Imported food risk advice

Human immunodeficiency virus in human milk and human milk products

Context of this risk advice

- Human milk means expressed milk collected from lactating women to be fed to infants that are not the biological infants of the women supplying the milk.
- Human milk products means products derived from human milk that have been specially formulated to meet the specific nutritional needs of infants such as fortifiers and formula.
- The level of risk for this hazard in human milk and human milk products was determined assuming that the most vulnerable category of infants (preterm infants in hospital neonatal intensive care units) would be receiving the products.

Nature of the hazard

Human immunodeficiency virus (HIV) belongs to the *Retroviridae* family of viruses. There are two immunologically distinct forms of HIV: HIV type 1 (HIV-1) and HIV type 2 (HIV-2). HIV is an enveloped virus with a RNA genome and cone or cylindrical shaped core. Retrovirus virions are sensitive to heat, detergent and formaldehyde (Freed and Martin 2013; Goff 2013). Like all viruses, HIV can multiply in living host cells but cannot replicate in food (Codex 2012). HIV infection causes acquired immunodeficiency syndrome (AIDS), a potentially life threatening illness with chronic sequelae.

Transmission

HIV can be transmitted sexually, parenterally[1] or via mother-to-infant transmission (predominantly occurs during delivery or through human milk). Only certain body fluids transmit the virus, and infection can only occur if these fluids come into contact with a mucous membrane, damaged tissue or go directly into the bloodstream (CDC 2018; Cock et al. 2000; Kuritzkes and Koup 2013; Milligan and Overbaugh 2014). The transmission rate through breastfeeding is relatively low as the mammary epithelium minimises HIV entry into human milk, with HIV levels in human milk at least 100-fold lower than in the circulation. Also, once in the infant the virus has to cross the mucosal surface (e.g. oral or intestinal) which is protected by an overlying epithelial barrier, and then infect susceptible cells (Kutty 2012; Milligan and Overbaugh 2014; Tobin and Aldrovandi 2013).

Despite these barriers to virus transmission, HIV can be transmitted through human milk to infants. In chronically HIV infected women not undergoing antiretroviral therapy (ART) the rate of transmission of HIV to infants through human milk is 10-20% (Aldrovandi and Kuhn 2010). This transmission rate can be reduced to 1-3% when the mother receives ART (Bulterys et al. 2010). However, the transmission rate is higher in women with a recent HIV infection. A study by Liang et al. (2009) reported a 36% transmission rate through human milk from women infected postnatally. Studies have demonstrated that HIV negative infants can become infected with HIV after being breastfed by a HIV positive mother (Lunney et al. 2010; Manji et al. 2016).

HIV has been detected in human milk, with 54-89% of HIV positive mothers having detectable levels of HIV in their milk (Henderson et al. 2004; Rousseau et al. 2003; Thea et al. 2006). HIV seroprevalence in potential human milk donors ranges from 0.1-0.4% (Cohen et al. 2010; Kupek and Savi 2017).

[1] Route does not involve the gastrointestinal tract, e.g. intravenous

Disease severity

HIV is a severe hazard as it causes potentially life threatening illness with chronic sequelae. In children, 20-30% of HIV infected infants rapidly develop AIDS or die in the first year of life, while the remainder deteriorate at rates similar to adults (10-year median progression to AIDS or death). Treatment of HIV infants with ART can reduce mortality and disease progression by approximately 75% (Tobin and Aldrovandi 2013). Patients with AIDS have a severely depleted immune system and are much more susceptible to other infections or infection-related cancers. Without treatment people with AIDS typically survive about three years (CDC 2018). HIV positive individuals also have a higher risk for developing cardiovascular disease, metabolic syndrome and particular malignancies, and can develop HIV-associated neurocognitive disorders and decreased bone mineral density (Yoshimura 2017).

Infectivity

HIV is moderately infectious, with transmission associated with human milk with higher viral loads (Ndirangu et al. 2012; Rousseau et al. 2003). For every ten-fold increase in HIV-1 RNA levels in human milk there is an associated two-fold increase in risk of transmission to the infant (Bulterys et al. 2010; Lehman and Farquhar 2007). There is an increase in viral shedding at birth (to a median 2.6 – 2.8 $\log_{10}$ RNA copies/ml) which decreases to an ongoing median level of 2 $\log_{10}$ RNA copies/ml in human milk (Humphrey et al. 2010; Rousseau et al. 2003). Also, for mothers infected postnatally there is a peak in viral load during the first 30 days after HIV infection (median 4.3 x $\log_{10}$ RNA copies/ml in human milk) (Humphrey et al. 2010). Local breast inflammation from mastitis or breast abscess has also been associated with increased human milk HIV load (Bulterys et al. 2010; Lunney et al. 2010). Some women only intermittently shed the virus, while others shed at a very low level (Aldrovandi and Kuhn 2010; Rousseau et al. 2003).

Risk mitigation

Controls are needed to minimise contamination of human milk with HIV. Pasteurisation of the milk is a primary control, however donor screening to exclude HIV seropositive individuals can reduce the viral load in the donor milk to be pasteurised. A study by Orloff et al. (1993) showed that Holder pasteurisation (62.5^{o}C, 30 min) of human milk artificially inoculated with HIV or HIV infected cells led to a 5-6 log reduction in viral load. A body of evidence from well conducted case-control or cohort studies has confirmed that Holder pasteurisation inactivates HIV (Baumer 2004). International human milk banks, including those in Australia, routinely perform Holder pasteurisation on human milk and screen donors for HIV-1 and HIV-2 to ensure the microbiological safety of donor human milk (Bharadva et al. 2014; Hartmann et al. 2007; HMBANA 2015; UKAMB 2003).

Evaluation of uncertainty

There is uncertainty around the infectivity of HIV in human milk and the viral load required for transmission.

Pooling of human milk from multiple donors is common practice amongst many human milk banks and would dilute the viral load from a single donor, however some milk banks only pool milk from individual donors (Haiden and Ziegler 2016). The Australian Red Cross milk bank pasteurises human milk in single donor batches (Australian Red Cross 2018).

Risk characterisation

There is evidence that HIV can be present in human milk and can be transmitted to infants via human milk. HIV is moderately infectious, with higher viral loads in the human milk associated with transmission. There is a medium likelihood of exposure as although a high proportion of HIV seropositive mothers shed the virus in their milk, there is a very low prevalence of HIV amongst potential donors. HIV causes severe disease which can be fatal. HIV in imported human milk and human milk products presents a potential medium or high risk to public health and safety.

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