immunodeficiency virus-exposed and -infected infants. *Antimicrob Agents Chemother* 2007; **51**: 4297–4302.

28. Hirt D, Ekouevi DK, Pruvost A *et al.* Plasma and intracellular tenofovir pharmacokinetics in the neonate (ANRS 12109 trial, step 2). *Antimicrob Agents Chemother* 2011; **55**: 2961–2967.

29. Hirt D, Urien S, Rey E *et al.* Population pharmacokinetics of emtricitabine in human immunodeficiency virus type 1-infected pregnant women and their neonates. *Antimicrob Agents Chemother* 2009; **53**: 1067–1073.

30. Jullien V, Urien S, Chappuy H *et al.* Abacavir pharmacokinetics in human immunodeficiency virus-infected children ranging in age from 1 month to 16 years: a population analysis. *J Clin Pharmacol* 2005; **45**: 257–264.

31. Mirochnick M, Siminski S, Fenton T *et al.* Nevirapine pharmacokinetics in pregnant women and in their infants after in utero exposure. *Pediatr Infect Dis J* 2001; **20**: 803–805.

32. Taylor GP, Lyall EG, Back D *et al.* Pharmacological implications of lengthened in-utero exposure to nevirapine. *Lancet* 2000; **355**: 2134–2135.

33. Benaboud S, Ekouevi DK, Urien S *et al.* Population pharmacokinetics of nevirapine in HIV-1-infected pregnant women and their neonates. *Antimicrob Agents Chemother* 2011; **55**: 331–337.

34. Mirochnick M, Dorenbaum A, Blanchard S *et al.* Predose infant nevirapine concentration with the two-dose intrapartum neonatal nevirapine regimen: association with timing of maternal intrapartum nevirapine dose. *J Acquir Immune Defic Syndr* 2003; **33**: 153–156.

35. Mirochnick M, Nielsen-Saines K, Pilotto JH *et al.* Nevirapine concentrations in newborns receiving an extended prophylactic regimen. *J Acquir Immune Defic Syndr* 2008; **47**: 334–337.

36. Mirochnick M, Fenton T, Gagnier P *et al.* Pharmacokinetics of nevirapine in human immunodeficiency virus type 1-infected pregnant women and their neonates. Pediatric AIDS Clinical Trials Group Protocol 250 Team. *J Infect Dis* 1998; **178**: 368–374.

37. Clarke DF, Acosta EP, Chain A *et al.* IMPAACT P1110. Raltegravir pharmacokinetics and safety in HIV-1 exposed neonates: dose finding study. *Conference on Retroviruses and Opportunistic Infections* February 2017. Seattle, WA, USA.

38. Chadwick EG, Capparelli EV, Yogev R *et al.* Pharmacokinetics, safety and efficacy of lopinavir/ritonavir in infants less than 6 months of age: 24 week results. *AIDS* 2008; **22**: 249–255.

39. Chadwick EG, Yogev R, Alvero CG *et al.* Long-term outcomes for HIV-infected infants less than 6 months of age at initiation of lopinavir/ritonavir combination antiretroviral therapy. *AIDS* 2011; **25**: 643–649.

40. Chadwick EG, Pinto J, Yogev R *et al.* Early initiation of lopinavir/ritonavir in infants less than 6 weeks of age: pharmacokinetics and 24-week safety and efficacy. *Pediatr Infect Dis J* 2009; **28**: 215–219.

41. Urien S, Firtion G, Anderson ST *et al.* Lopinavir/ritonavir population pharmacokinetics in neonates and infants. *Br J Clin Pharmacol* 2011; **71**: 956–960.

42. Simon A, Warszawski J, Kariyawasam D *et al.* Association of prenatal and postnatal exposure to lopinavir-ritonavir and adrenal dysfunction among uninfected infants of HIV-infected mothers. *JAMA* 2011; **306**: 70–78.

43. US Food and Drug Administration. *FDA drug safety communication: serious health problems seen in premature babies given Kaletra (lopinavir/ritonavir) oral solution*. 2011. Available at: www.fda.gov/Drugs/DrugSafety/ucm246002.htm (accessed October 2018).

44. Capparelli EV, Mirochnick M, Dankner WM *et al.* Pharmacokinetics and tolerance of zidovudine in preterm infants. *J Pediatr* 2003; **142**: 47–52.

45. Desfrere L, de Oliveira I, Goffinet F *et al.* Increased incidence of necrotizing enterocolitis in premature infants born to HIV-positive mothers. *AIDS* 2005; **19**: 1487–1493.

46. Wiznia A, Church J, Emmanuel P *et al.* Safety and efficacy of enfuvirtide for 48 weeks as part of an optimized antiretroviral regimen in pediatric human immunodeficiency virus 1-infected patients. *Pediatr Infect Dis J* 2007; **26**: 799–805.

47. Zhang X, Nieforth K, Lang JM *et al.* Pharmacokinetics of plasma enfuvirtide after subcutaneous administration to patients with human immunodeficiency virus: inverse Gaussian density absorption and 2-compartment disposition. *Clin Pharmacol Ther* 2002; **72**: 10–19.

48. Van Rompay KK, Otsyula MG, Marthas ML *et al.* Immediate zidovudine treatment protects simian immunodeficiency virus-infected newborn macaques against rapid onset of AIDS. *Antimicrob Agents Chemother* 1995; **39**: 125–131.

49. Tsai CC, Emau P, Follis KE *et al.* Effectiveness of postinoculation (R)-9-(2-phosphonylmethoxypropyl) adenine treatment for prevention of persistent simian immunodeficiency virus SIVmne infection depends critically on timing of initiation and duration of treatment. *J Virol* 1998; **72**: 4265–4273.

50. Bottiger D, Johansson NG, Samuelsson B *et al.* Prevention of simian immunodeficiency virus, SIVsm, or HIV-2 infection in cynomolgus monkeys by pre- and postexposure administration of BEA-005. *AIDS* 1997; **11**: 157–162.

51. Colgrove RC, Pitt J, Chung PH *et al.* Selective vertical transmission of HIV-1 antiretroviral resistance mutations. *AIDS* 1998; **12**: 2281–2288.

52. Kully C, Yerly S, Erb P *et al.* Codon 215 mutations in human immunodeficiency virus-infected pregnant women. Swiss Collaborative 'HIV and Pregnancy' Study. *J Infect Dis* 1999; **179**: 705–708.

53. Eastman PS, Shapiro DE, Coombs RW *et al.* Maternal viral genotypic zidovudine resistance and infrequent failure of zidovudine therapy to prevent perinatal transmission of human immunodeficiency virus type 1 in pediatric AIDS Clinical Trials Group Protocol 076. *J Infect Dis* 1998; **177**: 557–564.

54. Palumbo P, Holland B, Dobbs T *et al.* Antiretroviral resistance mutations among pregnant human immunodeficiency virus type 1-infected women and their newborns in the United States: vertical transmission and clades. *J Infect Dis* 2001; **184**: 1120–1126.

55. Masquelier B, Chaix ML, Burgard M *et al.* Zidovudine genotypic resistance in HIV-1-infected newborns in the French perinatal cohort. *J Acquir Immune Defic Syndr* 2001; **27**: 99–104.

56. Welles SL, Pitt J, Colgrove R *et al.* HIV-1 genotypic zidovudine drug resistance and the risk of maternal–infant transmission in the women and infants transmission study. The Women and Infants Transmission Study Group. *AIDS* 2000; **14**: 263–271.

57. Public Health England. *UK immunisation schedule: the green book, chapter 11*. 2016. Available at: www.gov.uk/government/publications/immunisation-schedule-the-green-book-chapter-11 (accessed October 2018).

58. Bispo S, Chikhungu L, Rollins N *et al.* Postnatal HIV transmission in breastfed infants of HIV-infected women on ART: a systematic review and meta-analysis. *J Int AIDS Soc* 2017; **20**: 1–8.

59. Taha T, Flynn P, Cababasay MP *et al.* Maternal triple antiretrovirals (mART) and infant nevirapine (iNVP) prophylaxis for the prevention of mother-to-child transmission (MTCT) of HIV during breastfeeding (BF). *International AIDS Conference*. July 2016. Durban, South Africa.

60. Becquet R, Bland R, Leroy V *et al.* Duration, pattern of breastfeeding and postnatal transmission of HIV: pooled analysis of individual data from West and South African cohorts. *PLoS One* 2009; **4**: e7397.

61. Rollins N, Mahy M, Becquet R *et al.* Estimates of peripartum and postnatal mother-to-child transmission probabilities of HIV for use in Spectrum and other population-based models. *Sex Transm Infect* 2012; **88 Suppl 2**: i44–51.

62. World Health Organization. *Updates on HIV and infant feeding. Guideline*. 2016. Available at: www.who.int/maternal_child_adolescent/documents/hiv-infant-feeding-2016/en (accessed OCtober 2018).

63. Waitt C, Low N, Van de Perre P *et al.* Does U=U for breastfeeding mothers and infants? Breastfeeding by mothers on effective treatment for HIV infection in high-income settings. *Lancet HIV* 2018; 5: e531–e536.

64. Tariq S, Elford J, Tookey P *et al.* 'It pains me because as a woman you have to breastfeed your baby': decision-making about infant feeding among African women living with HIV in the UK. *Sex Transm Infect* 2016; **92**: 331–336.

65. National AIDS Trust. *Policy briefing: access to formula milk for mothers living with HIV in the UK*. 2017. Available at: www.nat.org.uk/sites/default/files/publications/Access to Formula Milk Briefing FINAL.pdf (accessed August 2018).

66. Karpf B, Smith G, Spinks R. Affording formula: HIV-positive women's experiences of the financial strain of infant formula feeding in the UK. Abstract O27. *HIV Med* 2017; **18 Suppl S1**: 3–13.

67. Williams E, Barnes L, Rowsell C *et al.* The impact of financial support for replacement infant feeding on postpartum attendance and outcomes for women with HIV. Abstract P139. *HIV Med* 2015; **15 (Suppl 3)**: 17–159.

68. Hegazi A, Dwyer E, Barbour A *et al.* Genital tract infections in HIV-infected pregnant women in south west London. Abstract O29. *HIV Med* 2015; **16 Suppl 2**: 1–11.

69. Rains CP, Bryson HM, Fitton A. Cabergoline. A review of its pharmacological properties and therapeutic potential in the treatment of hyperprolactinaemia and inhibition of lactation. *Drugs* 1995; **49**: 255–279.

70. Jori MC, Dubini A. Cabergoline. In: Caraceni T, Nappi G, eds. *Focus on Parkinson's Disease*. Milan, Masson, 1991: 221–226.

71. Di Salle E, Ornati G, Giudici D, Britanico G. Prolactin lowering effect of a new ergoline derivative, FCE 21336, in the rat: a comparison with bromocriptine. *Acta Endocrinol* 1983; **103 Suppl 256**: 265.

72. Pontiroli AE, Cammelli L, Baroldi P, Pozza G. Inhibition of basal and metoclopramide-induced prolactin release by cabergoline, an extremely long-acting dopaminergic drug. *J Clin Endocrinol Metab* 1987; **65**: 1057–1059.

73. Morissette M, Goulet M, Grondin R *et al.* Associative and limbic regions of monkey striatum express high levels of dopamine D3 receptors: effects of MPTP and dopamine agonist replacement therapies. *Eur J Neurosci* 1998; **10**: 2565–2573.

74. Roy M, Thibaudeau R, Ferreira E *et al.* Evaluation of cabergoline for lactation suppression in women living with HIV. *7th International Workshop on HIV and Women*. February 2017. Seattle, WA, USA.

75. Johnson G, Levison J, Malek J. Should providers discuss breastfeeding with women living with HIV in high-income countries? An ethical analysis. *Clin Infect Dis* 2016; **63**: 1368–1372.

76. Nagot N, Kankasa C, Tumwine JK *et al.* Extended pre-exposure prophylaxis with lopinavir-ritonavir versus lamivudine to prevent HIV-1 transmission through breastfeeding up to 50 weeks in infants in Africa (ANRS 12174): a randomised controlled trial. *Lancet* 2016; **387**: 566–573.

77. Van de Perre P, Kankasa C, Nagot N *et al.* Pre-exposure prophylaxis for infants exposed to HIV through breast feeding. *BMJ* 2017; **356**: j1053.

78. Burgard M, Blanche S, Jasseron C *et al.* Performance of HIV-1 DNA or HIV-1 RNA tests for early diagnosis of perinatal HIV-1 infection during anti-retroviral prophylaxis. *J Pediatr* 2012; **160**: 60–66.e61.

79. Burgard M, Blanche S, Mayaux MJ *et al.* Impact of neonatal prophylaxis on early diagnosis in newborns. *Conference on Retroviruses and Opportunistic Infections*. February 2003. San Francisco, CA, USA.

80. Hindocha A, Foster C, Randell P *et al.* Optimal timing for serological screening for HIV-exposed uninfected infants: the later the better? *Annual Conference of the British HIV Association (BHIVA)*. April 2019. Bournemouth, UK.

81. Nastouli E, Atkins M, Seery P *et al.* False-positive HIV antibody results with ultrasensitive serological assays in uninfected infants born to mothers with HIV. *AIDS* 2007; **21**: 1222–1223.

82. Frange P, Burgard M, Lachassinne E *et al.* Late postnatal HIV infection in children born to HIV-1-infected mothers in a high-income country. *AIDS* 2010; **24**: 1771–1776.

83. Public Health England. *Hepatitis B: the green book, chapter 18*. 2017. Available at: www.gov.uk/government/publications/hepatitis-b-the-green-book-chapter-18 (accessed October 2018).

84. Wiseman E, Fraser MA, Holden S *et al.* Perinatal transmission of hepatitis B virus: an Australian experience. *Med J Aust* 2009; **190**: 489–492.

85. Evans C, Jones CE, Prendergast AJ. HIV-exposed, uninfected infants: new global challenges in the era of paediatric HIV elimination. *Lancet Infect Dis* 2016; **16**: e92-e107.

86. Afran L, Garcia Knight M, Nduati E *et al.* HIV-exposed uninfected children: a growing population with a vulnerable immune system? *Clin Exp Immunol* 2014; **176**: 11–22.

87. Taron-Brocard C, Le Chenadec J, Faye A *et al.* Increased risk of serious bacterial infections due to maternal immunosuppression in HIV-exposed uninfected infants in a European country. *Clin Infect Dis* 2014; **59**: 1332–1345.

88. Epalza C, Goetghebuer T, Hainaut M *et al.* High incidence of invasive group B streptococcal infections in HIV-exposed uninfected infants. *Pediatrics* 2010; **126**: e631-638.

89. Adler C, Haelterman E, Barlow P *et al.* Severe infections in HIV-exposed uninfected infants born in a European country. *PLoS One* 2015; **10**: e0135375.

90. Macdonald EM, Ng R, Yudin MH *et al.* Postpartum maternal and neonatal hospitalizations among women with HIV: a population-based study. *AIDS Res Hum Retroviruses* 2015; **31**: 967–972.

10. Postpartum management of women

10.1 Antiretroviral therapy

10.1.1	All women are recommended to continue cART postpartum.	1A

It is recommended that all women remain on ART postpartum [1,2], although ultimately this is a woman's choice. For women who start on ART in pregnancy there may be an opportunity to simplify regimens, for example to once daily co-formulated regimens, or switch to newer regimens. Additionally, women who started darunavir/r bd in pregnancy should be switched to daily dosing unless there is evidence of significant genotypic resistance (see also section 6) [3]. Viral rebound has been demonstrated in women living with HIV postpartum, with the risk greater than in non-pregnant women with HIV [4]. Adherence can decline in the postnatal period as a result of concerns about side effects, the lifelong nature of treatment, fear of HIV status being shared and fear of HIV-related stigma within the community and in clinics [5-7]. It is important to be aware of the potential for compromised adherence, and to provide appropriate support including peer mentoring, which has been shown to improve adherence [6].

10.2 Support services

10.2.1	Women should have their support needs assessed postpartum and be referred to appropriate services in the Trust, community and/or voluntary groups without delay.	1D

The support required by each woman and the support services available at each HIV service will vary considerably and should be individualised for each woman. Support required may include child care, help with housing, access to food, peer mentoring and legal and advocacy services. The HIV MDT should work with local peer-led and voluntary organisations to tailor support to each woman. Referrals to partner organisations should have commenced at first presentation in pregnancy (see section 4) and be continued in the postnatal period. For women with drug or alcohol issues, continued support should be offered on an on-going basis. The minority of women who experience pregnancy loss may require additional support through HIV peer mentoring or support services such as the Miscarriage Association (www.miscarriageassociation.org.uk/) or Sands (www.sands.org.uk/).

10.3 Postnatal follow-up of women

10.3.1	All women should be reviewed in the postnatal period by a named member of the MDT within 4–6 weeks.	1C

It is important to be aware that there may be issues with retention in care after pregnancy, with disengagement of care rates estimated at 12% in both the NSHPC and the Swiss Cohort, and caring responsibilities identified as a barrier to accessing care [8-10]. It is essential to see all women in the postpartum period for follow-up of both medical and social issues, and to promote linkage back to general HIV care. We recommend that all women receive an appointment to see a named member of the HIV MDT and adequate ART until this appointment prior to discharge after delivery. This is particularly important for women newly diagnosed with HIV in pregnancy. The infant's postnatal 6-week check provides a good opportunity to also see the woman. A full assessment of the birth experience is important to provide constructive feedback to the MDT and to ensure pregnancy pathways are working well. This will also allow women to receive support for any difficult experiences they may have had. Should a woman miss her first postnatal appointment, every effort should be made by the HIV MDT to contact her and address any barriers in order to re-establish care.