRV) has not been studied in HIV-infected children and should not be substituted for single antigen varicella vaccine
- Immunogenicity might be lower in HIV-infected adolescents (and adults)

Measles, mumps and rubella vaccine (MMR)

- MMR vaccine is recommended for HIV-infected children who are not severely immunosuppressed (CD4+ ≥15%) and who lack evidence of measles immunity
- The first dose of MMR vaccine should be administered as soon as possible after the first birthday. Consider administering the second dose 1 month after the first dose rather waiting until age 4 to 6 years.
- MMRV vaccine has not been studied in HIV-infected children and should not be substituted for MMR vaccine

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INACTIVATED VACCINES

Hepatitis B vaccine (HepB)

- Hepatitis B vaccination follows routine immunization recommendations with the following additions;
  - **Post vaccination:** Testing is recommended for HIV-infected children, 1–2 months after administration of the last dose of the vaccine series to verify achievement of a protective level of anti-HBs (≥10mIU/mL). Revaccinate with a 3 doses series if anti-HBs levels of <10 mIU/mL followed by anti-HBs testing 1–2 months after the 3rd dose.
  - **Booster dose:** In HIV-infected children, the need for booster doses has not been determined. Annual anti-HBs testing and booster doses when anti-HBs levels decline to <10 mIU/mL should be considered in persons with ongoing risk of exposure.
  - Modified dosing regimens, including a doubling of the standard antigen dose might increase response rates

Diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP), (Tdap), and *Haemophilus influenzae* type b conjugate vaccine (Hib).

- Recommendations in HIV-infected patients mimic routine immunization schedule
- Clinicians might consider use of Hib vaccine in HIV-infected > 59 months who did not receive the vaccine

Pneumococcal vaccine

- Heptavalent pneumococcal conjugate vaccine (PCV) is recommended for all HIV-infected children aged 2–59 months. Children ≤23 months should be vaccinated according to the routine PCV schedule
- For incompletely vaccinated children aged 24–59 months, administer two doses of PCV at least 8 weeks apart.
- Administering PCV to HIV-infected children ≥5 years is not contraindicated. Many experts would consider administering PCV vaccine followed by 23-valent pneumococcal polysaccharide (PPV) in this age group if previously not vaccinated
- Children aged ≥2 years should also receive the 23-valent pneumococcal polysaccharide vaccine (PPV) ≥2 months after their last PCV dose with a single revaccination with the 23-valent vaccine 3–5 years later
- A 13-valent pneumococcal conjugate vaccine is under study

Influenza vaccine

- All HIV-infected children and adolescents aged 6 months and older, and close contacts (including household members) of these children are recommended to receive yearly trivalent inactivated influenza vaccine (TIV)
- For healthy close contacts aged 2–49 years, live, attenuated influenza vaccine (LAIV) may be used as an alternative to TIV
- Vaccination schedule and doses are similar to those recommended for healthy children and adolescents
- Administration of H1N1 influenza vaccine in addition to the routine seasonal influenza vaccine will likely be recommended in 2009

Hepatitis A vaccine

- Hepatitis A vaccine is recommended for all children aged 1 year
- Schema: 2 doses, 6 months apart
- Review hepatitis A status in HIV patients, in particular in patients at higher risk, including MSM, IVDU, GI disease, clotting disorders, and co-infected with hepatitis B or C

Meningococcal vaccine

- Children with HIV are at increased risk for meningococcal disease although not to the extent that they are at risk for invasive *Streptococcus. pneumoniae* infection
- Although the efficacy of MCV4 among HIV-infected children is under study, this vaccine is recommended in HIV-infected children at ≥2 years
- Revaccination with MCV is indicated for children through age 18 years who received MCV4 or MPSV at ages 2 through 6 years or after 6 years, at 3 or 5 years after their first dose, respectively

Human papillomavirus vaccine (HPV)

- No data are available on immunogenicity, safety and efficacy of HPV vaccine in HIV-infected females but clinical trials are ongoing
- Because quadrivalent HPV vaccine is a noninfectious vaccine, and HPV-related disease is increased in HIV positive patients it can be administered to females regardless of CD4%
- Schema: females at age 11–12 years at 0, 2 and 6 months (minimum age 9, maximum age 26 years)

Inactivated poliovirus vaccine (IPV)

- Recommendations in HIV-infected patients mimic routine immunization schedule. Oral polio vaccine is contraindicated in HIV-infected children and adolescents.

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Summary
- HIV-infected infants and children can safely receive most childhood vaccines, although efficacy may vary
- Patients with severe immunosuppresion (CD4% <15%) should not received MMR or varicella vaccine
- Oral polio, and intranasal influenza vaccine are contraindicated in HIV-infected patients
- Immunization status should be reviewed at every visit and response to vaccination (antibody response) evaluated when indicated
- Additional vaccines may be indicated in HIV-infected patients travelling overseas. Information can be found in http://wwwn.cdc.gov/travel

References
1. http://www.cdc.gov/vaccines
2. http://aidsinfo.nih.gov/contentfiles/Pediatric_OI.pdf
3. http://www.cdc.gov/mmwr/pdf/rr/rr5804.pdf

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