



# *Use of CDC Vaccine Schedules Smartphone Application to Prescribe Vaccines for HIV-Infected Adults*

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## **Role of the Primary Care Provider in Treating the HIV-Infected Adult**

Infectious disease specialists have traditionally managed HIV infection in adults. However, as the need for clinicians to treat those infected with HIV outpaced a diminishing HIV workforce, primary care providers (PCPs), including physicians, nurse practitioners, and physician assistants, began playing a much greater role in the management of HIV (Chu et al., 2015). This could also be at least partially driven by more recent advances in the pharmacotherapeutic management of HIV infection through the use of effective antiretroviral therapy. Newer combination agents that require less frequent administration, have fewer adverse effects, and have lower risk of toxicity lessened the need for more vigilant monitoring by specialists.

The efficacy of antiretroviral therapy in prolonging life expectancy of those infected with HIV altered the perception of HIV, defining it more as a chronic illness rather than one associated with high acuity and rapid mortality (Griffin, 2010). In addition, the few studies that have compared the achievement of viral suppression and immunologic success between PCPs and specialists have shown statistically similar outcomes between the two (Chu, Umanski, Blank, Grossberg, & Selwyn, 2010; Chu et al., 2015). Thus, while infectious disease specialists continue to play a major role in the interdisciplinary treatment of HIV infection, PCPs should also

recognize their importance, not only in treating HIV infection in adults, but in promoting wellness in these persons as well (Burgess & Kasten, 2013). Consequently, meeting the vaccine needs of this population is critical in primary care practice.

## **Vaccination Recommendations for HIV-Infected Adults**

The Centers for Disease Control and Prevention (CDC) *Adult Immunization Schedule* lists general vaccination recommendations for adults. The vaccines include influenza, tetanus/diphtheria/pertussis (Td/Tdap), varicella, and zoster (CDC, 2013). Adults who are infected with HIV are at higher risk for acquiring vaccine-preventable diseases. This is because of either an overlap of risk factors associated with HIV acquisition or the presence of an immunocompromised state (Koenig, Garland, Weissman, & Mounzer, 2013). People living with HIV are also at higher risk for the development of more severe complications from vaccine-preventable diseases than adults not infected with HIV (Koenig et al., 2013).

Thus, there are specific vaccine recommendations for HIV-infected adults with CD4+ T cell counts at least 200/mm<sup>3</sup> (CD4+ T cell  $\geq$  15%), including influenza; Tdap; pneumococcal; hepatitis B; human papillomavirus; measles, mumps, and rubella; and

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varicella (CDC, 2014). For HIV-infected adults with CD4+ T cell counts less than 200/mm<sup>3</sup> (a CD4+ T cell < 15%), immunization against influenza, Tdap, pneumococcal, hepatitis B, and measles, mumps, and rubella are recommended (CDC, 2014). Additional recommendations for these persons are based on age, vaccination history, and the presence of other risk factors (CDC, 2015a). The vaccine recommendations for HIV-infected adults are divided based on CD4+ T cell count because live-attenuated vaccines are contraindicated in those who are immune suppressed. For these persons, live-attenuated vaccines could be pathogenic and cause a variant form of the disease they are actually intended to prevent (Gelnick & Kroon, 2009).

### Barriers to Effective Vaccination in HIV-Infected Adults

While little research assessing vaccination compliance in HIV-infected adults has been completed (Bailey, Smith, & Sands, 2008), data have indicated that appropriate vaccination in these persons is lacking (Bailey et al., 2008; Crum-Cianflone & Wallace, 2014; Gallagher, Juhasz, Harris, & Teshale, 2007; Tedaldi et al., 2004). The etiologic forces behind low rates of vaccination in HIV-infected adults are multifaceted. However, data suggest that providers have difficulty determining which vaccines are indicated for HIV-infected adults (Bailey et al., 2008; Aziz, Kessler and Huhn, 2013).

For example, a study by Aziz et al., 2013 showed that providers treating HIV-infected individuals did not have a sound understanding of the indications for prescribing herpes zoster and varicella zoster vaccinations. Just 41% of their sample correctly identified the prevalence of disease in HIV-infected individuals, while only 48% cited correct knowledge of vaccine potency. A majority (66%) understood the mechanism of protection afforded through varicella zoster vaccine, but most (75%) did not immunize their HIV-infected patients against herpes zoster (Aziz et al., 2013).

A study by Bailey and colleagues (2008) found significant underutilization of the hepatitis B vaccine in a large sample of HIV-infected adults; missed vaccination was most commonly associated with failure of the provider to offer it or to assure comple-

tion of the series. The authors postulated that other factors associated with low vaccination rates in their sample could be failure by providers to perceive the associated risk of hepatitis B.

Misunderstanding of the appropriateness of vaccines for patients with varying levels of CD4+ T cells/mm<sup>3</sup> was also postulated as a reason for provider failure to recommend vaccination (Bailey et al., 2008). To better meet the vaccine needs of HIV-infected adults, innovative strategies and technologies to help providers in clinical settings identify which vaccines are appropriate for these patients is essential. The CDC Immunization Schedule smartphone application provides users with digital versions of vaccination tables and figures, literally at their fingertips (CDC, 2015b).

The adult tables and figures are based on the *Advisory Committee on Immunization Practices (ACIP) Recommended Immunization Schedule for Persons Aged 19 or Older* (CDC, 2015a). A major benefit of the application is the ability to instantly view vaccination recommendations for persons with what the application terms “conditions,” including HIV infection. Recommendations for HIV-infected adults are separated in the app by CD4+ T cell count. The smartphone application can become an important component of provider resources and help to reduce vaccination disparities in HIV-infected persons.

## The CDC Immunization Schedule Smartphone Application

### Downloading the Application

Downloading the application to the user’s smartphone is first achieved by accessing the device’s associated application store. For example, Apple iPhone users download the application through the device’s Apple App Store. The icon for the Apple App Store is automatically downloaded on each Apple iPhone; the user cannot delete it. Android users can download the application through the Android App on Google Play. Touching the icon for the device’s associated app store will allow the user to access a series of menus that facilitate downloading of applications. The option to download the application will immediately be displayed by searching for “CDC Vaccine

Schedule” in the store. The application can then be downloaded to the device, at no charge, by touching the store’s associated download button.

## Main Menu

The main menu (Figure 1) is initially displayed when the user accesses the CDC Immunization Schedule Smartphone Application by touching the icon of the downloaded application. The main menu allows the user to select from immunization schedules for children (birth-6 months), adolescents (ages 7-19 years), or adults. Options for information related



Figure 1. Main menu.

to “catch up” vaccines (ages 4 months-18 years), contraindications, and specific schedules for adult conditions are also options. To access schedules for adults infected with HIV, adult conditions should be selected by touching that option on the main menu.

## Adult Conditions: HIV Infection Count Less Than 200 Cells; HIV Infection Count Less Than or Equal to 200 Cells

The application includes options for what are termed “adult conditions.” Once the user touches the dropdown menu located in the top left corner of the screen, a list of conditions becomes available for selection. HIV infection is considered an “adult condition” by the application and is divided into two separate categories, one for patients with a CD4+ T cell count less than or equal to 200 cells/mm<sup>3</sup> (Figure 2) and one for those with a CD4+ T cell count greater than 200 cells/mm<sup>3</sup> (Figure 3). Touching the desired schedule based on CD4+ T cell count and then selecting “done” will open another screen in which the appropriate schedule is displayed.

Figure 4 shows the display for the vaccination schedule for HIV-infected adults with CD4+ T cell counts less than 200 cells/mm<sup>3</sup>. Figure 5 is the display for the vaccination schedule for HIV-infected adults with CD4+ T cell counts at least 200 cells/mm<sup>3</sup>. Users can see the entire display of recommended vaccines by scrolling from the top to the bottom of the screen. Further information can be displayed by touching the color-coded Key button located in the upper right corner of the screen for each vaccination table.

## Key

Touching the color-coded key button in the upper right corner of the vaccination table allows the user to view more information appropriate to the interpretation of the vaccination schedule. For adult HIV infection schedules, the key provides additional information about age-requirement restrictions and information about zoster vaccination (indicated by the yellow colors over the influenza, tetanus/diphtheria/pertussis, human papillomavirus, PCV13, PPSV23, and hepatitis B vaccines). The purple color in the key indicates the vaccine is needed only if other risk factors are present,

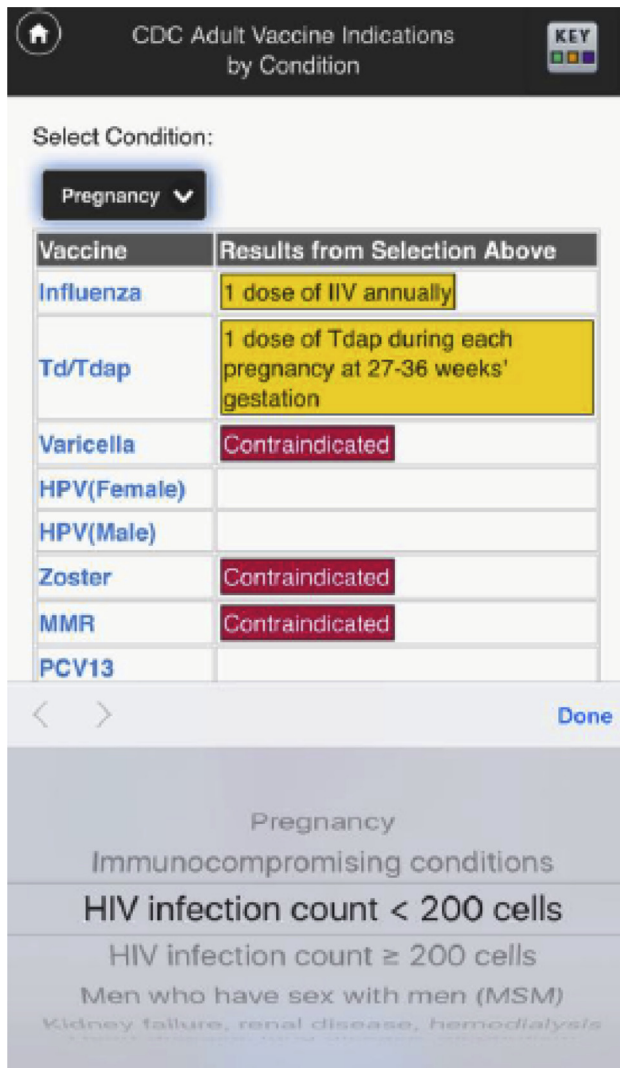


Figure 2. Conditions dropdown menu, HIV infection count less than 200 cells.

and is seen over the meningococcal, hepatitis A, and *Haemophilus influenzae* type b vaccines. The key screen is displayed in Figure 6. The user can toggle back to the schedule screen by selecting the arrow in the upper left corner of the key screen.

### Nursing Implications and Conclusions

Unfortunately, evidence suggests that vaccine compliance by HIV-infected adults is suboptimal

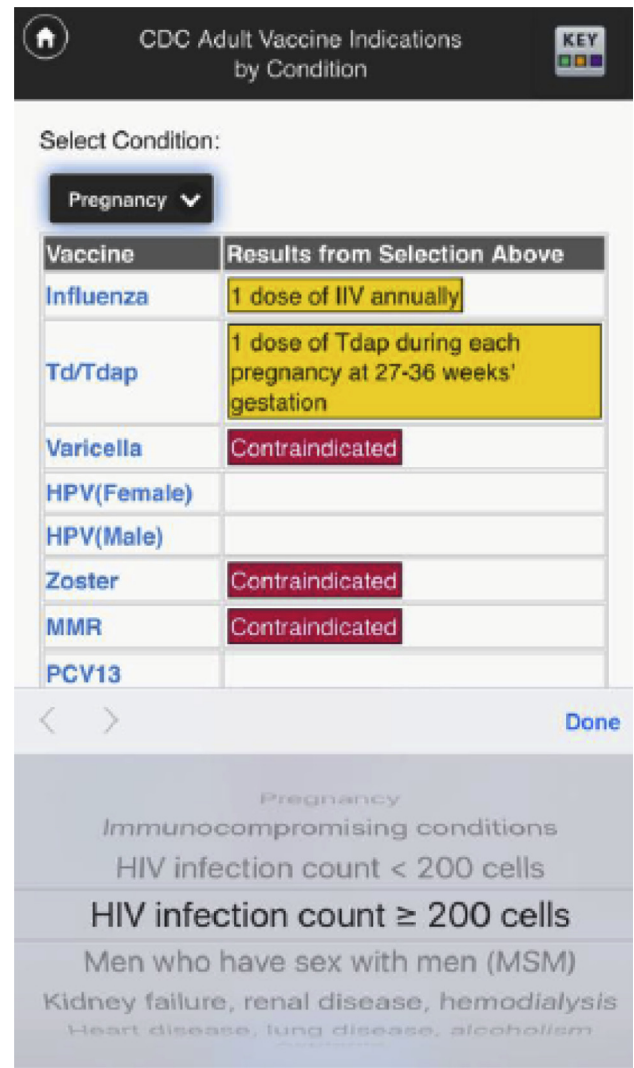


Figure 3. Conditions dropdown menu, HIV infection count at least 200 cells.

(Bailey et al., 2008; Crum-Cianflone & Wallace, 2014; Gallagher et al., 2007; Tedaldi et al., 2004). Overlapping risk factors for HIV acquisition and/or immune deficiency increases the disparity of acquiring vaccine-preventable diseases in HIV-infected adults (Koenig et al., 2013). The development of severe complications from vaccine-preventable diseases is also associated with HIV infection (Koenig et al., 2013).

Thus, increasing vaccine administration rates in HIV-infected adults should be a national health

The screenshot shows the app interface for HIV infection count < 200 cells. The selected condition is "HIV infection count < 200 cells". The table below lists the recommended immunization schedules for various vaccines.

Vaccine	Results from Selection Above
Influenza	1 dose of IIV annually
Td/Tdap	Substitute 1-time dose of Tdap for Td booster; then boost with Td every 10 yrs
Varicella	Contraindicated
HPV(Female)	3 doses through age 26 yrs
HPV(Male)	3 doses through age 26 yrs
Zoster	Contraindicated
MMR	Contraindicated
PCV13	1 dose
PPSV23	1 or 2 doses
Meningococcal	1 or more doses
Hepatitis A	2 doses
Hepatitis B	3 doses
Hib	1 or 3 doses

Figure 4. Immunization schedule, HIV-infected adult, less than 200 cells.

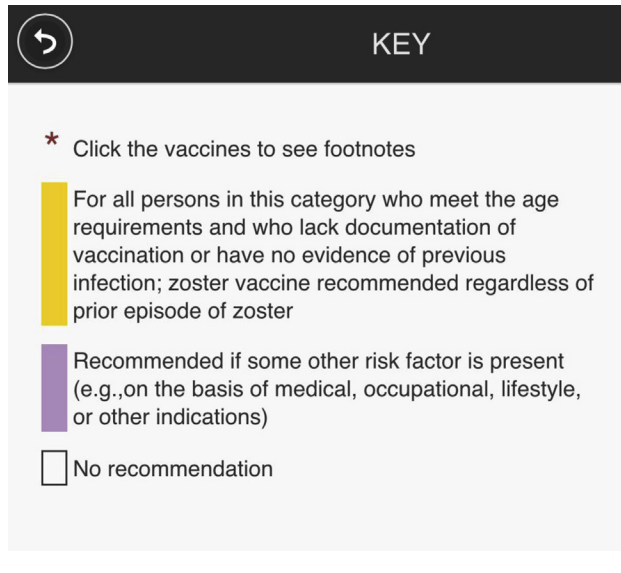
priority. Nurses have the responsibility to ensure that they are competent clinicians and understand the necessary resources available to increase vaccine administration in HIV-infected adults. This responsibility extends beyond those working in the field of HIV and public health. As the overall management of HIV has grown to incorporate PCPs, physicians, nurse practitioners, and physician assistants must develop the skills necessary to properly prescribe vaccinations to HIV-infected adults.

The screenshot shows the app interface for HIV infection count ≥ 200 cells. The selected condition is "HIV infection count ≥ 200 cells". The table below lists the recommended immunization schedules for various vaccines.

Vaccine	Results from Selection Above
Influenza	1 dose of IIV annually
Td/Tdap	Substitute 1-time dose of Tdap for Td booster; then boost with Td every 10 yrs
Varicella	2 doses
HPV(Female)	3 doses through age 26 yrs
HPV(Male)	3 doses through age 26 yrs
Zoster	
MMR	1 or 2 doses
PCV13	1 dose
PPSV23	1 or 2 doses
Meningococcal	1 or more doses
Hepatitis A	2 doses
Hepatitis B	3 doses
Hib	1 or 3 doses

Figure 5. Immunization schedule, HIV-infected adult, at least 200 cells.

Data suggest, however, that providers often lack the knowledge and ability to properly prescribe and/or administer vaccines to this vulnerable population (Aziz et al. 2013; Bailey et al., 2008). The CDC Immunization Schedule Smartphone Application can be a valuable tool for providers to use when making vaccination recommendations to every patient, including adults infected with HIV. The smartphone application can become an important component of the PCP's resources and may help reduce vaccination disparities in HIV-infected persons.



**Figure 6. Key.**

## Disclosures

The author reports no real or perceived vested interests that relate to this article that could be construed as a conflict of interest.

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