

Intrapartum HIV Care

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Panel's Recommendations

HIV Testing When Maternal HIV Status is Unknown in Labor

- Expedited antigen/antibody HIV testing should be performed when HIV status is unknown during labor and when there is increased risk of HIV infection but retesting was not performed in the third trimester **(AII)**. See [Pregnancy and Postpartum HIV Testing and Identification of Perinatal and Postnatal HIV Exposure](#) for more information.
 - If results are positive, an HIV-1/HIV-2 antibody differentiation test and an HIV-1 RNA assay should be done as soon as possible, and intravenous (IV) zidovudine (ZDV) should be initiated pending the result of the differentiation test **(AII)**.
 - If acute or recent HIV infection is suspected or if recent HIV exposure has occurred, an HIV RNA assay also should be done at the time of expedited antigen/antibody testing **(AII)**. See [Early \(Acute and Recent\) HIV Infection](#).

Intrapartum Antiretroviral Therapy, Zidovudine Prophylaxis, and Mode of Delivery in the Context of HIV During Pregnancy

- See [Table 9. Intrapartum Care and Recommended Interventions to Prevent Perinatal HIV Transmission](#) below.
- Patients should continue taking their antepartum antiretroviral therapy (ART) on schedule during labor and before scheduled cesarean birth **(AIII)**.
- **Based on laboratory and clinical information near the time of birth**, intrapartum IV ZDV should be administered in the following situations if—
 - HIV RNA >1,000 copies/mL,
 - Unknown HIV RNA,
 - Known or suspected lack of adherence since the last HIV RNA result, *or*
 - A positive expedited antigen/antibody HIV test result during labor **(AI)**.
- Begin IV ZDV when patients present in labor or at least 3 hours prior to scheduled cesarean birth **(AII)**.
- When HIV RNA is >1,000 copies/mL or is unknown near the time of birth, scheduled cesarean birth at 38 weeks gestation is recommended to minimize perinatal HIV transmission, irrespective of administration of antepartum ART **(AII)**. **Given the potential for rapid decreases in viral load with current ART options, individualized birth plans to extend these pregnancies beyond 38 weeks to avoid the need for a cesarean birth can be considered with expert consultation and shared decision-making. Expert guidance from the [National Perinatal HIV/AIDS Clinical Consultation Center](#) (1-888-448-8765) may be helpful when choosing to develop an individualized birth plan.**
 - Management of patients originally scheduled for cesarean birth because of HIV RNA >1,000 copies/mL who present in labor or with ruptured membranes must be individualized at the time of presentation **(BII)**. In these circumstances, evidence is insufficient to determine whether cesarean birth reduces the risk of perinatal HIV transmission. Consultation with an expert in perinatal HIV (e.g., telephone consultation with the [National Perinatal HIV/AIDS Clinical Consultation Center](#) [1-888-448-8765]) may be helpful for rapidly developing an individualized birth plan.

When ART is used and HIV RNA levels are $\leq 1,000$ copies/mL near the time of birth (within 4 weeks of birth):

- IV ZDV is **not required** when ALL of the following criteria are met: (1) ART is being taken, (2) HIV RNA levels are <50 copies/mL within 4 weeks of birth, and (3) adherence to the ARV regimen is achieved **(BII)**.

- IV ZDV may be considered when HIV RNA levels are ≥ 50 copies/mL and $\leq 1,000$ copies/mL within 4 weeks of birth (BII). Data are insufficient to determine whether administration of IV ZDV when HIV RNA levels are between 50 copies/mL and 1,000 copies/mL provides any additional protection against perinatal HIV transmission. This decision can be made on a case-by-case basis, taking into consideration their recent ART adherence and preferences, and involving expert consultation if needed (CII).
- Scheduled cesarean birth performed solely for prevention of perinatal HIV transmission in those receiving ART with HIV RNA $\leq 1,000$ copies/mL near the time of birth is **not recommended (AII)**.
- When HIV RNA levels are $\leq 1,000$ copies/mL during pregnancy, if scheduled cesarean birth or induction of labor is indicated for non-HIV-related reasons, it should be performed at the standard time for obstetric indications (AII). Labor should not be induced to prevent perinatal HIV transmission.
- When ART is being taken and HIV RNA levels are $\leq 1,000$ copies/mL during pregnancy, longer duration of ruptured membranes is not associated with an increased risk of perinatal transmission and is not an indication for cesarean birth to prevent HIV transmission (BII).

Other Intrapartum Management Considerations (See [Table 9](#) Below)

- Fetal scalp electrodes should be avoided in pregnancies impacted by HIV when viral suppression is achieved and should not be used in pregnancies when viral suppression (≥ 50 copies/mL) is not achieved (BIII).
- Artificial rupture of membranes and operative vaginal birth with forceps or a vacuum extractor should follow standard obstetric indications but should be avoided, if possible, in those with HIV RNA ≥ 50 copies/mL (BIII).
- The ARV regimen a patient is receiving should be taken into consideration when using methergine to treat excessive postpartum bleeding caused by uterine atony.
 - In patients who are receiving a cytochrome P450 (CYP) 3A4 enzyme inhibitor (e.g., a protease inhibitor or cobicistat), methergine should be used only if no alternative treatments for postpartum hemorrhage are available and the need for pharmacologic treatment outweighs the risks. If methergine is used, it should be administered at the lowest effective dose for the shortest possible duration (BIII).
 - In patients who are receiving a CYP3A4 enzyme inducer—such as nevirapine, efavirenz, or etravirine—additional uterotonic agents may be needed because of the potential for decreased methergine levels and inadequate treatment effect (BIII).

Rating of Recommendations: A = Strong; B = Moderate; C = Optional

Rating of Evidence: I = One or more randomized trials with clinical outcomes and/or validated laboratory endpoints; II = One or more well-designed, nonrandomized trials or observational cohort studies with long-term clinical outcomes; III = Expert opinion

Overview of HIV Care During Intrapartum

Specialized HIV care during labor and birth is required to optimize health outcomes and to prevent perinatal HIV transmission. Documentation of HIV status should always be assessed during labor, and HIV testing should be offered when HIV status is unknown or undocumented, there has been recent HIV exposure, and/or there are signs of acute HIV (see [Pregnancy and Postpartum HIV Testing and Identification of Perinatal and Postnatal HIV Exposure](#) and [Early \[Acute and Recent\] HIV Infection](#)). Because maternal HIV RNA level is linked directly to the risk of perinatal HIV transmission,¹ the Panel on Treatment of HIV During Pregnancy and Prevention of Perinatal Transmission (the Panel) recommends viral load testing throughout pregnancy, and specifically at approximately 36 weeks gestation (or within 4 weeks of anticipated birth), to inform decisions about intrapartum care. The risk of perinatal HIV transmission is reduced to very low levels (1% or less) when antiretroviral therapy (ART) is being taken during pregnancy and documented viral suppression (< 50 copies/mL) is achieved near birth.¹⁻³ The Panel's recommendations about

intrapartum care to prevent HIV transmission are based on maternal HIV RNA levels and encompass continuation of ART during pregnancy, intrapartum intravenous (IV) zidovudine (ZDV) during labor and birth, scheduled cesarean birth, and other intrapartum management considerations. [Table 9](#) provides an overview of the Panel’s recommendations for intrapartum care based on maternal HIV RNA. These recommendations are discussed in the following sections.

Presenting in Labor Without Documentation of HIV Status

All instances where documentation of HIV status is lacking at the time of labor should prompt screening for HIV with expedited testing unless declined (i.e., “opt-out” screening) (see [Pregnancy and Postpartum HIV Testing and Identification of Perinatal and Postnatal HIV Exposure](#) for details about testing procedures). Expedited repeat HIV testing also is recommended for those who present in labor and tested negative for HIV in early pregnancy but are at increased risk of HIV acquisition and were not retested in the third trimester.^{4,5} Factors that may increase the risk of HIV acquisition include having a sexually transmitted diagnosis, having a substance use disorder, exchanging sex for money or drugs, having multiple sexual partners during pregnancy, having a sexual partner who is at risk of HIV acquisition or who is known to have HIV, having signs or symptoms of acute HIV infection, or living in a region with an elevated incidence of HIV in women of childbearing age.⁴ **Those who test positive on the initial HIV test during labor should be presumed to have HIV until follow-up testing clarifies their HIV status.** Expert consultation should be obtained regarding starting patients on combination oral ART during labor and is available through the [National Perinatal HIV/AIDS Clinical Consultation Center](#) at 1-888-448-8765. To prevent perinatal HIV transmission, intrapartum IV ZDV should be started immediately, as discussed below, and patients should not initiate breastfeeding until HIV infection is ruled out definitively (see [Preventing HIV Transmission During Infant Feeding](#)). For additional information, see [Postpartum HIV Management and Follow-Up](#), [Antiretroviral Management of Infants With *In Utero*, Intrapartum, or Breastfeeding Exposure to HIV](#), and [Table 11.1. Drug Dosing Recommendations for Antiretroviral Prophylaxis and Presumptive HIV Therapy in Infants With *In Utero* or Intrapartum Exposure to HIV](#). No further testing is required for specimens that are nonreactive on the initial immunoassay, unless the patient has had recent HIV exposure or acute infection is suspected, in which case an HIV RNA assay should be obtained. For additional information regarding HIV testing during labor and birth, please see the HIV Testing During Labor When HIV Status is Unknown section of [Pregnancy and Postpartum HIV Testing and Identification of Perinatal and Postnatal HIV Exposure](#).

Expedited HIV testing should be available on a 24-hour basis, and results should be available within 1 hour at all facilities with a maternity service and/or neonatal intensive care unit. Statutes and regulations regarding expedited testing vary from state to state (see [State Laws That Address High-Impact HIV Prevention Efforts](#)).

Intrapartum Continuation of Antenatal Antiretroviral Drugs

ART is recommended for the treatment of HIV and prevention of perinatal HIV transmission in all pregnancies impacted by HIV, regardless of CD4 T lymphocyte cell count and HIV RNA (viral load). Antepartum antiretroviral (ARV) regimens should be continued on schedule during the intrapartum period to maintain virologic suppression and to minimize the chance of developing drug resistance. When cesarean birth is planned, oral medications can be administered preoperatively with sips of water. Medications that must be taken with food for absorption can be taken with liquid dietary supplements, contingent on consultation with the anesthesiologist during the preoperative period. If the ARV drug regimen must be interrupted temporarily (i.e., for <24 hours) during the

peripartum period, all drugs should be stopped and reinstated simultaneously to minimize the chance that resistance will develop.

Decisions Regarding the Use of Intrapartum Intravenous Zidovudine

Intrapartum administration of IV ZDV provides ARV pre-exposure prophylaxis at a time when infants are at increased risk of exposure to maternal blood and body fluids. Although the PACTG 076 ZDV regimen included a continuous IV infusion of ZDV during labor for all women, decisions regarding the use of IV ZDV during labor are now based on the maternal HIV RNA level and adherence considerations (see [Table 9](#)). IV ZDV also is recommended when an initial diagnosis of HIV is determined during labor and when HIV is confirmed but HIV RNA level is unknown during pregnancy.

Intrapartum IV ZDV reduces perinatal HIV transmission when HIV RNA levels are >1,000 copies/mL and ART is being taken, but the benefits when HIV RNA levels are ≤1,000 copies/mL are less clear. Using data from 1997 to 2010, the French Perinatal Cohort Study evaluated the association between IV ZDV and perinatal HIV transmission based on HIV RNA levels in >11,000 pregnant women with HIV who were on ART (72% of the women received triple-ARV regimens). The majority (95%) received IV intrapartum ZDV.⁶ Among women with HIV RNA ≥1,000 copies/mL whose infants received only ZDV for prophylaxis, the risk of perinatal HIV transmission was significantly higher without maternal IV ZDV (10.2%) than with maternal IV ZDV (2.5%; $P < 0.01$), but this difference was not observed if the neonate received a combination prophylaxis of two or more ARV drugs (4.8% with IV ZDV vs. 4.1% without IV ZDV, $P = 0.83$). Among women with HIV RNA <1,000 copies/mL at birth, transmission rates did not differ significantly between those who received IV ZDV (0.6%, 47 of 8,132 infants) and those who did not (0 of 369 infants, $P > 0.20$).

In a European cohort of infants who were considered to be at high risk of perinatal HIV transmission, lack of IV ZDV during labor was associated with transmission on univariate analysis, but not after the results were adjusted for maternal HIV RNA and other factors (adjusted odds ratio with IV ZDV was 0.79; 95% confidence interval, 0.55–1.15; $P = 0.23$).⁷ In a cohort of 717 women who delivered between 1996 and 2008 in Miami, not receiving IV ZDV during labor ($n = 67$) was not associated with an increased risk of perinatal HIV transmission.⁸ The majority of these women were receiving ART (89%) and had HIV RNA <1,000 copies/mL (75%) at birth.

Based on available data, the Panel recommends that IV ZDV continue to be administered during pregnancy when HIV RNA levels are >1,000 copies/mL within 4 weeks of birth (or when HIV is confirmed but HIV RNA levels are unknown within 4 weeks of birth), regardless of their antepartum ARV regimen. Administration of intrapartum IV ZDV may be considered when HIV RNA levels are ≥50 copies/mL and ≤1,000 copies/mL or when there are concerns about adherence to or tolerance of ARV regimens in late pregnancy. Specifically, patients who have not maintained an undetectable viral load consistently throughout the third trimester, patients who have had challenges consistently participating in prenatal care, and patients with ongoing psychosocial factors that raise additional concerns about adherence should be considered potential candidates for intrapartum IV ZDV despite a viral load <1,000 copies/mL. Some experts think the data are insufficient to determine whether administration of intrapartum IV ZDV during pregnancy when HIV RNA levels are between 50 and 1,000 copies/mL provides any additional protection against perinatal transmission. However, based on studies of women initiated therapy in the third trimester, the transmission risk is slightly higher (approximately 1% to 2%) when HIV RNA is in the range of 50 to 999 copies/mL than when it is <50 copies/mL (transmission risk is ≤1%).^{1,6,9,10}

The Panel does not recommend IV ZDV when **all** of the following criteria are met: (1) ART is being taken, (2) HIV RNA levels are <50 copies/mL within 4 weeks of birth, and (3) adherence to the ARV regimen is achieved. However, a study showing that 6% of women with suppressed HIV RNA levels during pregnancy had viral load rebound near birth¹¹ highlights the importance of using clinical judgment when making the decision to use intrapartum IV ZDV, regardless of the patient's viral load **within 4 weeks prior to birth**. The additional benefit of IV ZDV in pregnancy when ART is being taken and viral suppression (HIV RNA <50 copies/mL) is achieved has not been evaluated in randomized clinical trials.

If a patient has known or suspected ZDV resistance, intrapartum use of IV ZDV still is recommended in patients with HIV RNA >1,000 copies/mL near birth unless a documented history of hypersensitivity exists. This intrapartum use of IV ZDV is recommended because of its proven record in reducing the risk of perinatal HIV transmission, even in the context of maternal resistance to the drug (see [Antiretroviral Drug Resistance and Resistance Testing in Pregnancy](#)).

Administration of Intrapartum Intravenous Zidovudine

Intrapartum IV ZDV is recommended when HIV RNA levels are >1,000 copies/mL or unknown HIV RNA **within 4 weeks prior to birth**. In those with HIV RNA >1,000 copies/mL who are undergoing a scheduled cesarean birth for prevention of perinatal HIV transmission, IV ZDV administration should begin at least 3 hours before the scheduled cesarean birth; **a 1-hour loading dose of ZDV at 2 mg/kg followed by a continuous IV ZDV infusion of 1 mg/kg for 2 hours (minimum of 3 hours total) is recommended**. This recommendation is based on a pharmacokinetic (PK) study in which ZDV was administered orally during pregnancy and as a continuous infusion during labor. Maternal ZDV levels were measured at baseline, after the initial IV loading dose, and then every 3 to 4 hours until birth. ZDV levels were also measured in cord blood.¹² Systemic and intracellular ZDV levels increased from baseline but appeared to stabilize after 3 hours of infusion; cord blood ZDV levels were associated with maternal levels and maternal infusion duration. If cesarean birth is being performed for other indications and the maternal viral load is ≤1,000 copies/mL near the time of birth, administering IV ZDV is not required.

When an urgent unscheduled cesarean birth is indicated in a patient who has a viral load >1,000 copies/mL, consideration can be given to shortening the interval between initiation of IV ZDV administration and birth. For example, some experts recommend administering the 1-hour loading dose of IV ZDV and not waiting to complete additional administration before proceeding with birth when an expedited birth is indicated.

When IV ZDV is not available, substitution of single-agent oral ZDV for IV ZDV is not recommended. In some international studies, oral (rather than IV) ZDV has been administered during labor. Data are limited on the PK of oral versus IV ZDV during labor. In studies of oral dosing in labor, ZDV levels were lower than they were with IV dosing, and PK parameters suggested erratic absorption during labor.^{13,14} Therefore, IV administration is recommended over oral administration in the United States when HIV RNA levels are >1,000 copies/mL near birth. Prompt administration of combination ART during pregnancy is preferred to single therapy with oral ZDV. Consultation with a person experienced in HIV management during labor and birth is recommended and is available through the [National Perinatal HIV/AIDS Clinical Consultation Center](#) (1-888-448-8765).

Transmission and Mode of Delivery

Current Recommendations on Mode of Delivery

Scheduled cesarean birth, defined as cesarean birth performed before the onset of labor and before rupture of membranes (ROM), is recommended at 38 weeks gestation for prevention of perinatal HIV transmission when HIV RNA levels are >1,000 copies/mL near birth and when HIV RNA levels are unknown. Although most studies do not specify the exact time that the HIV RNA levels closest to birth were measured, the Panel recommends viral load testing at approximately 36 weeks gestation or within 4 weeks of anticipated birth to inform decisions about mode of birth and optimal treatment of the newborn. The American College of Obstetricians and Gynecologists (ACOG) recommends counseling about the potential benefits of scheduled cesarean birth when HIV RNA levels are >1,000 copies/mL during pregnancy.¹⁵

Recommendations for cesarean birth to prevent perinatal HIV transmission were based initially on findings from a multicenter, randomized clinical trial¹⁶ and a large individual patient data meta-analysis¹⁷ that were conducted before the availability of viral load information, when either no ARV drugs or ZDV as a single drug were prescribed during most pregnancies impacted by HIV. The HIV RNA threshold of 1,000 copies/mL for decisions about mode of birth was based largely on data from a 1999 report of the Women and Infants Transmission Study, a large prospective cohort study that reported no cases of perinatal HIV transmission among 57 women with HIV RNA levels <1,000 copies/mL.¹⁸ Results of studies conducted since then have been extrapolated to make current recommendations about the mode of birth in an era when ART is recommended during all pregnancies and viral load information is readily available.

In a report on births to women with HIV in the United Kingdom and Ireland between 2000 and 2011, perinatal transmission rates in women on ART with HIV RNA <1,000 copies/mL who had a planned cesarean birth (13 of 3,544 women; 0.3%) were not significantly different from those who had a planned vaginal birth (6 of 2,238 women; 0.3%).⁹ Similarly, data from the French Perinatal Cohort showed no difference in transmission rates between vaginal birth and planned cesarean birth among women with suppressed viral loads on ART (0.3% in both groups of women).¹⁹ Among 290 deliveries in women with HIV in Finland from 1993 to 2013, 75.4% of women delivered vaginally, 12.5% delivered by elective cesarean, and 12.5% delivered by emergency cesarean; 80% had HIV RNA <50 copies/mL. No perinatal HIV transmissions occurred across the birthing methods.²⁰ For preterm deliveries in women with HIV RNA <1,000 copies/mL, an analysis of data from the French Perinatal Cohort found that transmission rates were slightly higher among planned vaginal deliveries than among planned cesarean deliveries, but the number of women with viral loads <400 copies/mL was low, and the differences across viral load levels were not statistically significant.¹⁹

Given the low perinatal HIV transmission rates that can be achieved when ART is taken during pregnancy, the benefit of scheduled cesarean birth is difficult to evaluate in the context of viral suppression. It is unclear whether scheduled cesarean birth confers any additional benefit in reducing transmission, and there are harms associated with unindicated cesarean birth. No evidence to date suggests any benefit from scheduled cesarean birth when ART has been taken for several weeks and viral suppression has been achieved at or near birth. Furthermore, evidence exists that complication rates for cesarean deliveries are higher in women with HIV than in women without HIV.²¹ Therefore, decisions about mode of birth for pregnancies when ART is being taken and HIV RNA levels are ≤1,000 copies/mL should be individualized based on discussion between an obstetrician and a patient. Counseling should be provided explaining that no evidence indicates that a scheduled

cesarean birth performed solely for prevention of perinatal HIV transmission is of any benefit when ART is being taken and HIV RNA levels are $\leq 1,000$ copies/mL and, therefore, **is not routinely recommended** in these situations.

Timing of Delivery

ACOG recommends against nonmedically indicated cesarean birth prior to 39 0/7 weeks gestation because of the risk of iatrogenic prematurity.^{22,23} However, when the maternal viral load is $>1,000$ copies/mL, earlier birth is indicated. When cesarean birth is indicated to prevent transmission of HIV, ACOG recommends scheduling cesarean birth at 38 0/7 weeks gestation to decrease the likelihood of onset of labor or ROM before scheduled cesarean birth.⁵ However, recent evidence indicates that integrase strand transfer inhibitors (INSTIs) cause a rapid reduction in HIV viral loads when there is adherence to therapy, with the DoIPHIN-2 trial reporting a median time of 7 days for patients taking dolutegravir to achieve a viral load $<1,000$ copies/mL.²⁴ When INSTI-based ART was recently started, adherence to therapy is known, and viral loads are trending down and approaching the threshold of $<1,000$ copies/mL near term, it is reasonable to consider shared decision-making regarding mode and timing of birth while providing increased adherence support (possibly including directly observed therapy). When attempting to avoid a cesarean birth in the setting of a rapidly decreasing viral load, providers must balance the risks of ROM and spontaneous labor while simultaneously mitigating the reason for lack of viral suppression. For providers considering an individualized birth plan, consultation with the [National Perinatal HIV/AIDS Clinical Consultation Center](https://www.npcd.org/) (1-888-448-8765) may be helpful. Gestational age should be determined by best obstetrical dating criteria, including last menstrual period and early ultrasound for dating purposes. Consistent with ACOG guidelines for instances of suboptimal pregnancy dating, amniocentesis to document lung maturity should be avoided in pregnancies impacted by HIV²⁵ See Early Labor or Ruptured Membranes at Presentation below for management in the setting of early labor or ruptured membranes.

Among 1,194 infants born to mothers with HIV, 9 (1.6%) born vaginally and 18 (4.4%) delivered by scheduled cesarean had respiratory distress syndrome (RDS) ($P < 0.001$). No statistically significant association existed between mode of birth and infant RDS in an adjusted model that included infant gestational age and birth weight.²⁶ Although newborn complications may be increased with planned cesarean birth at <39 weeks gestation, the benefits of planned cesarean birth at 38 weeks generally are thought to outweigh the risks if the procedure is performed to prevent HIV transmission.

In pregnancies when HIV RNA levels are $\leq 1,000$ copies/mL, cesarean birth is not recommended to prevent perinatal HIV transmission. The Panel recommends delivering according to standard obstetric indications; **labor should not be induced at 38 weeks for prevention of perinatal HIV transmission.** When scheduled cesarean birth is performed during pregnancies when HIV RNA levels are $\leq 1,000$ copies/mL for an indication other than preventing HIV transmission, cesarean birth should be scheduled based on ACOG guidelines for pregnancies that are not impacted by HIV. Among women with HIV RNA levels $<1,000$ copies/mL, a comparison of 613 women who delivered vaginally at 38 to 40 weeks gestation and 303 women who delivered vaginally at ≥ 40 weeks gestation demonstrated no significant difference (0.3% vs. 0.5%) in perinatal HIV transmission by estimated gestational age at birth; these findings suggest that when there is no indication for scheduled cesarean birth for prevention of perinatal HIV transmission, providers should deliver according to standard obstetric indications.²⁷

Cesarean Delivery When Presenting Late in Pregnancy

When pregnancy is near term at the time of presentation and ARV drugs are not being taken, HIV RNA results may not be available before birth. Without current therapy, HIV RNA levels are unlikely to be $\leq 1,000$ copies/mL at baseline. Even when ART is initiated immediately, reduction in plasma HIV RNA to undetectable levels may take several weeks, depending on the baseline viral load and kinetics of viral decay for a particular drug regimen (see [Recommendations for the Use of Antiretroviral Drugs During Pregnancy: Overview](#) and [Lack of Viral Suppression While on Antiretroviral Therapy in Pregnancy](#)).^{24,28-31} In this instance, scheduled cesarean birth is likely to provide additional benefit in reducing the risk of perinatal transmission of HIV, unless viral suppression can be documented before 38 weeks gestation. Although some experts would recommend a cesarean birth when virologic suppression has been achieved for a brief period (e.g., <2 weeks), given this scenario, many others would support a vaginal birth as long as the plasma HIV RNA level was <1,000 copies/mL by the day of birth. In these situations, patient-centered counseling and shared decision-making should be used in planning for birth. Regardless of mode of birth, presumptive HIV therapy should be considered for the neonate in these circumstances (see Antiretroviral Management of Infants With *In Utero*, Intrapartum, or Breastfeeding Exposure to HIV). No data are available to address the management of an elite controller (i.e., someone who has previously maintained an undetectable HIV RNA level without ART) who presents in labor and is not receiving ART; however, in this setting, administering IV ZDV and supporting vaginal birth would be reasonable (CIII).

Risk of Complications With Cesarean Delivery

Administration of perioperative antimicrobial prophylaxis is recommended during all pregnancies to decrease infectious morbidity associated with cesarean birth. Most studies performed in the era before routine ART was recommended demonstrated that women with HIV have higher rates of postoperative complications (mostly infectious) than those without HIV and that their risk of complications is related to degree of immunosuppression and the receipt of suppressive ART.³²⁻³⁷ A Cochrane review of six studies in women with HIV concluded that urgent cesarean birth was associated with the highest risk of postpartum morbidity, scheduled cesarean birth was intermediate in risk, and vaginal birth had the lowest risk of morbidity.^{38,39} Complication rates in women with HIV in most studies^{16,40-44} were within the range reported in populations of women without HIV with similar risk factors and not of sufficient frequency or severity to outweigh the potential benefit of reduced perinatal HIV transmission.

A U.S. study of nationally representative data from a large administrative database demonstrated that—even in the era of ART—infected complications, surgical trauma, prolonged hospitalization, and in-hospital deaths remain higher among women with HIV than among those without HIV.²¹ The rate of any complication associated with cesarean birth was 117 per 1,000 deliveries among women with HIV and 67 per 1,000 deliveries among women without HIV. A meta-analysis of primarily observational studies in women with HIV also reported higher morbidity with elective cesarean birth than with vaginal birth (odds ratio 3.12) and no reduction in perinatal HIV transmission among the mothers on ART.⁴⁵ Therefore, during pregnancies impacted by HIV, counseling should be provided regarding the specific risks associated with undergoing cesarean birth in the setting of HIV infection.

In addition, caution should be exercised in proceeding with a cesarean birth in circumstances without clear evidence of benefit, especially in instances of younger maternal age when additional pregnancies and perhaps multiple cesarean deliveries are likely. The risks of abnormal placentation

(e.g., placenta previa, placenta accreta spectrum), bowel and bladder injury, and intrapartum hemorrhage increase with the number of reoccurring cesarean deliveries. These risks should be considered and discussed with the patient before proceeding with a cesarean birth.^{46,47}

Early Labor or Ruptured Membranes at Presentation

Most studies have shown a similar risk of perinatal HIV transmission for cesarean birth performed for obstetric indications after labor and membrane rupture as for vaginal birth. In one study, the HIV transmission rate was similar in women undergoing emergency cesarean birth and those delivering vaginally (1.6% vs. 1.9%, respectively).² Although a 2001 meta-analysis found that a longer duration of ruptured membranes was associated with an increased risk of perinatal HIV transmission,⁴⁸ it is not clear how soon after the onset of labor or ROM that the benefit of cesarean birth is lost for women with HIV RNA >1,000 copies/mL.⁴⁹ Later data are reassuring on the association between the duration of ROM and perinatal HIV transmission in the era of ART and viral load measurement. A prospective cohort study of 707 pregnant women in Ireland showed that among 493 women on ART with HIV RNA levels <1,000 copies/mL, no cases of perinatal transmission occurred among those with membranes ruptured for up to 25 hours. Only a viral load of >10,000 copies/mL was an independent risk factor for perinatal transmission.⁸

In a large, prospective, population-based surveillance study in the United Kingdom and Ireland that evaluated data on 2,116 pregnancies during 2007 to 2012, no difference was observed in perinatal HIV transmission between women with a ROM duration of ≥ 4 hours (0.64%) and those with a ROM duration of <4 hours (0.34%). Among women with HIV RNA <50 copies/mL, the transmission rate for a ROM duration ≥ 4 hours was 0.14% and did not differ from the rate for a ROM duration of <4 hours (0.12%). The median duration of ROM was 3 hours 30 minutes (interquartile range: 1–8 hours). The infants in this study were delivered at term—vaginally or by emergency cesarean birth—to women with HIV who were on ART; the majority of women (89%) had HIV RNA <50 copies/mL, and only 1% had HIV RNA $\geq 1,000$ copies/mL. Among preterm infants, no transmissions occurred during 163 deliveries where the maternal viral load was <50 copies/mL.⁵⁰

Because it is not clear whether cesarean birth after onset of labor reduces the risk of perinatal HIV transmission when HIV RNA levels are >1,000 copies/mL, management of patients originally scheduled for cesarean birth who present in labor or with ruptured membranes must be individualized at the time of presentation.

If spontaneous ROM occurs at >34 weeks gestation before labor or early in labor and HIV RNA levels are $\leq 1,000$ copies/mL, interventions to decrease the interval to birth (e.g., administration of oxytocin) should be considered based on obstetric considerations. When membrane rupture occurs before 34 weeks gestation, decisions about timing of birth should be based on best obstetric practices, considering infant risks of prematurity and HIV transmission. Antibiotics to prolong the time from membrane rupture to onset of labor (the latency period), magnesium sulfate for fetal neuroprotection, and antenatal corticosteroids should be given in accordance with usual obstetric guidelines because no data exist to suggest that these recommendations need to be altered for pregnancy in the context of HIV.

In these circumstances, where there is a paucity of data, consultation with an expert in perinatal HIV may be helpful. Because the birth plan in the setting of labor must be made quickly, telephone consultation via a 24-hour, 7-day-a-week hotline (e.g., the [National Perinatal HIV/AIDS Clinical](#)

[Consultation Center](#) [1-888-448-8765]) may provide assistance in rapidly developing an individualized plan.

Other Intrapartum Management

Obstetric Procedures

Obstetric procedures that increase the risk of fetal exposure to maternal blood—such as invasive fetal monitoring—have been associated with an increased risk of perinatal transmission in some studies, primarily those performed in the pre-ART era.⁵¹⁻⁵⁴ Data are limited on the use of fetal scalp electrodes during labor in women who are receiving suppressive ART and who have an undetectable viral load. **Fetal scalp electrodes should be avoided in pregnancies impacted by HIV when viral suppression is achieved and should not be used in pregnancy when viral suppression (≥ 50 copies/mL) is not achieved.** Consider consultation with the [National Perinatal HIV/AIDS Clinical Consultation Center](#) (1888-448-8765) for infant management when a scalp electrode is used in the setting of HIV infection. See [Antiretroviral Management of Infants With *In Utero*, Intrapartum, or Breastfeeding Exposure to HIV](#).

Based on data discussed in the previous section (see Early Labor or Ruptured Membranes at Presentation, above), artificial ROM can be performed for standard obstetric indications when HIV RNA levels are < 50 copies/mL and ART is being taken. Artificial ROM should be avoided when HIV RNA levels are ≥ 50 copies/mL unless there is a clear obstetric indication. Although no data exist about the risks of perinatal HIV transmission with intrauterine pressure catheters, clinicians may use them with caution when indicated.

Delayed cord clamping has been associated with improved iron stores in both term and preterm infants, as well as a lower incidence of necrotizing enterocolitis and intraventricular hemorrhage in preterm infants born to mothers without HIV. ACOG now recommends delaying cord clamping for 30 to 60 seconds after birth in vigorous term and preterm infants.⁵⁵⁻⁵⁷ In the setting of HIV infection, a study of 64 mother–infant pairs in which 32 infants had early cord clamping (performed < 30 seconds after birth) and 32 infants had delayed cord clamping (performed 120 seconds after birth) found that mean hemoglobin levels at 24 hours of life were significantly higher in the delayed cord clamping group ($P = 0.05$). This difference persisted at 1 month of age ($P < 0.05$) despite differential prescribing of iron supplementation to infants with anemia. All mothers were on stable ARV regimens. During 18 months of follow-up, no HIV transmissions were reported, and the risk of jaundice or polycythemia in infants with delayed cord clamping did not increase.⁵⁸

Intrapartum Epidural Use and Pharmacologic Interactions With ARV Drugs

Ritonavir (RTV) inhibition of cytochrome P450 (CYP) 3A4 decreases the elimination of fentanyl by 67%. This raises concerns about a possible increased risk of respiratory depression—particularly with patient-controlled analgesia during labor—in patients who are receiving regimens that contain RTV. However, a pharmacokinetic simulation study suggested that even with maximal clinical dosing regimens of epidural fentanyl over 24 hours, RTV-induced CYP3A4 inhibition is unlikely to produce the plasma fentanyl concentrations that are associated with a decrease in minute ventilation.⁵⁹ This suggests that epidural anesthesia can be used safely regardless of a patient's ARV regimen.

Operative Vaginal Delivery

In the past, before data from the era of ART were available, HIV was considered a relative contraindication to operative vaginal birth with forceps or a vacuum device. In a review of the deliveries of 9,072 women with HIV in the United Kingdom between 2008 and 2016, the percentage of women with viral suppression was 80% for the deliveries from 2007 through 2011 and 90% for those from 2012 through 2014. Among the 3,023 of 3,663 vaginal deliveries with data on whether forceps or a vacuum device were used, 249 (8.2%) involved operative birth (5.6% using forceps, 2.4% using a vacuum device, 0.1% using both forceps and a vacuum device, and 0.2% device type unknown). Among the 222 infants with known HIV status at 18 months of age, one case of HIV transmission with multiple possible causes was reported, and not enough evidence existed to confirm intrapartum transmission. The study authors concluded that operative birth is a safe option for women who are virally suppressed.⁶⁰ Based on these data, the Panel recommends that operative birth with forceps or a vacuum extractor should follow standard obstetric indications but should be avoided, if possible, when HIV RNA is ≥ 50 copies/mL. No data from the ART era address the risk of perinatal HIV transmission associated with episiotomy or with vaginal or perineal tears in the absence of maternal viremia; indications for episiotomy (e.g., a need for expedited vaginal birth, shoulder dystocia) should be the same as they are for pregnancies not impacted by HIV.

Postpartum Hemorrhage, ARV Drugs, and Methergine Use

Oral or parenteral methergine or other ergot alkaloids often are used as first-line treatment for postpartum hemorrhage caused by uterine atony. However, methergine should not be coadministered with drugs that are potent CYP3A4 enzyme inhibitors, including protease inhibitors (PIs). Concomitant use of ergotamines with PIs and/or cobicistat (COBI) has been associated with exaggerated vasoconstrictive responses, including acute ischemia of the lower extremities.^{61,62} When uterine atony results in excessive postpartum bleeding in people who are receiving PIs or COBI, methergine should be used only if alternative treatments—such as prostaglandin F₂-alpha, misoprostol, or oxytocin—are unavailable or are contraindicated. If no alternative medications are available and the need for pharmacologic treatment outweighs the risks, methergine should be used at the lowest effective dose for the shortest possible duration. In contrast, additional uterotonic agents may be needed when using other ARV drugs that are CYP3A4 inducers (e.g., nevirapine, efavirenz, etravirine) because of the potential for decreased methergine levels and inadequate treatment effect. No known drug–drug interactions limit the adjunctive use of tranexamic acid in this setting.

Table 9. Intrapartum Care and Recommended Interventions to Prevent Perinatal HIV Transmission Based on HIV RNA Levels at the Time of Delivery

Antiretroviral therapy (ART) should always be taken or initiated in pregnancy as early as possible to suppress HIV RNA to undetectable levels (<50 copies/mL).

HIV RNA at Time of Delivery Assessed at 36 Weeks Gestation or Within 4 Weeks Prior to Birth				
	<50 copies/mL and on ART With No Concerns About Adherence ^a	≥50 to ≤1,000 copies/mL	>1,000 copies/mL	Unknown HIV RNA ART Adherence Concerns ^a Not Receiving ART HIV Diagnosis in Labor
Intrapartum ART	Prescribed ART should be taken on schedule during labor and before scheduled cesarean birth (CIII). In general, ARV regimens are initiated postpartum when HIV is diagnosed during labor.			
Intrapartum IV ZDV	Not required (BII)	Not required but may be considered (CII); some experts recommend.	Yes, recommended (AI) ^b IV ZDV: 1-hour loading dose at 2 mg/kg followed by a continuous ZDV infusion of 1 mg/kg for 2 hours (at least 3 hours total) (AII)	
Mode of Delivery	Vaginal birth ^c (AII)	Vaginal birth ^c (AII)	Scheduled cesarean birth at 38 weeks gestation ^d (AII)	Individualized care ^d
Artificial Rupture of Membranes^e	Per standard obstetric indications (BII)	Avoid if possible (BIII).	Not applicable; cesarean birth recommended	Avoid, if possible, when viral load is detectable or unknown and a cesarean birth is not being performed (BIII).
Induction of Labor	Per standard obstetric indications, including use of oxytocin. When HIV RNA levels are ≤1,000 copies/mL, routine induction at 38 weeks gestation should NOT be performed.		Not applicable; scheduled cesarean birth at 38 weeks is recommended.	Avoid if possible (BIII).
IUPC	Data not available for pregnancies impacted with HIV; use IUPC with caution and only if clear obstetric indications exist.			
Fetal Scalp Electrodes for Fetal Monitoring	Avoid—particularly when maternal viral load is not suppressed (≥50 copies/mL) or is unknown—because of the potential risk of HIV transmission (BIII). See Antiretroviral Management of Infants With In Utero, Intrapartum, or Breastfeeding Exposure to HIV .			
Operative Delivery With Forceps or a Vacuum Extractor	Per standard obstetric indications (BIII)	Avoid during pregnancy in the setting of viremia if possible (BIII).		
Delayed Cord Clamping	Per standard obstetric indications and care			

Table 9. Intrapartum Care and Recommended Interventions to Prevent Perinatal HIV Transmission Based on HIV RNA Levels at the Time of Delivery

HIV RNA at Time of Delivery Assessed at 36 Weeks Gestation or Within 4 Weeks Prior to Birth				
	<50 copies/mL and on ART With No Concerns About Adherence ^a	≥50 to ≤1,000 copies/mL	>1,000 copies/mL	Unknown HIV RNA ART Adherence Concerns ^a Not Receiving ART HIV Diagnosis in Labor
Use of Methergine for Postpartum Hemorrhage	Due to potential drug interactions with some ARV drugs, consider a patient's ARV regimen when treating postpartum bleeding caused by uterine atony (BIII). ^f			
Infant ARV Drugs and Infant Feeding	See Antiretroviral Management of Infants With In Utero, Intrapartum, or Breastfeeding Exposure to HIV, Table 11, Table 11.1, Postpartum HIV Management and Follow-Up , and Preventing HIV Transmission During Infant Feeding .			

Key: ART = antiretroviral therapy; ARV = antiretroviral; IUPC = intrauterine pressure catheter; IV = intravenous; ZDV = zidovudine

^a Assess ART adherence at every visit and upon presentation for birth.

^b Begin IV ZDV when patients present in labor or at least 3 hours before a cesarean birth using a 1-hour loading dose of ZDV at 2 mg/kg followed by a continuous ZDV infusion of 1 mg/kg for at least 2 hours (AII).

^c Scheduled cesarean birth performed solely for prevention of perinatal HIV transmission when ART is being taken and HIV RNA levels are ≤1,000 copies/mL is **not recommended** given the low rate of perinatal transmission in this group (AII). When HIV RNA levels are ≤1,000 copies/mL, if scheduled cesarean birth or induction is indicated, it should be performed at the standard time for obstetric indications (AII).

^d Provide individualized care. If HIV RNA is >1,000 copies/mL or unknown, evidence is insufficient to determine whether cesarean birth reduces the risk of perinatal HIV transmission when spontaneous labor or rupture of membranes have occurred. When cesarean birth was originally scheduled because of HIV and labor is ongoing, management must be individualized at the time of presentation (BII). In these circumstances, consultation with an expert in perinatal HIV (e.g., telephone consultation with the [National Perinatal HIV/AIDS Clinical Consultation Center](#) [1-888-448-8765]) may be helpful in rapidly developing an individualized plan.

^e In pregnancies when ART is being taken and suppressed viral load (HIV RNA <50 copies/mL) is achieved, duration of ruptured membranes is not associated with an increased risk of perinatal transmission and is not an indication for cesarean birth to prevent HIV transmission (BII).

^f Consider drug interactions with ART when treating postpartum bleeding caused by uterine atony. When a cytochrome P450 3A4 (CYP3A4) enzyme inhibitor (e.g., a protease inhibitor, cobicistat) is being taken, methergine should be used only if no alternative treatments for postpartum hemorrhage are available and the need for pharmacologic treatment outweighs the risks. If methergine is used, it should be administered at the lowest effective dose for the shortest possible duration (BIII). When a CYP3A4 enzyme inducer—such as nevirapine, efavirenz, or etravirine—is being taken, additional uterotonic agents may be needed because of the potential for decreased methergine levels and inadequate treatment effect (BIII).

Rating of Recommendations: A = Strong; B = Moderate; C = Optional

Rating of Evidence: I = One or more randomized trials with clinical outcomes and/or validated laboratory endpoints; II = One or more well-designed, nonrandomized trials or observational cohort studies with long-term clinical outcomes; III = Expert opinion

References

1. Myer L, Phillips TK, McIntyre JA, et al. HIV viraemia and mother-to-child transmission risk after antiretroviral therapy initiation in pregnancy in Cape Town, South Africa. *HIV Med.* 2017;18(2):80-88. Available at: <https://pubmed.ncbi.nlm.nih.gov/27353189>.
2. Townsend CL, Cortina-Borja M, Peckham CS, et al. Low rates of mother-to-child transmission of HIV following effective pregnancy interventions in the United Kingdom and Ireland, 2000–2006. *AIDS.* 2008;22(8):973-81. Available at: <https://pubmed.ncbi.nlm.nih.gov/18453857>.
3. Mandelbrot L, Tubiana R, Le Chenadec J, et al. No perinatal HIV-1 transmission from women with effective antiretroviral therapy starting before conception. *Clin Infect Dis.* 2015;61(11):1715-25. Available at: <https://pubmed.ncbi.nlm.nih.gov/26197844>.
4. Branson BM, Handsfield HH, Lampe MA, et al. Revised recommendations for HIV testing of adults, adolescents, and pregnant women in health-care settings. *MMWR Recomm Rep.* 2006;55(RR-14):1-17; quiz CE1-4. Available at: <https://pubmed.ncbi.nlm.nih.gov/16988643>.
5. American College of Obstetricians and Gynecologists. ACOG Committee opinion no. 765: avoidance of nonmedically indicated early-term deliveries and associated neonatal morbidities. *Obstet Gynecol.* 2019;133(3):e156-e163. Available at: <https://www.acog.org/clinical/clinical-guidance/committee-opinion/articles/2019/02/avoidance-of-nonmedically-indicated-early-term-deliveries-and-associated-neonatal-morbidities>.
6. Briand N, Warszawski J, Mandelbrot L, et al. Is intrapartum intravenous zidovudine for prevention of mother-to-child HIV-1 transmission still useful in the combination antiretroviral therapy era? *Clin Infect Dis.* 2013;57(6):903-14. Available at: <https://pubmed.ncbi.nlm.nih.gov/23728147>.
7. Chiappini E, Galli L, Giaquinto C, et al. Use of combination neonatal prophylaxis for the prevention of mother-to-child transmission of HIV infection in European high-risk infants. *AIDS.* 2013;27(6):991-1000. Available at: <https://pubmed.ncbi.nlm.nih.gov/23211776>.
8. Cotter AM, Brookfield KF, Duthely LM, et al. Duration of membrane rupture and risk of perinatal transmission of HIV-1 in the era of combination antiretroviral therapy. *Am J Obstet Gynecol.* 2012;207(6):482 e1-5. Available at: <https://pubmed.ncbi.nlm.nih.gov/23103331>.
9. Townsend CL, Byrne L, Cortina-Borja M, et al. Earlier initiation of ART and further decline in mother-to-child HIV transmission rates, 2000–2011. *AIDS.* 2014;28(7):1049-57. Available at: <https://pubmed.ncbi.nlm.nih.gov/24566097>.
10. Sibiude J, Le Chenadec J, Mandelbrot L, et al. Update of perinatal human immunodeficiency virus type 1 transmission in France: zero transmission for 5,482 mothers on continuous antiretroviral therapy from conception and with undetectable viral load at delivery. *Clin Infect Dis.* 2023;76(3):e590-e598. Available at: <https://pubmed.ncbi.nlm.nih.gov/36037040>.

11. Boucoiran I, Albert AYZ, Tulloch K, et al. Human immunodeficiency virus viral load rebound near delivery in previously suppressed, combination antiretroviral therapy-treated pregnant women. *Obstet Gynecol.* 2017;130(3):497-501. Available at: <https://pubmed.ncbi.nlm.nih.gov/28796673>.
12. Rodman JH, Flynn PM, Robbins B, et al. Systemic pharmacokinetics and cellular pharmacology of zidovudine in human immunodeficiency virus type 1-infected women and newborn infants. *J Infect Dis.* 1999;180(6):1844-50. Available at: <https://pubmed.ncbi.nlm.nih.gov/10558940>.
13. Bhadrakom C, Simonds RJ, Mei JV, et al. Oral zidovudine during labor to prevent perinatal HIV transmission, Bangkok: tolerance and zidovudine concentration in cord blood. Bangkok Collaborative Perinatal HIV Transmission Study Group. *AIDS.* 2000;14(5):509-16. Available at: <https://pubmed.ncbi.nlm.nih.gov/10780713>.
14. Mirochnick M, Rodman JH, Robbins BL, et al. Pharmacokinetics of oral zidovudine administered during labour: a preliminary study. *HIV Med.* 2007;8(7):451-6. Available at: <https://pubmed.ncbi.nlm.nih.gov/17760737>.
15. American College of Obstetricians and Gynecologists. ACOG Committee opinion no. 751: labor and delivery management of women with human immunodeficiency virus infection. *Obstet Gynecol.* 2018;132(3):e131-e137. Available at: <https://pubmed.ncbi.nlm.nih.gov/30134427>.
16. European Mode of Delivery Collaboration Elective caesarean-section versus vaginal delivery in prevention of vertical HIV-1 transmission: a randomised clinical trial. *Lancet.* 1999;353(9158):1035-9. Available at: <https://pubmed.ncbi.nlm.nih.gov/10199349>.
17. International Perinatal HIV Group, Andiman W, Bryson Y, et al. The mode of delivery and the risk of vertical transmission of human immunodeficiency virus type 1—a meta-analysis of 15 prospective cohort studies. *N Engl J Med.* 1999;340(13):977-87. Available at: <https://pubmed.ncbi.nlm.nih.gov/10099139>.
18. Garcia PM, Kalish LA, Pitt J, et al. Maternal levels of plasma human immunodeficiency virus type 1 RNA and the risk of perinatal transmission. Women and Infants Transmission Study Group. *N Engl J Med.* 1999;341(6):394-402. Available at: <https://pubmed.ncbi.nlm.nih.gov/10432324>.
19. Briand N, Jasseron C, Sibiude J, et al. Cesarean section for HIV-infected women in the combination antiretroviral therapies era, 2000–2010. *Am J Obstet Gynecol.* 2013;209(4):335 e1-335 e12. Available at: <https://pubmed.ncbi.nlm.nih.gov/23791563>.
20. Aho I, Kaijomaa M, Kivela P, et al. Most women living with HIV can deliver vaginally: national data from Finland 1993–2013. *PLoS One.* 2018;13(3):e0194370. Available at: <https://pubmed.ncbi.nlm.nih.gov/29566017>.
21. Kourtis AP, Ellington S, Pazol K, et al. Complications of cesarean deliveries among HIV-infected women in the United States. *AIDS.* 2014;28(17):2609-18. Available at: <https://pubmed.ncbi.nlm.nih.gov/25574961>.

22. American College of Obstetricians Gynecologists. ACOG practice bulletin no. 97: fetal lung maturity. *Obstet Gynecol.* 2008;112(3):717-26. Available at: <https://pubmed.ncbi.nlm.nih.gov/18757686>.
23. Tita AT, Landon MB, Spong CY, et al. Timing of elective repeat cesarean delivery at term and neonatal outcomes. *N Engl J Med.* 2009;360(2):111-20. Available at: <https://pubmed.ncbi.nlm.nih.gov/19129525>.
24. Kintu K, Malaba TR, Nakibuka J, et al. Dolutegravir versus efavirenz in women starting HIV therapy in late pregnancy (DolPHIN-2): an open-label, randomised controlled trial. *Lancet HIV.* 2020;7(5):e332-e339. Available at: <https://pubmed.ncbi.nlm.nih.gov/32386721>.
25. American College of Obstetricians and Gynecologists. Committee opinion no. 688: management of suboptimally dated pregnancies. *Obstet Gynecol.* 2017;129(3):e29-e32. Available at: <https://pubmed.ncbi.nlm.nih.gov/28225423>.
26. Livingston EG, Huo Y, Patel K, et al. Mode of delivery and infant respiratory morbidity among infants born to HIV-1-infected women. *Obstet Gynecol.* 2010;116(2 Pt 1):335-43. Available at: <https://pubmed.ncbi.nlm.nih.gov/20664394>.
27. Scott RK, Chakhtoura N, Burke MM, et al. Delivery after 40 weeks of gestation in pregnant women with well-controlled human immunodeficiency virus. *Obstet Gynecol.* 2017;130(3):502-510. Available at: <https://pubmed.ncbi.nlm.nih.gov/28796679>.
28. European Collaborative Study, Patel D, Cortina-Borja M, et al. Time to undetectable viral load after highly active antiretroviral therapy initiation among HIV-infected pregnant women. *Clin Infect Dis.* 2007;44(12):1647-56. Available at: <https://pubmed.ncbi.nlm.nih.gov/17516411>.
29. Read PJ, Mandalia S, Khan P, et al. When should HAART be initiated in pregnancy to achieve an undetectable HIV viral load by delivery? *AIDS.* 2012;26(9):1095-103. Available at: <https://pubmed.ncbi.nlm.nih.gov/22441248>.
30. Aziz N, Sokoloff A, Kornak J, et al. Time to viral load suppression in antiretroviral-naïve and -experienced HIV-infected pregnant women on highly active antiretroviral therapy: implications for pregnant women presenting late in gestation. *BJOG.* 2013;120(12):1534-47. Available at: <https://pubmed.ncbi.nlm.nih.gov/23924192>.
31. Alagaratnam J, Peters H, Francis K, et al. An observational study of initial HIV RNA decay following initiation of combination antiretroviral treatment during pregnancy. *AIDS Res Ther.* 2020;17(1):41. Available at: <https://pubmed.ncbi.nlm.nih.gov/32660502>.
32. Semprini AE, Castagna C, Ravizza M, et al. The incidence of complications after caesarean section in 156 HIV-positive women. *AIDS.* 1995;9(8):913-7. Available at: <https://pubmed.ncbi.nlm.nih.gov/7576327>.
33. Grubert TA, Reindell D, Kastner R, et al. Complications after caesarean section in HIV-1-infected women not taking antiretroviral treatment. *Lancet.* 1999;354(9190):1612-3. Available at: <https://pubmed.ncbi.nlm.nih.gov/10560681>.

34. Maiques-Montesinos V, Cervera-Sanchez J, Bellver-Pradas J, et al. Post-cesarean section morbidity in HIV-positive women. *Acta Obstet Gynecol Scand.* 1999;78(9):789-92. Available at: <https://pubmed.ncbi.nlm.nih.gov/10535342>.
35. Vimercati A, Greco P, Loverro G, et al. Maternal complications after caesarean section in HIV infected women. *Eur J Obstet Gynecol Reprod Biol.* 2000;90(1):73-6. Available at: <https://pubmed.ncbi.nlm.nih.gov/10767514>.
36. Rodriguez EJ, Spann C, Jamieson D, et al. Postoperative morbidity associated with cesarean delivery among human immunodeficiency virus-seropositive women. *Am J Obstet Gynecol.* 2001;184(6):1108-11. Available at: <https://pubmed.ncbi.nlm.nih.gov/11349171>.
37. Urbani G, de Vries MM, Cronje HS, et al. Complications associated with cesarean section in HIV-infected patients. *Int J Gynaecol Obstet.* 2001;74(1):9-15. Available at: <https://pubmed.ncbi.nlm.nih.gov/11430935>.
38. Read JS, Newell MK. Efficacy and safety of cesarean delivery for prevention of mother-to-child transmission of HIV-1. *Cochrane Database Syst Rev.* 2005;(4):CD005479. Available at: <https://pubmed.ncbi.nlm.nih.gov/16235405>.
39. Livingston EG, Huo Y, Patel K, et al. Complications and route of delivery in a large cohort study of HIV-1-infected women-IMPAACT P1025. *J Acquir Immune Defic Syndr.* 2016;73(1):74-82. Available at: <https://pubmed.ncbi.nlm.nih.gov/27082506>.
40. Watts DH, Lambert JS, Stiehm ER, et al. Complications according to mode of delivery among human immunodeficiency virus-infected women with CD4 lymphocyte counts of < or = 500/microL. *Am J Obstet Gynecol.* 2000;183(1):100-7. Available at: <https://pubmed.ncbi.nlm.nih.gov/10920316>.
41. Faucher P, Batallan A, Bastian H, et al. Management of pregnant women infected with HIV at Bichat Hospital between 1990 and 1998: analysis of 202 pregnancies. *Gynecol Obstet Fertil.* 2001;29(3):211-25. Available at: <https://pubmed.ncbi.nlm.nih.gov/11300046>.
42. Fiore S, Newell ML, Thorne C, et al. Higher rates of post-partum complications in HIV-infected than in uninfected women irrespective of mode of delivery. *AIDS.* 2004;18(6):933-8. Available at: <https://pubmed.ncbi.nlm.nih.gov/15060441>.
43. Marcollet A, Goffinet F, Firtion G, et al. Differences in postpartum morbidity in women who are infected with the human immunodeficiency virus after elective cesarean delivery, emergency cesarean delivery, or vaginal delivery. *Am J Obstet Gynecol.* 2002;186(4):784-9. Available at: <https://pubmed.ncbi.nlm.nih.gov/11967508>.
44. Read JS, Tuomala R, Kpamegan E, et al. Mode of delivery and postpartum morbidity among HIV-infected women: the women and infants transmission study. *J Acquir Immune Defic Syndr.* 2001;26(3):236-45. Available at: <https://pubmed.ncbi.nlm.nih.gov/11242196>.
45. Kennedy CE, Yeh PT, Pandey S, et al. Elective cesarean section for women living with HIV: a systematic review of risks and benefits. *AIDS.* 2017;31(11):1579-1591. Available at: <https://pubmed.ncbi.nlm.nih.gov/28481770>.

46. Silver RM, Landon MB, Rouse DJ, et al. Maternal morbidity associated with multiple repeat cesarean deliveries. *Obstet Gynecol.* 2006;107(6):1226-32. Available at: <https://pubmed.ncbi.nlm.nih.gov/16738145>.
47. Greenbaum S, Wainstock T, Dukler D, et al. Underlying mechanisms of retained placenta: evidence from a population based cohort study. *Eur J Obstet Gynecol Reprod Biol.* 2017;216:12-17. Available at: <https://pubmed.ncbi.nlm.nih.gov/28692888>.
48. International Perinatal HIV Group. Duration of ruptured membranes and vertical transmission of HIV-1: a meta-analysis from 15 prospective cohort studies. *AIDS.* 2001;15(3):357-68. Available at: <https://pubmed.ncbi.nlm.nih.gov/11273216>.
49. Jamieson DJ, Read JS, Kourtis AP, et al. Cesarean delivery for HIV-infected women: recommendations and controversies. *Am J Obstet Gynecol.* 2007;197(3 Suppl):S96-100. Available at: <https://pubmed.ncbi.nlm.nih.gov/17825656>.
50. Peters H, Byrne L, De Ruiter A, et al. Duration of ruptured membranes and mother-to-child HIV transmission: a prospective population-based surveillance study. *BJOG.* 2016;123(6):975-981. Available at: <https://pubmed.ncbi.nlm.nih.gov/26011825>.
51. Boyer PJ, Dillon M, Navaie M, et al. Factors predictive of maternal-fetal transmission of HIV-1. Preliminary analysis of zidovudine given during pregnancy and/or delivery. *JAMA.* 1994;271(24):1925-30. Available at: <https://pubmed.ncbi.nlm.nih.gov/7911164>.
52. Mandelbrot L, Mayaux MJ, Bongain A, et al. Obstetric factors and mother-to-child transmission of human immunodeficiency virus type 1: the French perinatal cohorts. SEROGEST French Pediatric HIV Infection Study Group. *Am J Obstet Gynecol.* 1996;175(3 Pt 1):661-7. Available at: <https://pubmed.ncbi.nlm.nih.gov/8828431>.
53. Mofenson LM, Lambert JS, Stiehler ER, et al. Risk factors for perinatal transmission of human immunodeficiency virus type 1 in women treated with zidovudine. Pediatric AIDS Clinical Trials Group Study 185 Team. *N Engl J Med.* 1999;341(6):385-93. Available at: <https://pubmed.ncbi.nlm.nih.gov/10432323>.
54. Shapiro DE, Sperling RS, Mandelbrot L, et al. Risk factors for perinatal human immunodeficiency virus transmission in patients receiving zidovudine prophylaxis. Pediatric AIDS Clinical Trials Group Protocol 076 Study Group. *Obstet Gynecol.* 1999;94(6):897-908. Available at: <https://pubmed.ncbi.nlm.nih.gov/10576173>.
55. Rabe H, Diaz-Rossello JL, Duley L, et al. Effect of timing of umbilical cord clamping and other strategies to influence placental transfusion at preterm birth on maternal and infant outcomes. *Cochrane Database Syst Rev.* 2012;8CD003248. Available at: <https://pubmed.ncbi.nlm.nih.gov/22895933>.
56. McDonald SJ, Middleton P, Dowswell T, et al. Effect of timing of umbilical cord clamping of term infants on maternal and neonatal outcomes. *Cochrane Database Syst Rev.* 2013;7CD004074. Available at: <https://pubmed.ncbi.nlm.nih.gov/23843134>.

57. American College of Obstetricians and Gynecologists. Committee opinion no. 684: delayed umbilical cord clamping after birth. *Obstet Gynecol.* 2017;129(1):e5-e10. Available at: <https://pubmed.ncbi.nlm.nih.gov/28002310>.
58. Pogliani L, Erba P, Nannini P, et al. Effects and safety of delayed versus early umbilical cord clamping in newborns of HIV-infected mothers. *J Matern Fetal Neonatal Med.* 2017;1-4. Available at: <https://pubmed.ncbi.nlm.nih.gov/28969479>.
59. Cambic CR, Avram MJ, Gupta DK, et al. Effect of ritonavir-induced cytochrome P450 3A4 inhibition on plasma fentanyl concentrations during patient-controlled epidural labor analgesia: a pharmacokinetic simulation. *Int J Obstet Anesth.* 2014;23(1):45-51. Available at: <https://pubmed.ncbi.nlm.nih.gov/24333052>.
60. Peters H, Francis K, Harding K, et al. Operative vaginal delivery and invasive procedures in pregnancy among women living with HIV. *Eur J Obstet Gynecol Reprod Biol.* 2017;210295-299. Available at: <https://pubmed.ncbi.nlm.nih.gov/28092853>.
61. Navarro J, Curran A, Burgos J, et al. Acute leg ischaemia in an HIV-infected patient receiving antiretroviral treatment. *Antivir Ther.* 2017;22(1):89-90. Available at: <https://pubmed.ncbi.nlm.nih.gov/27546463>.
62. Hostench-Junoy N, Ramirez-Montoya M, Arefai-Refai B, et al. Acute ischemia of lower extremities caused by ergotamine toxicity due to pharmacologic interaction with cobicistat in an HIV-positive patient. *Ann Vasc Surg.* 2022;80392 e1-392 e6. Available at: <https://pubmed.ncbi.nlm.nih.gov/34775015>.