Preventing Perinatal HIV Transmission

Overview

Risk of Perinatal HIV Transmission

The World Health Organization estimates that nearly 10 million cases of perinatal HIV transmission have occurred globally since the beginning of the HIV epidemic, with most of these in resource-poor settings.[1] In the United States, the annual number of perinatal HIV infections peaked at 1,650 cases in 1991;[2,3] since 2013, the number of perinatal HIV infections in the United States has consistently been less than 150 cases per year (Figure 1).[4] In the United States, on an annual basis, approximately 5,000 pregnant persons with HIV give birth.[5] For pregnant persons with HIV, the estimated rate of perinatal transmission of HIV in the absence of intervention is approximately 25%; among children who acquire HIV perinatally, about 20% of the transmission events occur before 36 weeks of gestation, 50% between 36 weeks and delivery, and 30% during active labor and delivery.[6,7] With the use of suppressive combination antiretroviral therapy during pregnancy, followed by postnatal infant antiretroviral prophylaxis (and with the judicious use of elective cesarean section and the avoidance of breastfeeding), the current rate of perinatal HIV transmission rate in the United States is less than 1%.[8,9,10]

Impact of Antiretroviral Therapy on Perinatal HIV Transmission

In 1994, the landmark Pediatric AIDS Clinical Trials Group (PACTG) 076 trial established that a three-part zidovudine regimen reduced perinatal HIV transmission by 67.5% when compared with placebo (Figure 2).[6] In this trial, the three-part regimen consisted of (1) oral zidovudine initiated at 14 to 34 weeks of gestation and continued throughout pregnancy, (2) intravenous zidovudine given during labor and delivery, and (3) oral zidovudine given to the newborn for 6 weeks. The HIV transmission rate (determined at 18 months after birth) was 8.3% in the three-part zidovudine group compared to 25.5% in the placebo group.[6] Later that year, the U.S. Public Health Service (USPHS) issued guidelines recommending the use of zidovudine to reduce perinatal HIV transmission. The PACTG study and the subsequent USPHS recommendations spurred a dramatic decline in the number of cases of HIV perinatal transmission during the 1990s in the United States (Figure 3).[11] Clinical trials and observational studies in the United States, as well as clinical trials of shorter course regimens in lower resource settings, have demonstrated that a variety of antiretroviral regimens markedly reduce the risk of perinatal HIV transmission, with the greatest risk reductions seen with longer duration of antiretroviral therapy during pregnancy (Figure 4) and with use of combination antiretroviral therapy (Figure 5).[1,11,12,13,14]

Perinatal HIV Prevention and Care for Transgender or Gender Diverse Individual

The current Perinatal Guidelines for HIV prevention and care in the prepregnancy antepartum and postpartum
periods are primarily driven by data from studies involving pregnant women or women of reproductive age, whose gender identity is not known. Studies on perinatal HIV prevention and care periods for individuals who are transgender or gender diverse are in nascent stages with only limited data available. As such, for now, the Perinatal Guidelines have opted to extrapolate the existing recommendations to transgender and gender diverse persons with additional guidance provided if specific data is available for these populations. This is congruent with other HIV-related primary care and family planning guidelines and recommendations for gender minority populations.

Information and Consultation Resources

This topic review will highlight key points from the Perinatal Guidelines.[15] The full text of the Perinatal Guidelines should be consulted for all management decisions and for further reading. In addition, expert consultation can be obtained by calling the National Clinician Consultation Center’s Perinatal HIV/AIDS Line at (888) 448-8765; this free resource provides information and clinical consultation to medical providers caring for pregnant persons with HIV and their infants.
Screening for HIV During Pregnancy

Routine HIV Screening in Pregnancy

Multiple organizations strongly recommend screening all pregnant persons for HIV.[16,17,18,19] This recommendation is grounded in data that knowledge of HIV status during pregnancy provides an opportunity to (1) administer antiretroviral therapy to persons with HIV during pregnancy, (2) optimize strategies during delivery to minimize transmission risk, (3) give post-delivery antiretroviral therapy to the newborn, and (4) counsel on avoiding breastfeeding—all of which markedly reduce the risk of perinatal HIV transmission. In addition, the partners of all pregnant persons should undergo testing for HIV if their status is unknown.[19] All pregnant persons should have HIV testing performed as early as possible in the pregnancy.[19] The recommendation to test all pregnant persons for HIV applies to persons presenting at any stage of pregnancy, including during labor.[19] Maternal HIV test results should be communicated to the newborn's medical provider and documented in the newborn's chart.[19]

Repeat Testing During Pregnancy

It is also important to remember that pregnant persons with a negative HIV test result in the first trimester of pregnancy should undergo repeat HIV testing in the third trimester if they have increased risk for HIV acquisition.[18,19] Repeat HIV testing in the third trimester should also be done for women receiving care in facilities that have an HIV incidence of at least 1 case per 1,000 pregnant people per year, those who reside in jurisdictions with elevated HIV incidence, or in states that mandate third-trimester testing.[19] Further, additional HIV testing should be performed during pregnancy if a pregnant person has a suspected or confirmed diagnosis of a sexually transmitted infection.[19] Any pregnant or breastfeeding person who presents with symptoms suggestive of acute HIV should have prompt diagnostic evaluation for acute HIV, even if they have previously undergone HIV testing during the pregnancy.[19,20]
Antepartum Management

Indications for Antiretroviral Therapy in Pregnancy

The Perinatal Guidelines recommend using combination antiretroviral therapy for all pregnant persons with HIV, regardless of CD4 count or HIV RNA level, to decrease the risk of perinatal HIV transmission and to benefit the pregnant person’s health.[21,22,23] All instances of antiretroviral exposure during pregnancy should be reported online to the Antiretroviral Pregnancy Registry. The risk of perinatal HIV transmission increases with higher maternal plasma HIV RNA levels, but transmission can occur in pregnant persons who have low plasma HIV RNA levels.[24] Therefore, even pregnant persons with a low plasma HIV RNA level should receive antiretroviral therapy. Regardless of antiretroviral therapy use, pregnant persons with HIV may be at risk for adverse outcomes, such as hypertensive pregnancy disorders or neonatal complications, including preterm delivery, low birth weight infants, or stillbirth.

Timing of Initiating Antiretroviral Therapy in Pregnancy

Due to the overwhelming benefits of antiretroviral therapy in preventing perinatal HIV transmission, the Perinatal Guidelines recommend that all persons with HIV who become pregnant and are not receiving antiretroviral therapy should start antiretroviral therapy without delay.[22] Prior to starting antiretroviral therapy, HIV genotypic drug-resistance testing should be ordered, but treatment should not be delayed while waiting for the drug resistance test results; the antiretroviral regimen can subsequently be modified if needed, based on the HIV drug resistance test results.[22] A French prospective cohort study reported the risk of perinatal transmission was increased in pregnant persons with HIV who received a short duration of antenatal antiretroviral therapy and in pregnant persons with preterm delivery (at less than 33 weeks) (Figure 6).[10] In addition, a subsequent nested case-control study of the initial French cohort showed that a high HIV RNA level in the early part of pregnancy was an identified risk factor in some cases of HIV transmission among pregnant persons who had low or undetectable HIV RNA levels near delivery.[25] Given that approximately 50% of perinatal transmissions occur between 36 weeks and the time of birth, intense efforts are warranted to lower HIV RNA levels as much as possible prior to the delivery, even for those individuals who are diagnosed with HIV late in pregnancy.[1,7]

Use of Dolutegravir in Pregnant Persons and Persons Trying to Conceive

In May 2018, the U.S. Food and Drug Administration (FDA) issued a safety alert that warned of potential serious neural tube birth defects in infants born to mothers who received dolutegravir at the time of becoming pregnant or early in the first trimester. This announcement was preceded by preliminary data from an observational surveillance study of birth outcomes in a cohort of pregnant women with HIV in Botswana who received dolutegravir.[26] Subsequently, these data from Botswana were updated, and investigators reported a lower rate of neural tube defects than initially reported, albeit slightly higher than the baseline rate of neural tube defects in women without HIV and slightly higher than in pregnant women who received efavirenz.[27] Another multicenter, open-label, randomized, controlled trial enrolled approximately 600 pregnant women with HIV in 9 countries to receive one of three different antiretroviral regimens at 14 to 28 weeks of gestation: (1) dolutegravir plus tenofovir alafenamide-emtricitabine, (2) dolutegravir plus tenofovir DF-emtricitabine, or (3) efavirenz plus tenofovir DF-emtricitabine.[28] The dolutegravir-containing regimens, especially when combined with tenofovir alafenamide-emtricitabine, had more rapid rates of virological suppression when compared with the efavirenz-anchored regimen and the dolutegravir with tenofovir alafenamide-emtricitabine regimen had the best safety profile.[28] Further, in 2021, additional data from the Botswana study group indicated that the prevalence of neural tube defects among the pregnant women who received dolutegravir was not statistically increased compared with pregnant women with HIV who received antiretroviral regimens that did not contain dolutegravir.[29] Taking into account the updated data and the known benefits of dolutegravir as a potent, well-tolerated antiretroviral agent that provides rapid and sustained viral suppression, the Perinatal Guidelines now recommend the following:[21,30,31]
• Dolutegravir is a preferred drug for pregnant persons, regardless of trimester and for persons trying to conceive.
• In most cases, dolutegravir should be continued in persons taking dolutegravir who become pregnant.
• The clinician and pregnant individual have a thorough discussion regarding the risks and benefits of dolutegravir in order to make an informed decision.

**Persons on Antiretroviral Therapy Who Become Pregnant**

In most circumstances, if a person with HIV is taking a fully suppressive combination antiretroviral regimen and becomes pregnant, they should continue the current antiretroviral regimen; discontinuing therapy could cause a viral rebound that could increase the risk of HIV transmission to the fetus. There are several medications or regimens that, according to the Perinatal Guidelines, require special consideration, including some that may require discontinuation.

- **Atazanavir**: Available data suggest that levels of atazanavir decline during pregnancy, even when given with a booster.[34,35] When atazanavir is used in pregnancy, it should be combined with low-dose ritonavir boosting, and it should be administered with food.[32,35] In addition, some experts recommend increasing the dose of atazanavir (from 300 mg once daily to 400 mg once daily) when combined with ritonavir 100 mg once daily during the second and third trimester—to generate levels similar to those in nonpregnant persons.[32,35] Initiating therapy with atazanavir-cobicistat is not recommended during pregnancy due to the concern of lowered drug levels.[35] If, however, a person becomes pregnant while taking a fully suppressive antiretroviral regimen that contains atazanavir-cobicistat, the regimen may be continued (provided there is frequent plasma HIV RNA level monitoring throughout the pregnancy), or it can be switched to a more effective and preferred regimen for use during pregnancy.[32,33]

- **Bictegravir**: There are insufficient data to recommend use of bictegravir in pregnancy at this time.[32,33] If an individual with viral suppression on a bictegravir-containing regimen, becomes pregnant, then the decision regarding whether to switch must be made in consultation with the clinical provider, taking into account the possibility of viral rebound that may occur during a regimen change.[32,33] If the decision is made to continue the same regimen, then plasma HIV RNA levels should be monitored more frequently, typically every 1 to 2 months.[32,33]

- **Cobicistat**: Data from the IMPAACT P1026s protocol study suggest that pregnant persons taking a regimen that includes elvitegravir-cobicistat have significantly reduced drug levels of elvitegravir and cobicistat during the third trimester of pregnancy, which would presumably lead to an increased risk of virologic failure late in the pregnancy.[36] Similar concern has been raised with regimens containing atazanavir-cobicistat or darunavir-cobicistat. If a person becomes pregnant while taking a fully suppressive antiretroviral regimen that contains cobicistat, the regimen may be continued provided there is frequent viral load monitoring throughout the pregnancy.[32,33] Alternatively, the medical provider may consider switching to a more effective and preferred regimen for use during pregnancy.[32,33]

- **Darunavir**: Available data suggest that levels of darunavir significantly decline during pregnancy, even when given with a booster.[34,35] Accordingly, the recommended dosing during pregnancy is darunavir 600 mg twice daily given with ritonavir 100 mg twice daily, taken with food; once-daily darunavir plus ritonavir is not recommended during pregnancy.[34,35] In addition, darunavir-cobicistat should not be initiated during pregnancy.[35] If, however, a person becomes pregnant while taking a fully suppressive antiretroviral regimen that contains darunavir-cobicistat, the regimen may be continued (provided there is frequent plasma HIV RNA level monitoring throughout the pregnancy), or it can be switched to a more effective and preferred regimen for use during pregnancy.[32,33]

- **Dolutegravir**: For persons trying to conceive and persons who are pregnant, regardless of trimester, dolutegravir is a preferred drug. Thus, dolutegravir should be continued in persons taking dolutegravir who become pregnant.[30,31,32]

- **Doravirine**: There are insufficient data on doravirine in pregnancy to recommend its use at this time. If an individual doing well with suppression of plasma HIV RNA levels on a doravirine-containing regimen, becomes pregnant, then the decision regarding whether to switch must be made in...
consultation with the clinical provider, taking into account the possibility of viral rebound that may occur during a regimen change.[31, 32] If the decision is made to continue the same regimen, then HIV RNA levels should be monitored more frequently, typically every 1 to 2 months.[31, 32]

- **Efavirenz**: Individuals with HIV who are taking an efavirenz-based regimen and present for care during pregnancy, including during the first trimester, can continue to take efavirenz if the regimen is adequately suppressing plasma HIV RNA levels.[32] The rationale to permit efavirenz use in the first trimester is threefold: (1) the risk of neural tube defects is limited to the first 5 to 6 weeks of pregnancy and confirmation of pregnancy typically occurs after week 6, (2) a meta-analysis that did not show an increased risk of birth defects among infants born to pregnant persons who had exposure to efavirenz during the first trimester of pregnancy,[37] and (3) unnecessary changes in antiretroviral therapy could lead to loss of suppression of HIV RNA levels.

- **Ibalizumab**: Animal studies suggest that infants exposed to ibalizumab during pregnancy may have reversible immunosuppression. If a person receiving ibalizumab becomes pregnant, expert consultation should be obtained.

- **Rilpivirine**: Although rilpivirine plasma levels are expected to decrease during the second and third trimester of pregnancy, the level of reduction is considered unlikely to result in virologic failure. Rilpivirine can be continued at standard doses during pregnancy, but maternal plasma HIV RNA levels should be monitored every 1 to 2 months during the second and third trimester of pregnancy.[32]

- **Stavudine**: Pregnant persons who are taking a regimen that contains stavudine should not continue on this medication during pregnancy due to toxicity risks.[32]

- **Tenofovir alafenamide**: Based on accumulating safety data, tenofovir alafenamide is now recommended as a preferred nucleoside reverse transcriptase inhibitor for people who are pregnant or are trying to conceive.[32] Persons who become pregnant while taking a fully suppressive combination antiretroviral regimen that includes tenofovir alafenamide can continue this medication.[33]

- **Two-Drug Regimens**: There are very limited data for the use of 2-drug regimens in pregnancy. If an individual becomes pregnant while taking either dolutegravir plus lamivudine or dolutegravir plus rilpivirine, the clinician can consider continuing the same 2-drug regimen, provided the patient has viral suppression. Alternatively, the pregnant individual can be switched to a preferred 3-drug regimen recommended for use in pregnancy. If the decision is made to continue the same 2-drug regimen, then HIV RNA levels should be monitored more frequently, typically every 1-2 months. For individuals who become pregnant while taking long-acting cabotegravir-rilpivirine, this regimen should be switched to a preferred 3-drug combination antiretroviral regimen, since there are no data regarding the use of injectable cabotegravir-rilpivirine in pregnancy. Pregnant individuals taking such a regimen should have either additional antiretroviral drugs added to make a full 3-drug regimen or be switched to a preferred 3-drug combination antiretroviral regimen.[32]

**Pregnant Persons with Prior Antiretroviral Treatment but Not on Therapy**

Some persons with HIV who become pregnant may have previously received antiretroviral therapy or antiretroviral prophylaxis but are not currently taking any antiretroviral medications at the time when they are first evaluated during their pregnancy. In this situation, it is very important to obtain detailed information regarding past regimens, tolerance of prior medications, adherence with past regimens, evidence of prior virologic failure, and resistance testing data, if available.[38] If the pregnant person’s current HIV RNA level is above the threshold for resistance testing (e.g. greater than 500 to 1,000 copies/mL depending on the laboratory performing the testing), then resistance testing should be ordered prior to starting the antiretroviral regimen during the pregnancy. After the drug resistance test blood sample has been obtained, antiretroviral therapy should be started, with modification of the regimen as needed when results from the drug resistance test become available.[38] For pregnant persons who previously took antiretroviral therapy and had no history of virologic failure or HIV drug resistance, then reinitiating antiretroviral therapy is relatively straightforward. For treatment-experienced individuals with prior virologic failure and HIV drug resistance, genotypic drug resistance testing is recommended.[39] If the treatment-experienced person has suspected multidrug resistant HIV, then phenotypic drug resistance is indicated.[39] For pregnant persons with prior virologic failure and HIV drug resistance, choosing an antiretroviral regimen is more complicated.
and should ideally be done in conjunction with an HIV treatment specialist.\[38\]

**Recommended Antiretroviral Regimens in Treatment-Naïve Pregnant Persons**

The Perinatal Guidelines provide recommendations for initial combination regimens for antiretroviral-naïve pregnant persons that include four categories:\[30\]

- Preferred initial regimens in pregnancy (Table 1),
- Alternative initial regimens in pregnancy (Table 2),
- Insufficient data in pregnancy to recommend routine use in initial regimen (Table 3),
- Not recommended for initial antiretroviral therapy in pregnancy (Table 4).\[30\]

The preferred antiretroviral regimens for use in pregnancy consist of a dual nucleoside reverse transcriptase inhibitor (NRTI) backbone combined with either a protease inhibitor (PI) boosted with low-dose ritonavir or an integrase strand transfer inhibitor (INSTI).\[30\]

**Use of Raltegravir or Dolutegravir Late in Pregnancy**

Some experts recommend utilizing the INSTIs raltegravir or dolutegravir as a component of the antiretroviral regimen for pregnant persons with high baseline HIV RNA levels who start antiretroviral therapy late in pregnancy, since INSTIs generate a very rapid decline in HIV RNA levels (estimated 2 log decline in 2 weeks).\[40,41\] In addition, some experts have added raltegravir (to an existing regimen) in the setting of incomplete virologic suppression late in pregnancy;\[41,42,43\] the benefit of this approach remains unproven, and concerns exist that resistance could develop to raltegravir when used in this setting. The Perinatal Guidelines now suggest that a clinician may opt to intensify an inadequate antiretroviral therapy regimen by adding an INSTI for pregnant persons who do not have virologic suppression late in pregnancy, as long as the individual’s treatment history, including any information on antiretroviral drug resistance testing, has been thoroughly reviewed, and their regimen does not already contain an INSTI.\[44\]

**Monitoring HIV RNA and CD4 Count During Pregnancy**

For pregnant persons with HIV, the Perinatal Guidelines recommend the following times for monitoring HIV RNA levels during pregnancy:\[45\]

- At the first antenatal visit
- For pregnant persons initiating (or changing) an antiretroviral drug regimen, check the HIV RNA level after 2 to 4 weeks and then monthly until RNA levels are undetectable
- In pregnant persons with undetectable HIV RNA levels, check at least every 3 months
- For all pregnant persons, check an HIV RNA at approximately 34 to 36 weeks of gestation to inform decisions about mode of delivery

For pregnant persons with HIV, the Perinatal Guidelines recommend the following for monitoring of CD4 cell count during pregnancy:\[45\]

- All pregnant persons should have a CD4 cell count checked at the first antenatal visit
- Individuals who have been on antiretroviral therapy for at least 2 years with consistently suppressed HIV RNA levels and CD4 counts consistently greater than 300 cells/mm\(^3\) do not need CD4 count monitoring after the initial antenatal visit during pregnancy
- CD4 counts should be monitored every 3 to 6 months during pregnancy for persons who have any of the following: (1) receipt of antiretroviral therapy for less than 2 years, (2) CD4 count less than 300 cells/mm\(^3\), or (3) inconsistent adherence (and/or detectable HIV RNA levels)
Intrapartum Management

For pregnant people with HIV, the major management decisions at the time of labor are whether to administer intravenous zidovudine and whether to perform cesarean section. These decisions are primarily based on the pregnant person’s antiretroviral history during the pregnancy and recent HIV RNA levels. Pregnant people who have been taking combination antiretroviral therapy prior to onset of labor should continue taking their antiretroviral regimen on schedule (as good as possible) during and after labor.[46] If, however, the combination oral antiretroviral regimen includes zidovudine and the pregnant person receives intravenous zidovudine during labor, the oral zidovudine can be held while they receive intravenous zidovudine.[46]

In Labor without Antepartum Antiretroviral Therapy

Expedited HIV-1/2 antigen-antibody immunoassay is recommended for pregnant people who present in labor and have unknown HIV antibody status and for pregnant individuals who have high risk for HIV acquisition but were not tested for HIV during their third trimester of pregnancy.[46] In addition, any pregnant individual presenting in labor with symptoms of acute HIV (or with a history of a recent HIV exposure) should get an HIV RNA level in addition to an expedited HIV-1/2 antigen-antibody immunoassay.[46] Pregnant individuals who have a reactive test (preliminary positive) should be assumed to have HIV, and all available prevention measures (for the pregnant individual and the infant) should be initiated immediately to reduce the risk of perinatal transmission.[46] If the initial HIV-1/2 antigen-antibody immunoassay is positive, additional confirmatory testing should be performed with an HIV-1/2 differentiation assay and an HIV RNA level.[46] In this situation, the infant should immediately start on oral antiretroviral therapy, and potential continuation of antiretroviral therapy for the birth parent and infant will depend on the results of subsequent HIV confirmatory tests.[46]

- **Intrapartum Zidovudine**: Since a substantial proportion perinatal HIV transmission occurs at or near the time of delivery, intrapartum intravenous zidovudine should be provided to all pregnant individuals with HIV who are newly diagnosed at the time of labor and to pregnant individuals with known HIV who are not taking antiretroviral therapy late in pregnancy.[46] The administration of intravenous zidovudine should include individuals who have a positive HIV-1/2 antigen-antibody immunoassay but confirmatory testing (HIV RNA and/or HIV antibody differentiation) results are not yet known. In these settings, the use of intrapartum and postpartum zidovudine for the newborn reduces the risk of perinatal HIV transmission from 27% to 10%.[14]

- **Cesarean Delivery**: Most experts recommend cesarean delivery for pregnant persons newly diagnosed with HIV at the time of labor and for those with known HIV who are not on antiretroviral therapy, since these individuals are likely to have an HIV RNA level above 1,000 copies/mL—the threshold for elective cesarean section.[46] Cesarean delivery is also recommended for pregnant people with HIV who have a known HIV RNA level greater than 1,000 copies/mL obtained within 4 weeks of delivery.[46] The benefit of cesarean section after rupture of membranes or onset of labor is unknown.

Indications for Intravenous Zidovudine in Labor

Intravenous zidovudine, when given early in labor, rapidly crosses the placenta and thus can efficiently provide high systemic levels of zidovudine for the infant. Available data show the use of intravenous zidovudine in labor clearly reduces perinatal HIV transmission when the pregnant individual has an HIV RNA level greater than 1,000 copies/mL near the time of delivery—defined as 34 to 36 weeks of gestation or within 4 weeks before delivery.[47] Accordingly, the Perinatal Guidelines recommendation for the use of intravenous zidovudine for the pregnant person during delivery depends on the individual’s HIV RNA level near the time of delivery and whether there are any concerns for adherence with antiretroviral medication near delivery.[46]

- **HIV RNA Level >1,000 copies/mL**: Intravenous zidovudine during delivery is recommended if the
pregnant individual’s HIV RNA level near delivery is known to be greater than 1,000 copies/mL.

- **HIV RNA Level Suspected to be >1,000 copies/mL or HIV RNA Level Unknown**: Intravenous zidovudine during delivery is recommended if the pregnant individual’s HIV RNA level near delivery is not known, or it is suspected to be greater than 1,000 copies/mL.
- **HIV RNA Level between 50 and 1,000 copies/mL**: For pregnant people with HIV who have an HIV RNA level between 50 and 1,000 copies/mL within 4 weeks of delivery, inadequate data exist to guide a clear recommendation, but some experts would use intravenous zidovudine in this setting; these situations should be addressed, ideally with expert consultation, on a case-by-case basis.
- **Suspected Lack of Adherence to Antiretroviral Therapy**: If there is doubt about a pregnant person’s adherence with the antiretroviral therapy regimen near delivery, then intravenous zidovudine during delivery is recommended, regardless of the prior HIV RNA level.
- **Positive Expedited HIV-1/2 Antigen-Antibody Test Obtained During Labor**: Intravenous zidovudine during delivery is recommended if the pregnant person has a reactive expedited HIV test during labor.
- **Maternal HIV RNA Level ≤50 copies/mL**: The use of intrapartum zidovudine is not required in pregnant people who have an HIV RNA level equal to or less than 50 copies/mL within 4 weeks of delivery, as long as no concerns exist regarding antiretroviral adherence.

### Dosing of Zidovudine in Labor

The recommended intravenous dose of zidovudine during labor is a 2 mg/kg loading dose over the first hour, followed by a continuous infusion of 1 mg/kg/hour until delivery.[35] The intravenous zidovudine should ideally be started at the onset of active labor. For pregnant people scheduled to have a cesarean delivery, the intravenous infusion should be started at least 3 hours prior to the scheduled delivery.[46]

### Single-dose Nevirapine in Labor is Not Recommended

The Perinatal Guidelines do not recommend giving single-dose nevirapine during labor for any pregnant person with HIV in the United States, regardless of whether they have received antepartum combination antiretroviral therapy.[46]

### Indications for Cesarean Section Delivery

The guidance for performing cesarean delivery for the purpose of preventing HIV transmission depends predominantly on the pregnant person’s HIV RNA level near delivery. For this reason, obtaining an HIV RNA level at approximately week 24 to 36 gestation is recommended. Note that for pregnant persons HIV coinfection with either hepatitis C virus (HCV) or hepatitis B virus (HBV) is not an independent indication for cesarean section.[48,49] The Perinatal Guidelines recommend the following based on the HIV RNA level of the pregnant person:[46]

- **HIV RNA Level >1,000 copies/mL**: A scheduled cesarean delivery at 38 weeks of gestation should be performed for all pregnant people with HIV who have an HIV RNA level greater than 1,000 copies/mL within 4 weeks of delivery or with unknown HIV RNA levels near the time of delivery, regardless of whether they are receiving antiretroviral therapy.[46] The pregnant person’s CD4 cell count has no bearing on recommendations regarding cesarean delivery.
- **HIV RNA ≤1,000 copies/mL**: Insufficient data exist to indicate cesarean delivery would reduce the risk of HIV transmission for pregnant people receiving antiretroviral therapy who have detectable viremia that is less than or equal to 1,000 copies/mL within 4 weeks of delivery.[46] Accordingly, cesarean delivery is not recommended for the purpose of preventing HIV transmission for pregnant persons who have an HIV RNA level less than 1,000 copies/mL within 4 weeks of delivery.[46]
- **HIV RNA Level >1,000 copies/mL and Rupture of Membranes**: For pregnant people who have an HIV RNA level above 1,000 copies/mL within 4 weeks of delivery, but who present with rupture of membranes (or present after the onset of labor), the benefit of cesarean delivery is unknown; a meta-analysis has found that the risk of HIV transmission increases by 2% every hour following rupture of...
membranes.[46] 

- **HIV RNA Level ≤1,000 copies/mL and Rupture of Membranes**: For pregnant people receiving antiretroviral therapy who have an HIV RNA level less or equal to 1,000 copies/mL within 4 weeks of delivery, the duration of membrane rupture has not been shown to correlate with risk of perinatal HIV transmission and vaginal delivery is recommended in this setting.[46, 50, 51, 52] Complex cases should be managed in consultation with an expert in HIV perinatal transmission.

### Timing for Cesarean Section Delivery

Despite the potential risk of iatrogenic prematurity, the American Congress of Obstetricians and Gynecologists (ACOG) and the Perinatal Guidelines recommend performing an elective cesarean delivery for pregnant persons who have an HIV RNA level greater than 1,000 copies/mL (or unknown HIV RNA levels) at 38 weeks of gestation to avoid onset of labor.[46] If the pregnant person has an HIV RNA level less than 1,000 copies/mL and the decision is made to perform cesarean delivery for obstetric reasons, the elective cesarean delivery should be performed at the standard time for the specific obstetrical indication.[46]

### Obstetric Procedures and Risk of HIV Transmission

Although limited data exist regarding the impact of obstetrical procedures on HIV transmission risk, the Perinatal Guidelines recommend against the routine use of the following procedures: artificial rupture of membranes, invasive fetal scalp monitoring with scalp electrodes, and operative delivery with forceps or vacuum extractor.[13] If, however, any of these procedures are deemed to have a clear obstetrical indication, they should be performed. The possible risk of HIV transmission from these procedures is likely lower in pregnant people who have an undetectable HIV RNA level at the time of delivery. Epidural anesthesia is considered safe during labor, regardless of the antiretroviral regimen the individual is receiving.[46] In addition, the indications for episiotomy should be the same for pregnant people with or without HIV.

### Methylergonovine for Postpartum Hemorrhage

Methylergonovine and other ergot alkaloids, which are generally the first-line treatment for postpartum hemorrhage due to uterine atony, are metabolized primarily by the P450 CYP3A4 enzyme system. Potent CYP3A4 inhibitors, such as ritonavir or cobicistat, significantly increase systemic levels of methylergonovine, whereas CYP34A inducers, such as efavirenz or nevirapine, lower systemic levels of methylergonovine. Coadministering methylergonovine with medications that may cause a drug interaction can lead to overtreatment (with resulting excessive vasoconstriction) or undertreatment of uterine atony, respectively. Accordingly, other treatment options for uterine atony and bleeding should be considered if the individual who gave birth is taking a medication that may significantly impact the cytochrome P450 CYP3A4 enzyme system.
Acute HIV in Pregnancy

Diagnosis of Acute HIV in People who are Pregnant or Breastfeeding

Persons who are pregnant or are breastfeeding have an increased risk of acquiring HIV.[54,55] Acute HIV that occurs during pregnancy or while breastfeeding confers a very high risk of HIV transmission to the child because of the high HIV RNA levels in the parent’s plasma, genital tract, and breastmilk that occur with acute infection. In one cohort study in New York state, investigators reported the rate of perinatal transmission was 22% among neonates born to persons who acquired HIV during pregnancy compared to 1.8% of newborns born to persons who did not acquire HIV during pregnancy.[56] Therefore, pregnant or breastfeeding individuals with symptoms of acute retroviral syndrome should undergo prompt evaluation for acute HIV infection.[20] When acute HIV is suspected during pregnancy or while breastfeeding, the evaluation should include an HIV RNA assay in combination with an HIV-1/2 antigen-antibody immunoassay.[20] If acute HIV is diagnosed during pregnancy or in a breastfeeding persons, an HIV drug resistance genotype should be ordered, the newly diagnosed person should immediately start on antiretroviral therapy, and contact initiated with a pediatric HIV expert.

Antiretroviral Therapy for Acute HIV in Pregnancy

Given the high risk of HIV transmission to the fetus in the setting of acute maternal HIV infection, the Perinatal Guidelines recommend that pregnant or breastfeeding persons with acute HIV infection should immediately begin triple antiretroviral therapy while the HIV drug resistance genotype is pending.

- **Acute HIV in Pregnancy:** For persons who are pregnant and have acute HIV (regardless of the trimester), the preferred antiretroviral regimen is dolutegravir plus either tenofovir DF-emtricitabine or tenofovir alafenamide-emtricitabine.[20] Alternatively, the pregnant person can take twice daily ritonavir-boosted darunavir plus one of the following dual-NRTI regimens: tenofovir DF-emtricitabine, tenofovir DF plus lamivudine, tenofovir alafenamide-emtricitabine, or tenofovir alafenamide plus lamivudine.[20] If needed, adjustments to the regimen can be made once the genotype results are known.[20]

- **Acute HIV when Breastfeeding:** For persons who are breastfeeding and have acute HIV, the preferred antiretroviral regimens are bictegravir-tenofovir alafenamide-emtricitabine; dolutegravir plus either tenofovir DF-emtricitabine or tenofovir alafenamide-emtricitabine; ritonavir-boosted darunavir plus one of the following dual NRTI regimens: tenofovir DF-emtricitabine, tenofovir DF plus lamivudine, tenofovir alafenamide-emtricitabine, or tenofovir alafenamide plus lamivudine.[20]

Acute HIV in the Postpartum Period

If acute HIV is suspected in the postpartum period, the parent should receive counseling to immediately stop breastfeeding to reduce the risk of HIV transmission to the child.[20] If acute HIV is diagnosed, then breastfeeding should be permanently discontinued, an HIV drug resistance genotype should be ordered, and the newly diagnosed individual promptly started on antiretroviral therapy.[20] In this situation, expert consultation should be obtained regarding the evaluation and management of the breastfeeding infant who may have been exposed to HIV.[20]
Management of the Infant Exposed to HIV

Antiretroviral Medications for the Newborn

Appropriate management of infants born to pregnant individuals with HIV plays a significant role in preventing perinatal HIV transmission. All newborns with perinatal HIV exposure should receive antiretroviral medications in the neonatal period, with the first doses initiated as soon as possible after birth, ideally within 6 to 12 hours following delivery.[57] Antiretroviral management of the newborn with perinatal HIV exposure consists of the administration of one or more antiretroviral drugs as antiretroviral prophylaxis or presumptive HIV therapy depending on the estimated risk of perinatal HIV transmission (Table 5).[57] The risk of perinatal HIV transmission is estimated primarily by whether the birthing parent received antiretroviral therapy during pregnancy and their HIV RNA level within the 4 weeks prior to delivery. This information, as well as some other factors, are used to make decisions about neonatal antiretroviral intervention (Table 6).[57] The dosing for all antiretroviral medications in newborns should be based on weight and gestational age (Table 7).[57]

Initial Care of the Neonate Exposed to HIV

In addition to providing antiretroviral management for all neonates born to people with HIV, other aspects of care need to be addressed. Breastfeeding is not recommended for infants born to individuals with confirmed or presumed HIV.[58] Following delivery, infants born to persons with HIV require hematological monitoring in addition to routine infant care; there is no evidence that changes in routine bathing practices or timing of circumcision are required.[58] A complete blood count (CBC) and differential should be performed at birth prior to the initiation of infant antiretroviral drug prophylaxis and again at 4 weeks of age since anemia is the primary complication of zidovudine.[58] In addition, some experts advise checking serum chemistry and liver function tests depending on which antiretroviral therapies the infant was exposed to in utero.

Evaluating the Infant for HIV

Initial HIV testing in infants should be performed using an HIV nucleic acid amplification test (NAAT), and either an HIV DNA or HIV RNA assay.[59] Routine HIV antibody testing should not be used in newborns since HIV antibody crosses the placenta and can persist through 18 months of age.[58] For the criteria listed below for presumptive and definitive exclusion of infant HIV infection, the child should not have any laboratory or clinical indicator that may suggest HIV infection (e.g. a low CD4 cell count or any clinical findings).

- **Recommended Testing:** Virologic testing with either an HIV DNA or HIV RNA test should be performed at 14 to 21 days of life, 1 to 2 months of age, and 4 to 6 months of age. If the risk for HIV infection is higher than usual, such as when the parent does not have virologic suppression near the time of delivery, some experts recommend obtaining an HIV NAAT on the infant at birth (Figure 7).[58]
- **Testing for Non-B Virus Subtypes:** Due to the increasing proportion of foreign-born children with HIV in the United States, testing for non-B viral subtypes is now recommended and HIV NAAT should be performed in a laboratory that will detect non-B HIV subtypes if the birthing parent is known to have or suspected to have non-B subtype HIV.[58]
- **Antibody Testing After 12 Months of Age:** A negative HIV antibody test at 12 to 18 months of age provides further confirmation of the child’s HIV-negative status and some experts perform antibody testing at this age in infants with prior negative HIV NAAT.[58]
- **Presumptive Exclusion of HIV:** In non-breastfed infants, HIV can be presumptively excluded when any of the following criteria are met: (1) two or more negative HIV NAATs (one at age 14 days or older and the other at age 1 month or older), (2) one negative HIV NAAT at age 8 weeks or older, or (3) one negative HIV antibody test at age 6 months or older.[59]
- **Definitive Exclusion of HIV:** Definitive exclusion of HIV in non-breastfed infants can be based on either (1) two or more negative HIV NAATs, with one test performed at age 1 month or older and the other test at age 4 months or older, or (2) two negative HIV antibody tests obtained at 6 months of age or older.[59]
- **Indeterminate HIV Status:** This refers to an HIV-exposed child aged younger than 18 months of age
who was born to a person with HIV and the child does not meet the criteria for having HIV or for not having contracted HIV.[59]

**Pneumocystis Pneumonia Prophylaxis for the Infant**

At 4 to 6 weeks of age, all infants born to individuals with HIV should begin prophylaxis for *Pneumocystis* pneumonia unless HIV has been presumptively excluded with virologic testing.[58] The preferred agent for *Pneumocystis* pneumonia prophylaxis in neonates is trimethoprim-sulfamethoxazole.[60] The prophylaxis for *Pneumocystis* pneumonia can be discontinued if the HIV diagnosis in the child is presumptively or definitively excluded.

**Long-term Follow-up of Infants Born to Persons with HIV**

Although the long-term effects of *in utero* exposure to antiretroviral therapy and to HIV itself (even if the infant was not infected) are not fully known, available data suggest that antiretroviral therapy taken during pregnancy does not cause subsequent long-term risk of neoplasia or organ toxicities to these children.[61,62,63,64,65] Nevertheless, further study is needed since newer antiretroviral agents continue to be used in pregnant people with HIV. Multiple studies and surveillance projects at the state and national level are ongoing. The Perinatal Guidelines recommend that any children with *in utero/perinatal* exposure to antiretroviral therapy who develop organ system abnormalities, particularly neurological or cardiac, should be evaluated for mitochondrial dysfunction, and follow-up of children exposed to antiretroviral medications should continue lifelong due to concern for potential carcinogenicity of nucleoside reverse transcriptase inhibitor drugs.[64] In the long-term medical record of the child, the medical provider should document specific information related to the child's exposure to antiretroviral medications *in utero* and in the postpartum period.
Postpartum Follow-Up for Women with HIV

Breastfeeding and Premastication Recommendations

In the United States, breastfeeding is not recommended for people with HIV in the United States.[66] Colostrum and breastmilk can efficiently transmit HIV from the breastfeeding person with HIV to the infant; persons with HIV who are breastfeeding and not taking antiretroviral therapy have a 15 to 20% risk of transmitting HIV to their child over a 2-year period of breastfeeding.[58,67] This risk is even higher (25 to 30%) if the breastfeeding individual newly acquires HIV during the postpartum period.[68] It is important to note that transmission of HIV has occurred via breastfeeding even when the person breastfeeding had an undetectable HIV RNA level while taking antiretroviral therapy.[69] In addition, studies have shown that infants who acquire HIV through breastfeeding—when the breastfeeding parent is taking antiretroviral therapy—have an increased risk of acquiring drug-resistant HIV.[67,70] Persons with HIV should also receive instructions to avoid premastication (prechewing) of food for their infant.[71] Individuals who elect to breastfeed despite intensive counseling should receive counseling on using harm reduction methods to minimize the risk of HIV transmission to their child.[66]

Postpartum Antiretroviral Therapy

Pregnant people with HIV who receive antiretroviral therapy during pregnancy should continue to receive antiretroviral therapy after delivery, both for their own health and to prevent sexual transmission of HIV to their sex partners.[71] The HPTN 052 study, among others, has shown that antiretroviral therapy markedly reduces the risk of sexual HIV transmission to uninfected partners in HIV-serodifferent couples.[72] Taking antiretroviral therapy in the postpartum period may be very challenging due to the mother's fatigue, psychosocial stress, and demands and responsibilities of taking care of a newborn. Indeed, multiple studies have shown that antiretroviral adherence and viral suppression decline after persons with HIV give birth.[73,74,75] All people with HIV who give birth should undergo screening for postpartum depression since depression in the postpartum period is common and may negatively impact antiretroviral adherence.[74] Medical providers should make sure that the individual recently giving birth and their infant receive any prescribed antiretroviral medications prior to hospital discharge.[71]
Summary Points

- All pregnant people should undergo screening for HIV, including individuals who present in labor without prior testing during the pregnancy.
- For pregnant people with HIV, perinatal HIV transmission rates less than 1% can be achieved with a comprehensive, multipronged approach that includes suppressive combination antiretroviral therapy during pregnancy, use of elective cesarean section (when indicated), intravenous zidovudine during labor (when indicated), postnatal infant antiretroviral prophylaxis, and avoidance of breastfeeding.
- The risk of perinatal HIV transmission correlates with HIV RNA levels in the pregnant person, but there is no HIV RNA level cutoff at which transmission cannot occur.
- All persons diagnosed with HIV during pregnancy should start combination antiretroviral therapy and continue it throughout the pregnancy.
- People with known HIV who become pregnant and are not receiving antiretroviral therapy should start antiretroviral therapy and continue therapy throughout the pregnancy.
- In most circumstances, persons with established HIV who become pregnant and are already taking fully suppressive antiretroviral therapy should continue the same regimen. Consideration should be given to switching from any 2-drug regimen or any regimen that contains cobicistat.
- Laboratory monitoring of HIV RNA levels should occur every 3 months during pregnancy to evaluate for viral suppression; more frequent HIV RNA monitoring (every 1 to 2 months) may be needed depending on the antiretroviral regimen taken during pregnancy. Obtaining an HIV RNA level at 34 to 36 weeks of gestation is important in making decisions about delivery and newborn management.
- Since approximately 80% of perinatal transmission takes place between week 36 and birth, pregnant individuals who present late to prenatal care should start on antiretroviral therapy immediately, and additional interventions, including intravenous zidovudine and elective cesarean section, may be recommended to help decrease the risk of perinatal transmission.
- For pregnant people with HIV, cesarean section and intravenous zidovudine during labor are indicated if the HIV RNA level is greater than 1,000 copies/mL within the 4 weeks prior to delivery (or if they have an unknown HIV RNA level within the 4 weeks prior to delivery).
- Evaluation for HIV infection of infants younger than 18 months of age who are born to individuals with HIV requires use of HIV nucleic acid amplification tests; a positive HIV antibody test is not reliable since HIV antibodies cross the placenta and often persist in the infant for at least 18 months.
- Infants born to persons with HIV should receive antiretroviral management based on the infant’s risk of having acquired HIV, which is determined by the birth parent’s antiretroviral history (and HIV RNA levels within the 4 weeks prior to delivery), and the neonate’s HIV diagnostic test results.
- People with HIV in the United States who give birth are advised to avoid breastfeeding due to the risk of transmitting HIV to their infant through colostrum and breastmilk and the availability of affordable, safe, and acceptable feeding alternatives.
Citations


References


• Panel on Antiretroviral Guidelines for Adults and Adolescents. Guidelines for the use of antiretroviral agents in adults and adolescents with HIV. Department of Health and Human Services. Considerations for antiretroviral use in special patient populations: acute and recent (early) HIV infection. January 20, 2022. [HIV.gov] -


Figures

Figure 1 Perinatal HIV Infections in the United States, 2013-2018

Figure 2 Pediatric AIDS Clinical Trials Group Protocol 076

In the Pediatric AIDS Clinical Trials Group Protocol (PACTG) 076, pregnant people with HIV were randomized to receive either zidovudine or placebo. The zidovudine regimen consisted of antepartum oral zidovudine, intravenous zidovudine during labor and delivery, and postpartum oral zidovudine for the infant. The proportion of babies who were determined to have HIV infection at 18 months postpartum was 67.5% lower in the zidovudine arm.

This graphic shows trends in HIV transmission rates (from pregnant people to their infants) during the years 1990-1999. A major decline occurred in 1994 concurrent with clinician implementation of findings from PATG 076 and then again in 1996 with the more widespread use of antenatal combination antiretroviral therapy.

Figure 4 Timing of Abbreviated Regimens of Zidovudine and Risk of Perinatal HIV Transmission

Figure 5 Antenatal Antiretroviral Therapy and Impact on Perinatal HIV Transmission

In the ANRS French Perinatal Cohort study, investigators evaluated the risk of mother-to-child HIV transmission in 5,271 mothers who received antiretroviral therapy during pregnancy. This graph shows the HIV transmission rate based on the HIV RNA level of the mother at delivery and the time of gestation when the baby was born.

Figure 7 Recommended Virologic Testing Schedules for Infants Exposed to HIV by Perinatal HIV Transmission Risk

Abbreviations: NAT = nucleic acid test

For lower-risk infants the last test may be timed to occur at least 2 weeks after stopping antiretroviral therapy. For higher-risk infants, additional virologic diagnostic testing should be considered at birth and 2 to 6 weeks after cessation of antiretroviral prophylaxis (i.e., at 8 to 12 weeks of life). "Low Risk" refers to infants born to persons with HIV who received standard antiretroviral therapy during pregnancy and achieved sustained suppression of HIV RNA levels and no concerns exist regarding antiretroviral adherence during the pregnancy. "Higher Risk" infants are those born to persons with HIV who did not receive prenatal care, did not receive antepartum or intrapartum antiretroviral therapy, received only intrapartum antiretroviral medications, initiated antiretroviral therapy late in pregnancy (late second or third trimester), were diagnosed with acute HIV infection during pregnancy, or had detectable HIV viral loads close to the time of delivery.

Table 1. Perinatal Guidelines: Recommendations for Use of Antiretroviral Drugs During Pregnancy

| Preferred Initial Combination Regimens for Antiretroviral-Naïve Pregnant Persons |
|----------------------------------|----------------------------------|
| Drug                             | Comment                          |

**Preferred Initial Regimens in Pregnancy:**

Drugs or drug combinations are designated as Preferred for therapy during pregnancy when clinical trial data in adults have demonstrated efficacy and durability with acceptable toxicity and ease of use, and pregnancy-specific pharmacokinetic data are available to guide dosing. In addition, the available data must suggest a favorable risk-benefit balance for the drug or drug combination compared to other antiretroviral drug options; the assessment of risks and benefits should incorporate outcomes for maternal, pregnancy, fetal, and infant outcomes. Some Preferred drugs or regimens may have minimal toxicity or teratogenicity risks that are offset by other advantages for people with HIV who are pregnant or who are trying to conceive. Therefore, it is important to read all the information on each drug in the Perinatal Guidelines before administering any of these medications to patients.

**Preferred Dual-NRTI Backbones**

| Abacavir-lamivudine | • Available as fixed-dose combination. Can be administered once daily.  
|                     | • Abacavir should not be used in patients who test positive for HLA-B*5701 because of risk of hypersensitivity reaction.  
|                     | • Abacavir-lamivudine with either ritonavir-boosted atazanavir or efavirenz is not recommended if pretreatment HIV RNA is >100,000 copies/mL. |

| Tenofovir alafenamide-emtricitabine or Tenofovir alafenamide plus lamivudine | • Tenofovir alafenamide-emtricitabine is available as a fixed-dose combination.  
|                                                                          | • Either coformulated tenofovir alafenamide-emtricitabine or separate doses of tenofovir alafenamide and lamivudine can be administered once daily.  
|                                                                          | • When combined with dolutegravir, the efficacy and toxicity of tenofovir alafenamide-emtricitabine and tenofovir DF-emtricitabine for treatment of pregnant patients are similar, but tenofovir alafenamide-emtricitabine is associated with fewer adverse birth outcomes and slightly higher gestational weight gain. |

| Tenofovir DF-emtricitabine or Tenofovir DF plus lamivudine | • Tenofovir DF-emtricitabine is available as a fixed-dose combination.  
|                                                             | • Either coformulated tenofovir DF-emtricitabine or separate doses of tenofovir DF and lamivudine can be administered once daily.  
|                                                             | • Tenofovir DF has potential renal toxicity; thus, tenofovir DF-based, dual-NRTI combinations should be used with caution in patients with renal insufficiency. |

**Preferred Integrase Stand Transfer Inhibitor (INSTI) Regimens**

| Dolutegravir-Abacavir-Lamivudine or Dolutegravir plus a Preferred Dual-NRTI Backbone | • Administered once daily.  
|                                                                                     | • The use of dolutegravir-abacavir-lamivudine requires HLA-B*5701 testing because this fixed-dose combination contains abacavir.  
|                                                                                     | • INSTI-based regimens may be useful when drug interactions or the potential for preterm delivery with a PI-based regimen are a concern.  
|                                                                                     | • In nonpregnant adults, dolutegravir is associated with lower rates of INSTI resistance than raltegravir; like raltegravir, dolutegravir has been shown to rapidly decrease viral load in antiretroviral-naïve pregnant persons who present to care later in pregnancy.  
|                                                                                     | • Dolutegravir is the only Preferred agent recommended for the treatment of acute HIV infection during pregnancy. |
### Drug

<table>
<thead>
<tr>
<th>Drug</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Either dolutegravir or raltegravir is the <em>Preferred</em> agent for patients who present to care late in pregnancy. Specific timing and/or fasting recommendations apply if dolutegravir is taken with calcium or iron (e.g., in prenatal vitamins). The use of dolutegravir at conception has been associated with a small increase in the risk of neural tube defects, but this was not seen when dolutegravir was started during pregnancy. However, in the most recent data from Botswana, there was no longer a significant difference in neural tube defects with the use of dolutegravir-containing compared to non-dolutegravir containing antiretroviral regimens at conception. This information should be discussed with patients to ensure informed decision-making.</td>
<td>Dolutegravir at conception has been associated with a small increase in the risk of neural tube defects, but this was not seen when dolutegravir was started during pregnancy. However, in the most recent data from Botswana, there was no longer a significant difference in neural tube defects with the use of dolutegravir-containing compared to non-dolutegravir containing antiretroviral regimens at conception. This information should be discussed with patients to ensure informed decision-making. See Updated Guidance About the Use of Dolutegravir in Pregnancy in the Perinatal Guidelines.</td>
</tr>
</tbody>
</table>

### Raltegravir plus a *Preferred* Dual-NRTI Backbone

| Raltegravir plus a *Preferred* Dual-NRTI Backbone | Pharmacokinetic data are available for raltegravir use in pregnancy when using the twice-daily formulation (400 mg twice daily), but data are not available for the once-daily 1,200 mg (2 x 600 mg) extended-release formulation “raltegravir HD”. Twice daily dosing is required in pregnancy. Raltegravir has been shown to produce rapid viral load decline to undetectable levels in women who present for initial therapy late in pregnancy and thus is a *Preferred* option in this setting. However, raltegravir is an *Alternative* antiretroviral for persons diagnosed with acute HIV during pregnancy. INSTI-based regimens may be useful when drug interactions or the potential for preterm delivery with PI-based regimens are a concern. Specific timing and/or fasting recommendations apply if raltegravir is taken with calcium or iron (e.g. in prenatal vitamins). |

### Preferred Protease Inhibitor (PI) Regimens

<table>
<thead>
<tr>
<th>Atazanavir boosted with ritonavir plus a <em>Preferred</em> Dual-NRTI Backbone</th>
<th>Once-daily administration. Extensive experience in pregnancy. Maternal hyperbilirubinemia; no clinically significant neonatal hyperbilirubinemia or kernicterus reported, but neonatal bilirubin monitoring recommended. Cannot be administered with proton-pump inhibitors; specific timing recommended for dosing with H2 blockers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Darunavir boosted with ritonavir plus a <em>Preferred</em> Dual-NRTI Backbone</td>
<td>Must be used twice daily in pregnancy.</td>
</tr>
</tbody>
</table>

**Abbreviations:** INSTI = integrase strand transfer inhibitor; NRTI = nucleoside reverse transcriptase inhibitor; PI = protease inhibitor

**Source:**

### Table 2. Perinatal Guidelines: Recommendations for Use of Antiretroviral Drugs During Pregnancy

#### Alternative Initial Combination Regimens for Antiretroviral-Naïve Pregnant Persons

<table>
<thead>
<tr>
<th>Drug</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alternative Initial Regimens in Pregnancy:</strong></td>
<td></td>
</tr>
<tr>
<td>Zidovudine-lamivudine</td>
<td></td>
</tr>
</tbody>
</table>

- Drugs or drug combinations are designated as *Alternative* options for therapy during pregnancy when clinical trial data in adults show efficacy and the data in pregnant individuals are generally favorable but limited. Most *Alternative* drugs or regimens are associated with more pharmacokinetic, dosing, tolerability, formulation, administration, or interaction concerns than those in the *Preferred* category, but they are acceptable for use in pregnancy. Some Alternative drugs or regimens may have known toxicity or teratogenicity risks that are offset by other advantages for people with HIV who are pregnant or who are trying to conceive. Therefore, it is important to read all the information on each drug in the Perinatal Guidelines before administering any of these medications to patients.

#### Alternative Dual-NRTI Backbones

- Zidovudine-lamivudine
  - Available as a fixed-dose combination.
  - Although not recommended for initial therapy in nonpregnant adults, zidovudine-lamivudine is the NRTI combination with most experience for use in pregnancy.
  - It has the disadvantages of requiring twice-daily.
<table>
<thead>
<tr>
<th>Drug</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative NNRTI Regimens</td>
<td>Birth defects have been seen in primate studies of efavirenz, but there has been no evidence of an increased risk of birth defects in human studies and extensive experience in pregnancy; cautionary text remains in the package insert.</td>
</tr>
<tr>
<td>Efavirenz-Tenofovir DF-Emtricitabine or Efavirenz-Tenofovir DF-Lamivudine or Efavirenz plus a Preferred Dual-NRTI Backbone</td>
<td>These regimens are useful for women who require treatment with drugs that have significant interactions with Preferred agents, or who need the convenience of a coformulated, single-tablet, once-daily regimen and are not eligible for dolutegravir or rilpivirine.</td>
</tr>
<tr>
<td></td>
<td>Screening for antenatal and postpartum depression is recommended. Higher rate of adverse events than some.</td>
</tr>
<tr>
<td>Drug</td>
<td>Comment</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
</tr>
</tbody>
</table>
| Rilpivirine-tenofovir DF-emtricitabine or Rilpivirine plus a Preferred Dual-NRTI Backbone | • Rilpivirine is **not recommended** with pretreatment HIV RNA >100,000 copies/mL or CD4 cell count <200 cells/mm³.  
• Do not use with proton-pump inhibitors (PPIs).  
• Pharmacokinetic data are available for pregnant individuals, but there is relatively little experience with use in pregnancy.  
• Pharmacokinetic data suggest lower drug levels and risk of viral rebound in second and third trimesters; if used, consider monitoring viral load more frequently.  
• Should be taken with food.  
• Available in a coformulated, single-tablet, once-daily regimen. |

**Abbreviations:** NRTI = nucleoside reverse transcriptase inhibitor; NNRTI = non-nucleoside reverse transcriptase inhibitor; PI = protease inhibitor
### Table 3. Perinatal Guidelines: Recommendations for Use of Antiretroviral Drugs During Pregnancy

**Insufficient Data in Pregnancy to Recommend Routine Use in Initial Regimens in People who are Antiretroviral-Naïve**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bictegravir-tenofovir alafenamide-emtricitabine (Fixed-dose combination)</strong></td>
<td>• Limited data on the use of bictegravir in pregnancy.</td>
</tr>
<tr>
<td><strong>Doravirine</strong></td>
<td>• No data on the use of doravirine in pregnancy.</td>
</tr>
<tr>
<td><strong>Ibalizumab</strong></td>
<td>• No data on the use of ibalizumab in pregnancy.</td>
</tr>
</tbody>
</table>

*These drugs are approved for use in adults but lack adequate pregnancy-specific pharmacokinetic or safety data.*

Source:
### Table 4. Perinatal Guidelines: Recommendations for Use of Antiretroviral Drugs During Pregnancy

#### Antiretroviral Therapy Not Recommended for Use in Pregnancy

<table>
<thead>
<tr>
<th>Drug</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Not Recommended for Initial Antiretroviral Therapy or Use in Pregnancy</strong></td>
<td></td>
</tr>
<tr>
<td>• These drugs and drug combinations are recommended for use in adults but are not recommended for use during pregnancy because of limited data about use in pregnancy and/or concerns about maternal or fetal safety or pharmacokinetic changes or inferior efficacy, including viral breakthroughs in the second and third trimester.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Note:</strong> When a pregnant person presents to care while virally suppressed on one of these drugs or drug combinations, providers should consider whether to continue their current regimen or switch to a recommended antiretroviral regimen.</td>
<td></td>
</tr>
</tbody>
</table>

| Atazanavir-cobicistat | • Limited data on the use of atazanavir with cobicistat in pregnancy.  
| Darunavir-cobicistat (fixed-dose combination) or Darunavir-cobicistat-tenofovir alafenamide-emtricitabine (fixed-dose combination) | • Limited data on use of darunavir with cobicistat in pregnancy.  
| Elvitegravir-cobicistat-tenofovir alafenamide-emtricitabine (fixed-dose combination) or Elvitegravir-cobicistat-tenofovir DF-emtricitabine (fixed-dose combination) | • Limited data on use of elvitegravir with cobicistat in pregnancy.  
| Elvitegravir-cobicistat-tenofovir DF-emtricitabine (fixed-dose combination) | • Limited data on use of elvitegravir with cobicistat in pregnancy.  
| Long-acting injectable Cabotegravir plus Rilpivirine (co-packaged formulation) | • Limited data on the use of cabotegravir plus rilpivirine in pregnancy.  
| | • Not recommended for initial treatment for antiretroviral-naïve adults or adolescents (pregnant or nonpregnant).  
<p>| | • Due to the long half-life of injectable cabotegravir and rilpivirin... |</p>
<table>
<thead>
<tr>
<th>Drug</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug</td>
<td>drug levels may persist up to 12 months after the last dose.</td>
</tr>
<tr>
<td><strong>Not Recommended for Initial ART in Pregnancy and Not Recommended, Except in Special Circumstances, for Treatment-Experienced People in Pregnancy</strong></td>
<td></td>
</tr>
<tr>
<td>• These drugs <strong>are not recommended</strong> for use in pregnant people who have never received antiretroviral therapy. With the exception of nevirapine and lopinavir-ritonavir, data about the pharmacokinetics, safety, and efficacy of these drugs during pregnancy are limited.</td>
<td></td>
</tr>
<tr>
<td>• Some of these drugs are also categorized as not recommended except in special circumstances during pregnancy, because the Panel recognizes that circumstances may exist in which pregnant women who are antiretroviral-experienced may need to initiate or continue these drugs to reach or maintain viral suppression.</td>
<td></td>
</tr>
<tr>
<td>Etravirine</td>
<td>• Not recommended for use in antiretroviral-naïve populations.</td>
</tr>
<tr>
<td></td>
<td>• Data about the use of etravirine in pregnancy are limited.</td>
</tr>
<tr>
<td>Fostemsavir</td>
<td>• Not recommended for use in antiretroviral-naïve populations.</td>
</tr>
<tr>
<td></td>
<td>• Data about the use of fostemsavir in pregnancy are limited.</td>
</tr>
<tr>
<td>Lopinavir-ritonavir plus a Preferred Dual NRTI Backbone</td>
<td>• Abundant experience and established pharmacokinetics in pregnancy.</td>
</tr>
<tr>
<td></td>
<td>• Has been associated with an increased risk of preterm delivery.</td>
</tr>
<tr>
<td></td>
<td>• More nausea than with Preferred or Alternative agents.</td>
</tr>
<tr>
<td></td>
<td>• If lopinavir-ritonavir is used, it should be dosed twice daily in pregnancy; data suggest once-daily lopinavir-ritonavir will not achieve plasma concentrations. Lopinavir-ritonavir is not recommended for use in pregnant persons; twice-daily administration required.</td>
</tr>
<tr>
<td></td>
<td>• Some experts recommend an increased dose of lopinavir-ritonavir in the second and third trimesters.</td>
</tr>
<tr>
<td>Maraviroc</td>
<td>• Not recommended for use in antiretroviral-naïve populations.</td>
</tr>
<tr>
<td></td>
<td>• Maraviroc requires tropism testing before use.</td>
</tr>
<tr>
<td></td>
<td>• Available pharmacokinetic data suggest that using the standard adult dose is appropriate for pregnant patients, although data about use in pregnancy are limited.</td>
</tr>
<tr>
<td>Nevirapine</td>
<td>• Not recommended because of greater potential for adverse events, complex lead-in dosing, and low barrier to resistance.</td>
</tr>
<tr>
<td></td>
<td>• Nevirapine should be used with caution when initiating antiretroviral therapy in women with CD4 cell count &gt;250 cells/mm$^3$.</td>
</tr>
<tr>
<td></td>
<td>• Use nevirapine and abacavir together with caution; both can</td>
</tr>
<tr>
<td>Drug</td>
<td>Comment</td>
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<tr>
<td>------</td>
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</tr>
<tr>
<td></td>
<td>cause hypersensitivity reactions within the first few weeks after initiation.</td>
</tr>
<tr>
<td>Enfuvirtide (T-20)</td>
<td>• Not recommended in antiretroviral-naïve populations.</td>
</tr>
</tbody>
</table>

**Note:** The following drugs and drug combinations (not listed above) should not be used during pregnancy:
- persons who become pregnant while taking these medications should switch to a recommended regimen: stavudine, didanosine, fosamprenavir, fosamprenavir plus ritonavir, indinavir, indinavir plus ritonavir, nelfinavir, ritonavir (as the sole protease inhibitor), saquinavir, saquinavir plus ritonavir, tipranavir, tipranavir plus ritonavir, two-drug antiretroviral regimens, or a three-drug nucleoside reverse transcriptase inhibitor (NRTI) antiretroviral regimen (e.g. abacavir-zidovudine-lamivudine).

Source:
### Table 5. Perinatal Guidelines: Management of Infants Born to People with HIV Infection

#### Types of Antiretroviral Management of Newborns with Perinatal HIV Exposure

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antiretroviral Therapy Prophylaxis</td>
<td>The administration of one or more antiretroviral drugs to a newborn without documented HIV infection to reduce the risk of perinatal acquisition of HIV.</td>
</tr>
<tr>
<td>Presumptive HIV Therapy</td>
<td>The administration of a three-drug combination antiretroviral regimen to newborns at highest risk of perinatal acquisition of HIV. Presumptive HIV therapy is intended to be preliminary therapy for newborns who are later documented to have HIV, but also serves as prophylaxis against HIV acquisition for those newborns who are exposed to HIV <em>in utero</em>, during the birthing process, or during breastfeeding and who do not acquire HIV.</td>
</tr>
<tr>
<td>HIV Therapy</td>
<td>The administration of a three-drug antiretroviral regimen at treatment doses to newborns with documented HIV infection.</td>
</tr>
</tbody>
</table>

Source:

# Table 6. Perinatal Guidelines: Management of Infants Born to People with HIV Infection

## Neonatal Antiretroviral Management According to Risk of HIV Infection in the Newborn

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Neonatal Antiretroviral Management</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low Risk of Perinatal HIV Transmission</strong></td>
<td>Mothers who received antiretroviral (ARV) therapy during pregnancy with sustained viral suppression (defined as a confirmed HIV RNA level less than 50 copies/mL) within 4 weeks prior to delivery and no concerns related to adherence</td>
<td>Zidovudine for 4 weeks</td>
</tr>
<tr>
<td><strong>Higher Risk of Perinatal HIV Transmission</strong></td>
<td>Mothers who received neither antepartum nor intrapartum ARV drugs&lt;br&gt;Mothers who received only intrapartum ARV drugs&lt;br&gt;Mothers who received antepartum ARV drugs but did not have viral suppression (defined as a confirmed HIV RNA level &lt;50 copies/mL) within 4 weeks prior to delivery&lt;br&gt;Mothers with acute or primary HIV infection during pregnancy or breastfeeding (in which case, the mother should discontinue breastfeeding)</td>
<td>Presumptive HIV therapy using either:&lt;br&gt;• Zidovudine, lamivudine, and nevirapine (treatment dose) from birth up to age 6 weeks&lt;sup&gt;d&lt;/sup&gt;&lt;br&gt;or&lt;br&gt;• Zidovudine, lamivudine, and raltegravir administered from birth up to age 6 weeks&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Presumed Newborn HIV Exposure</strong></td>
<td>Mothers with unconfirmed HIV status who have at least one positive HIV test at delivery or postpartum&lt;br&gt;or&lt;br&gt;Mothers whose newborns have a positive HIV antibody test</td>
<td>ARV management as above for newborns with a higher risk of perinatal HIV transmission&lt;br&gt;Infant ARV drugs should be discontinued immediately if supplemental testing confirms that the mother does not have HIV</td>
</tr>
<tr>
<td><strong>Newborn with Confirmed HIV</strong></td>
<td>Positive newborn HIV virologic test/nucleic acid test (NAT)</td>
<td>Start recommended 3-drug ARV regimen using treatment doses</td>
</tr>
</tbody>
</table>

<sup>a</sup> Zidovudine prophylaxis regimen is recommended for infants born to mothers with HIV-2 monoinfection. If the mother has HIV-1 and HIV-2 infection, the infant ARV regimen should be based on the determination of low or high risk of HIV-1 transmission as described in the above table. Because HIV-2 is not susceptible to nevirapine, raltegravir should be considered for infants at high risk of perinatal HIV-2 transmission.<br><sup>b</sup> See the Intrapartum Care section for guidance on indications for scheduled cesarean delivery and intrapartum intravenous zidovudine to reduce the risk of perinatal HIV transmission for mothers with elevated viral load at delivery.<br><sup>c</sup> Most Panel members would opt to administer empiric HIV therapy to infants whose mothers had acute HIV during pregnancy because of the high risk for in utero transmission. If acute HIV is diagnosed during...
breastfeeding, the mother should immediately discontinue breastfeeding.

d The optimal duration of presumptive HIV therapy in newborns who are at higher risk of perinatal HIV transmission is unknown. If possible, newborns who are at a higher risk of HIV acquisition should receive zidovudine for 6 weeks. Additional medications, such as lamivudine, raltegravir, or nevirapine, may need to administered for 2 to 6 weeks; the recommended durations for these drugs vary based on HIV NAT results, maternal viral load at the time of delivery, and additional risk factors for HIV transmission. Consultation with an expert in pediatric HIV is recommended when selecting a therapy duration, as this decision should be based on case-specific risk factors and interim HIV NAT results. The two-drug regimen used in NICHD-HPTN 040/PACTG 1043 for infants who were at a higher risk of HIV acquisition is described in the Two-Drug Antiretroviral Prophylaxis section.

e Infant ART should be initiated without waiting for the results of confirmatory HIV NAT testing, given the low likelihood of a false-positive HIV NAT. However, the specimen for confirmatory HIV testing should be obtained prior to ART initiation.

Note: ARV drugs should be initiated as close to the time of birth as possible, preferably within 6 hours of delivery.

Key to Acronyms: ART = antiretroviral therapy; ARV = antiretroviral; NAT = nucleic acid test

Source:

Table 7. **Perinatal Guidelines: Management of Infants Born to People with HIV Infection**

### Antiretroviral Dosing Recommendations for Newborns

<table>
<thead>
<tr>
<th>Drug</th>
<th>Drug Doses by Gestation Age at Birth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zidovudine</td>
<td></td>
</tr>
</tbody>
</table>

#### ≥35 Weeks Gestation at Birth

*Birth to Age 4 Weeks:*

- Zidovudine 4 mg/kg/dose orally twice daily

*Age >4 weeks:*

- Zidovudine 12 mg/kg per dose orally twice daily; only make this dose increase for infants with confirmed HIV infection

#### Simplified Weight-Band Dosing for Newborns Aged ≥35 Weeks Gestation from Birth to 4 Weeks

<table>
<thead>
<tr>
<th>Weight Band</th>
<th>Volume of Zidovudine 10 mg/mL Oral Syrup Twice Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 to &lt;3 kg</td>
<td>1 mL</td>
</tr>
<tr>
<td>3 to &lt;4 kg</td>
<td>1.5 mL</td>
</tr>
<tr>
<td>4 to &lt;5 kg</td>
<td>2 mL</td>
</tr>
</tbody>
</table>

#### ≥30 to <35 Weeks Gestation at Birth

*Birth to Age 2 Weeks:*

- Zidovudine 2 mg/kg per dose orally twice daily

*Age 2 Weeks to 6 to 8 Weeks:*

- Zidovudine 3 mg/kg per dose orally twice daily

*Age >6 to 8 Weeks:*

- Zidovudine 12 mg/kg per dose orally twice daily; make this dose increase only for infants with confirmed HIV infection

#### <30 Weeks Gestation at Birth

*Birth to Age 4 Weeks:*

- Zidovudine 2 mg/kg per dose orally twice daily

*Age 4 to 8 to 10 Weeks:*

- Zidovudine 3 mg/kg per dose orally twice daily

*Age >8 to 10 Weeks:*

- Zidovudine 12 mg/kg per dose orally twice
<table>
<thead>
<tr>
<th>Drug</th>
<th>Drug Doses by Gestation Age at Birth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abacavir</td>
<td><strong>≥37 Weeks’ Gestation at Birth</strong></td>
</tr>
<tr>
<td></td>
<td><em>Birth to 1 Month:</em></td>
</tr>
<tr>
<td></td>
<td>• Abacavir 2 mg/kg per dose orally twice daily</td>
</tr>
<tr>
<td></td>
<td><em>Age 1 Month to &lt; 3 Months:</em></td>
</tr>
<tr>
<td></td>
<td>• Abacavir 4 mg/kg per dose orally twice daily</td>
</tr>
<tr>
<td>Lamivudine</td>
<td><strong>≥32 Weeks’ Gestation at Birth</strong></td>
</tr>
<tr>
<td></td>
<td><em>Birth to Age 4 Weeks:</em></td>
</tr>
<tr>
<td></td>
<td>• Lamivudine 2 mg/kg/dose orally twice daily</td>
</tr>
<tr>
<td></td>
<td><em>Age &gt; 4 Weeks:</em></td>
</tr>
<tr>
<td></td>
<td>• Lamivudine 4 mg/kg per dose orally twice daily</td>
</tr>
<tr>
<td>Nevirapine</td>
<td><strong>≥37 Weeks Gestation at Birth:</strong></td>
</tr>
<tr>
<td></td>
<td><em>Birth to Age 4 Weeks:</em></td>
</tr>
<tr>
<td></td>
<td>• Nevirapine 6 mg/kg per dose orally twice daily</td>
</tr>
<tr>
<td></td>
<td><em>Age &gt; 4 Weeks:</em></td>
</tr>
<tr>
<td></td>
<td>• Nevirapine 200 mg/m^2 of body surface area (BSA) per dose orally twice daily; make this dose increase only for infants with confirmed HIV</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> Nevirapine dose adjustment at 4 weeks of age is optional for empiric HIV therapy</td>
</tr>
<tr>
<td></td>
<td><strong>≥34 to &lt;37 Weeks Gestation at Birth</strong></td>
</tr>
<tr>
<td></td>
<td><em>Birth to Age 1 Week:</em></td>
</tr>
<tr>
<td></td>
<td>• Nevirapine 4 mg/kg per dose orally twice daily</td>
</tr>
<tr>
<td></td>
<td><em>Age 1 to 4 Weeks:</em></td>
</tr>
<tr>
<td></td>
<td>• Nevirapine 6 mg/kg per dose orally twice daily</td>
</tr>
<tr>
<td></td>
<td><em>Age &gt; 4 Weeks:</em></td>
</tr>
<tr>
<td></td>
<td>• Nevirapine 200 mg/m^2 of BSA per dose orally twice daily; make this dose increase only for infants with confirmed HIV infection.</td>
</tr>
<tr>
<td>Raltegravir</td>
<td><strong>≥37 Weeks Gestation at Birth and Weighing ≥2 kg</strong></td>
</tr>
</tbody>
</table>

**Note:** abacavir is not approved by the FDA for use in neonates and infants aged < 1 month. However, dosing recommendations have been modeled using PK simulation.
**Note:** If the mother has taken raltegravir 2 to 24 hours prior to delivery, the neonate’s first dose of RAL should be delayed until 24 to 48 hours after birth; additional antiretroviral drugs should be started as soon as possible.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Drug Doses by Gestation Age at Birth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Birth to Age 6 Weeks:</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Body Weight</strong></td>
</tr>
<tr>
<td><strong>Birth to 1 Week: Once Daily Dosing</strong></td>
<td><strong>Approximately 1.5 mg/kg per dose</strong></td>
</tr>
<tr>
<td>2 to &lt;3 kg</td>
<td>0.4 mL (4 mg) once daily</td>
</tr>
<tr>
<td>3 to &lt;4 kg</td>
<td>0.5 mL (5 mg) once daily</td>
</tr>
<tr>
<td>4 to &lt;5 kg</td>
<td>0.7 mL (7 mg) once daily</td>
</tr>
<tr>
<td><strong>1 to 4 Weeks: Twice Daily Dosing</strong></td>
<td><strong>Approximately 3 mg/kg per dose</strong></td>
</tr>
<tr>
<td>2 to &lt;3 kg</td>
<td>0.8 mL (8 mg) twice daily</td>
</tr>
<tr>
<td>3 to &lt;4 kg</td>
<td>1 mL (10 mg) twice daily</td>
</tr>
<tr>
<td>4 to &lt;5 kg</td>
<td>1.5 mL (15 mg) twice daily</td>
</tr>
<tr>
<td><strong>4 to 6 Weeks: Twice Daily Dosing</strong></td>
<td><strong>Approximately 6 mg/kg per dose</strong></td>
</tr>
<tr>
<td>3 to &lt;4 kg</td>
<td>2.5 mL (25 mg) twice daily</td>
</tr>
<tr>
<td>4 to &lt;6 kg</td>
<td>3 mL (30 mg) twice daily</td>
</tr>
<tr>
<td>6 to &lt;8 kg</td>
<td>4 mL (40 mg) twice daily</td>
</tr>
</tbody>
</table>

Source:
