

# How and when maternal viral infections can be a contraindication to breastfeeding: a narrative review

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## Abstract

The positive effects of breastfeeding on the health of infants and mothers are largely established. It is generally recommended that a mother should breastfeed exclusively for at least 6 months. Sometimes, however, this is not possible owing to a maternal disease. The purpose of this review was to understand the possibility and the mechanisms of transmission of viral agents to breastfed infants when the mother is infected and to evaluate whether and when breastfeeding can be harmful and, therefore, a real contraindication exists.

In order to produce this narrative review, an extensive literature search was conducted on PubMed. The query included “breastfeeding”, “mother to child” and “transmission” as keywords and a filter for publication date – from 2014 to 2019. Additionally, the bibliography of the selected articles was reviewed to identify further pertinent studies, which were then included.

Only the following maternal infections were found to represent an absolute contraindication to breastfeeding: Human Immunodeficiency Virus and Human T-Lymphotropic Virus, because of their possible transmission via milk, and Ebola Virus, in which transmission to the child seems to be linked more to the close proximity relationship itself than the presence of the virus in human milk.

Other viruses – Herpes Simplex Virus, Varicella Zoster Virus and Hepatitis C Virus – constituted a source of contraindication only in specific high-risk circumstances.

To date, for the remaining viruses reviewed in this paper – including Severe Acute Respiratory Syndrome Coronavirus 2, no evidence exists that warrants contraindication of breastfeeding.

Health professionals who deal with pregnant and puerperal women, such as obstetricians, pediatricians or family medicine doctors, must be aware of these particularities in the management of breastfeeding women in order to provide correct information and better take care of their patients and their respective infants.

## Keywords

Breastfeeding, virus, transmission, newborn, human milk, prevention.

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## Introduction

Breast milk is considered the best source of nutrition for infants due to its association with enhanced maternal and infant health.

Regarding the benefits for the infant, it has been demonstrated that breastfeeding decreases the incidence of respiratory tract infections, gastrointestinal tract infections, atopic diseases, excess weight and obesity, and type 1 and 2 diabetes mellitus. Breastfeeding has also been found to be linked to better neurodevelopmental outcomes [1, 2].

The breastfeeding mother experiences advantages such as lactational amenorrhea (which leads to greater birth spacing), reduced post-pregnancy weight retention, and reduced risk of type 2 diabetes mellitus, cardiovascular disease and breast and ovarian cancer [1-4].

The American Academy of Pediatrics (AAP) and the World Health Organization (WHO) recommend exclusive breastfeeding for the first 6 months of the infants' life, followed by the introduction of complementary foods and maintained breastfeeding. They add that breastfeeding can be continued for 1-2 years or as long as the mother and infant wish [5, 6].

Although few and limited, some situations – e.g. particular maternal or infant illnesses and/or specific maternal medications – warrant a contraindication to breastfeeding. Health professionals should be aware of them to provide correct information and better take care of their patients. This narrative review will focus on several maternal viral infections as possible contraindications to breastfeeding.

This review aimed to comprehend the mechanisms by which some viruses can be transmitted to breastfed infants and be harmful to them, and to assess the risk and the eventual contraindication to breastfeeding.

## Methods

In order to review the existing literature on the topic of breastfeeding as a means of transmission of viral disease, a search was conducted on PubMed using the following query: (breastfeeding OR breast-feeding OR breast feeding OR breastfed OR breastmilk OR nursing) AND (mother-to-child OR mother to child OR maternal-child OR maternal child OR vertical OR perinatal) AND (infection OR infected OR transmission OR transmitted OR transmittal OR contagion). The resulting articles – written in English, Portuguese or Spanish and published from 2014 to 2019 – were read and the relevant ones were included in the study. Later, upon reviewing the selected papers' bibliography, additional pertinent articles were found and selected to be part of the review. Additionally, some epidemiologic data and recommendations from the WHO and the Centers for Disease Control and Prevention (CDC) were utilized.

## Results

After an extensive review of current literature, it was found that three maternal viral infections contraindicate breastfeeding in an unequivocal way: Human Immunodeficiency Virus (HIV), Human T-Lymphotropic Virus (HTLV) and Ebola Virus (EBOV).

HIV and HTLV can be transmitted from mother to child via milk and consequently represent absolute contraindications [5, 7-10]. Maternal Ebola Virus disease is a contraindication, as the mother-infant proximity itself represents a high risk of viral transmission [11, 12].

In specific and selected circumstances, also Herpes Simplex Virus (HSV), Varicella Zoster Virus (VZV) and Hepatitis C Virus (HCV) can

contraindicate breastfeeding: HSV and herpes zoster, when breast shows lesions, varicella, if it has developed from 5 days prior to delivery up to 2 days after delivery, HCV in the case of bleeding or cracked nipples [5, 7, 13-21].

When it comes to the remaining viruses discussed in this review, most evidence points to the safety of breastfeeding or no evidence exists to support its contraindication.

**Tab. 1** recapitulates each of the reviewed viruses' acceptability or contraindication regarding the practice of breastfeeding.

## Discussion

### *Cytomegalovirus*

Cytomegalovirus (CMV) is a DNA virus and is part of the Herpesviridae family [22, 23]. Transmission mostly results in latent CMV infection, which is asymptomatic. CMV can also present as a mononucleosis-like syndrome – with constitutional symptoms such as fever and myalgias [23, 24].

Studies have estimated a global 83% CMV seroprevalence and 66% in Europe [25]. CMV is very prevalent in the Portuguese population. A nationwide study estimates 77% seropositivity [26].

CMV can be transmitted from mother to child in different ways: *in utero* transmission – which can lead to congenital CMV infection, intrapartum transmission and postnatal transmission, that can occur through contact with infectious bodily fluids (saliva, blood, human milk) [22, 27].

In healthy, full-term infants, postnatal CMV infection is without consequence [22, 23, 27]. To date, there is no evidence that points to the need to prohibit breastfeeding for CMV infected mothers of healthy full-term infants [5, 7].

In preterm low birth weight infants, postnatal CMV disease can be symptomatic and manifest as a sepsis-like syndrome, respiratory distress, hepatosplenomegaly [23, 27, 28]. However, these manifestations are not usually associated with long-term sequelae [29, 30] and, consequently, the AAP states that the benefits of breastfeeding preterm infants far outweigh the risk of postnatal symptomatic CMV infection and continues to advocate for breastfeeding [5].

It is important to note that asymptomatic seropositive mothers can also transmit CMV. Up to 95% of healthy seropositive women have CMV reactivation during lactation, with viral DNA shedding in breast milk. This is particularly important in the case of preterm infants since they are most at risk of symptomatic disease [23, 28, 31].

**Table 1.** Recommendations on breastfeeding during maternal viral infections addressed in this review.

<b>CMV</b>	Breastfeeding is accepted [5, 7].
<b>HSV</b>	Breastfeeding is accepted, except if there are herpetic lesions on the breasts [5, 7, 13-16].
<b>VZV</b>	Varicella – breastfeeding is contraindicated if active varicella develops within 5 days prior to 2 days after delivery [5, 7, 21]. Herpes zoster – breastfeeding is accepted, except if there are active lesions on the breasts [7, 17].
<b>HIV-1</b>	Breastfeeding is contraindicated in industrialized countries [5, 7-10].
<b>HTLV-1</b>	Breastfeeding is contraindicated [5, 7].
<b>HCV</b>	Breastfeeding is accepted, except if the mother's nipples are bleeding or cracked [7, 18-20].
<b>HBV</b>	Breastfeeding is accepted if HBV vaccine and immunoglobulin are administered at birth [20, 59].
<b>HAV</b>	Breastfeeding is accepted if appropriate hygiene is ensured. HAV vaccine and immunoglobulin can be administered at birth [11, 20].
<b>HDV</b>	Breastfeeding is accepted if HBV vaccine and immunoglobulin are administered at birth [11].
<b>HEV</b>	Breastfeeding is accepted in asymptomatic mothers. Acutely ill mothers should be discouraged from breastfeeding [11, 66, 67].
<b>EBOV</b>	Breastfeeding is contraindicated. Mother-child separation and airborne and contact precautions are recommended [11, 12].
<b>Influenza</b>	Breastfeeding is accepted [11, 76, 77].
<b>Rubella</b>	Breastfeeding is accepted [11].
<b>ZIKV</b>	Breastfeeding is accepted [83, 84].
<b>DENV</b>	Breastfeeding is accepted [11, 90].
<b>SARS-CoV-2</b>	Breastfeeding is accepted and appropriate hygiene must be ensured [91-93, 100-107].

CMV: Cytomegalovirus; HSV: Herpes Simplex Virus; VZV: Varicella Zoster Virus; HIV-1: Human Immunodeficiency Virus 1; HTLV-1: Human T-Lymphotropic Virus 1; HCV: Hepatitis C Virus; HBV: Hepatitis B Virus; HAV: Hepatitis A Virus; HDV: Hepatitis D Virus; HEV: Hepatitis E Virus; EBOV: Ebola Virus; ZIKV: Zika Virus; DENV: Dengue Virus; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2.

Pasteurization or freezing of breast milk can be used to lessen the risk of neonatal infection, which is vital in preterm infants. Pasteurization can eliminate viral CMV load, although it lessens some of the nutritional and immunologic properties of breast milk. Freezing of breast milk does not affect its properties; however, most studies show that it only reduces the viral load and does not eliminate it [23, 28, 31-35]. It is the physician's role to weigh the risks and benefits of each option and discuss them with the mother to arrive at a joined decision regarding feeding modality.

### *Herpes Simplex Virus*

HSV is a DNA virus and is part of the Herpesviridae family. It includes two types: HSV-1, which causes mostly orolabial herpetic lesions, and HSV-2, which is responsible for most of the genital herpetic infections [13, 16].

This virus is highly prevalent worldwide. The WHO estimates that 3.7 billion people under 50 years (67%) are HSV-1 infected and 417 million people from 15-49 years (11%) are HSV-2 infected [36].

HSV can be transmitted from mother to child *in utero*, intrapartum (by exposure to genital lesions), and postpartum (by direct contact) [13].

Neonatal herpes can occur as a result of infection by HSV-1 or HSV-2, mostly through intrapartum transmission [13, 15]. This entity can have different clinical presentations, namely disseminated disease, central nervous system disease, disease limited to the skin, eyes and/or mouth [14, 15].

There is no reason to contraindicate breastfeeding, except if there are herpetic lesions on the breasts [5, 7, 13-16]. In this case, breastfeeding is temporarily contraindicated, and some authors state that the infant can be fed with expressed breast milk from either the affected or unaffected breast [5, 7]. Instead, the CDC advises against providing the infant with expressed breast milk originating from the affected breast – because of the risk of contamination via contact with herpetic lesions [16]. Additionally, if only one breast is affected, the mother can breastfeed from the unaffected breast [7, 16]. It is also recommended that mothers who have active herpetic lesions anywhere on the body should frequently wash their hands [13-16]. Direct breastfeeding can be resumed when all active lesions have resolved [7, 16].

### *Varicella Zoster Virus*

VZV is a DNA virus and is part of the Herpesviridae family. When the primary infection occurs, it manifests as varicella/chickenpox, a highly contagious and pruritic vesicular rash usually seen in children [37, 38]. The virus then becomes latent in ganglionic neurons, and can reactivate decades later, presenting as herpes zoster/shingles, a typically unilateral and dermatome circumscribed painful rash [37-39].

The WHO states that the annual incidence of varicella is equivalent to each year's birth cohort for any developed country and the European Centre for Disease Prevention and Control (ECDC) claims the same regarding Europe. Additionally, the ECDC asserts that most people become CMV seropositive by 15-19 years of age, and the WHO estimates the lifetime risk of herpes zoster incidence to be 20-35% [40, 41].

A Portuguese nationwide study has estimated the prevalence of VZV seropositivity to be 86.8%. This study also showed that the infection occurs predominantly in children, with 41.3% already infected by age 2-3 years and doubling this number by age 6-7 years (to 83.6%) [26]. These numbers show the actual incidence of infection and not the effects of vaccine coverage because in Portugal the VZV vaccine is not routinely administered – as it is not part of the national program [42].

Varicella is very contagious, and it is transmitted through direct contact with lesions or by aerosols [38, 39, 43]. Maternal varicella may be transmitted to the infant *in utero* – which can lead to neonatal varicella or congenital varicella syndrome burdened by possible severe presentation and long-term sequelae [38, 43], intrapartum and postpartum [21]. Maternal herpes zoster is rarely associated with *in-utero* VZV transmission [44], but postnatal transmission can occur through contact with open skin lesions [39].

The AAP recommends temporary mother-child separation if the mother develops varicella from 5 days prior to delivery up to 2 days after delivery and expressed milk feeding [5, 7, 21]. The infant should receive VZV immunoglobulin [45], and direct breastfeeding can be resumed after the contagious phase has passed [7].

A mother with herpes zoster can breastfeed, except if there are lesions on the breast. In this case, the lesions should be covered to prevent direct contact with the baby and, if only one breast is affected, the mother can breastfeed from the

unaffected breast [7, 17]. Some authors state that the infant can be fed with expressed breast milk from the affected breast [7], while the CDC strongly discourages this practice [17].

### *Human Immunodeficiency Virus 1*

HIV is a retrovirus and can be divided into HIV-1, the most relevant one, and HIV-2. This virus targets CD4+ T cells, leading to a gradual decline in their number during the course of infection. Ultimately, the disease culminates in a state of immunodeficiency – acquired immune deficiency syndrome (AIDS), in which increased incidence of infection and cancer occurs [46, 47].

The WHO estimates that there are 37.9 million people HIV infected globally [48] and 41,000 HIV infected people reside in Portugal [49]. The estimated rate of new diagnoses in Portugal in 2017 was 10.3 per 100,000 [50].

Mother to child transmission of HIV-1 can occur *in utero*, intrapartum and postnatally also through breastfeeding [46, 47].

In industrialized countries, such as Portugal, where replacement feeding is accessible and safe, breastfeeding is contraindicated and mothers are advised to practice exclusive formula feeding [5, 7-10].

When it comes to developing nations, especially those with high HIV prevalence, the WHO recommends HIV infected mothers to breastfeed for at least 12 months. Exclusive breastfeeding should be practiced in the first 6 months of the infant's life and, subsequently, complementary foods are to be introduced while still breastfeeding [51]. This recommendation is based on the rationale that, in these countries, the advantages of breastfeeding may outweigh the risk of HIV transmission, since non-breastfeeding infants suffer from increased mortality due to undernutrition and infectious disease such as diarrhea and pneumonia [5, 51].

### *Human T-Lymphotropic Virus 1*

HTLV is a retrovirus divided into four subtypes: HTLV-1, HTLV-2, HTLV-3 and HTLV-4. Of these subtypes, HTLV-1 has the highest clinical significance. Most individuals with HTLV-1 infection are asymptomatic, nonetheless still contagious, but infection can result in adult T cell leukemia or lymphoma and tropical spastic paraparesis/HTLV-1 associated myelopathy [52, 53].

A report by the ECDC estimates the number of people living with HTLV-1 infection worldwide to be at least 5-10 million. HTLV-1 is present worldwide with clusters of high endemicity, mainly in southern Japan and the Caribbean region. Portugal was deemed to be a “low HTLV-1 prevalence or no HTLV-1 infection” country, based on a study by Taylor et al., which reported a seroprevalence of 1.3 per 10,000 pregnant women [54, 55].

This virus can be transmitted from mother to child, mainly through breastfeeding [52, 53].

HTLV-1 (or HTLV-2) seropositivity is an absolute contraindication both to direct breastfeeding and expressed milk feeding [5, 7].

### *Hepatitis C Virus*

HCV is an RNA virus that can cause acute or chronic inflammation of the liver – hepatitis. Acute hepatitis may resolve spontaneously or evolve into chronic hepatitis, which can lead to progressive hepatic fibrosis – cirrhosis, or liver cancer – hepatocellular carcinoma [19, 20].

In 2015 the WHO estimated that there were 71 million people living with HCV infection globally and pointed to a 1.5% prevalence of HCV infection in Europe [56].

A mother can transmit HCV infection to her child *in utero*, intrapartum and postnatally – through contact with infected blood [20, 57]. Most studies do not show an association between breastfeeding and HCV transmission [58].

A mother with HCV can, thus, breastfeed [7, 20]. Relative and temporary contraindications are cracked or bleeding nipples [18, 19].

### *Hepatitis B Virus*

Hepatitis B Virus (HBV) is a DNA virus that can cause acute or chronic hepatitis and ultimately lead to cirrhosis or hepatocellular carcinoma [20, 59, 60].

The WHO estimates that there were 257 million people living with HBV infection globally in 2015 [56]. A nationwide study reported a 0.4% prevalence of chronic HBV infection in Portugal [61].

Mother to child transmission of HBV can occur *in utero*, intrapartum and postnatally – through exposure to infected blood [59, 60]. As adequate immunoprophylaxis is widely practiced, there is no evidence to support a significant role of breastfeeding in HBV mother to child transmission [62].



Thus, breastfeeding for HBV infected mothers is not contraindicated, as long as the infant receives HBV vaccine and immunoglobulin at birth [20, 59] and HBV vaccine boosters at 2 and 6 months, according to the national plan guides [42].

### *Hepatitis Virus A, D and E*

These viruses are less relevant than the ones previously described, since HCV and HBV sequelae account for 96% of all viral hepatitis mortality [56].

Hepatitis A Virus (HAV) is an RNA virus that can cause acute hepatitis and is most commonly transmitted through exposure to contaminated food/water [20, 56]. The WHO estimated that, in 2016, hepatitis A was responsible for approximately 7,134 deaths [63]. Breastfeeding is not contraindicated for HAV infected mothers as long as appropriate hygienic conditions are guaranteed [20]. Some authors recommend the administration of HAV vaccine and immunoglobulin to the breastfed infant [11].

Hepatitis D Virus (HDV) infects only people already infected by HBV, as it is an incomplete virus. It can cause acute or chronic hepatitis and is mostly transmitted through exposure to contaminated blood [20, 56]. Vertical transmission can occur, mainly intrapartum [64]. The WHO estimates that there are 15-20 million people living with HDV infection worldwide [64]. Data regarding the role of breastfeeding in HDV transmission is limited. Nonetheless, breastfeeding is considered acceptable when HBV vaccine and immunoglobulin are given to the infant, because the risk of transmission in these circumstances is thought to be negligible [11].

Hepatitis E Virus (HEV) can cause acute hepatitis and it is mostly transmitted through exposure to contaminated water [20, 56]. Vertical transmission can rarely occur [65]. The WHO estimated that, in 2015, hepatitis E was responsible for approximately 44,000 deaths [65]. Data regarding the role of breastfeeding in HEV transmission are scarce. Although colostrum of HEV infected mothers contains both anti-HEV antibody and HEV-RNA, breastfeeding appears to be safe for HEV infected asymptomatic mothers. Acutely ill mothers, instead, having a high viral load, should be discouraged from breastfeeding because of the possible risk of viral transmission either from infected breastmilk or nipple micro-abrasions stemming from suckling [11, 66, 67].

### *Ebola Virus*

EBOV is an RNA virus responsible for a severe hemorrhagic fever – Ebola Virus disease, usually emerging in clusters, termed outbreaks. The WHO estimates the average case fatality rate to be approximately 50% [68].

EBOV is mostly transmitted through direct contact with a sick person's bodily fluids, including blood and breast milk [12, 68]. Vertical transmission can also occur [69, 70]. The presence of EBOV in breast milk has been demonstrated, but the risk of contagion seems to be associated more with the close proximity relationship of the act of breastfeeding than via milk transmission [71, 72].

If a mother has Ebola Virus disease, she should be separated from her child. Airborne and contact precautions must be taken and, thus, breastfeeding is to be discouraged [11, 12].

### *Influenza*

Influenza is an RNA virus that can be divided into four types: A and B are responsible for seasonal influenza – commonly referred to as the flu (with fever, malaise and respiratory symptoms); C is identified less frequently; D is not known to cause human disease [73, 74].

The WHO estimates an annual incidence of 3-5 million cases of severe influenza illness and of 290,000-650,000 respiratory deaths [74]. The 2019-2020 influenza season started on week 47/2019 in Europe, with Influenza B being reported as the dominant type for Portugal [75].

Transmission of seasonal influenza occurs via respiratory droplets [74, 76]. The best way to prevent illness is the influenza vaccine, which is recommended for pregnant women during the influenza season [74, 77, 78].

Breastfeeding is encouraged for mothers with seasonal influenza [11]. Expressed breast milk can be given to the infant if the mother is too sick to breastfeed [76, 77].

### *Rubella*

Rubella is an RNA virus responsible for a clinical picture of maculopapular exanthem, fever and lymphadenopathy [11, 79, 80].

In 2019 there were more than 47,600 Rubella cases reported to the WHO worldwide, with 634 cases in Europe (data reported as of April 2020) [81]. Portugal maintained Rubella elimination status

in 2018 [82]. A nationwide study has estimated the IgG seroprevalence of Rubella to be 95.3% in the Portuguese population, which is consistent with high vaccine coverage [61].

Rubella can be transmitted from mother to child through several manners, including *in utero* transmission – which may result in congenital Rubella syndrome, and postnatal transmission – via respiratory droplets [79, 80].

To date, there is no data that warrants contraindication of breastfeeding for Rubella infected mothers [11].

### Zika Virus

Zika Virus (ZIKV) is a mosquito-borne RNA virus that can present as a maculopapular exanthem with fever, arthralgias and conjunctivitis [83, 84].

India reported a ZIKV outbreak in 2018, with a total of 290 confirmed cases. More than 31,000 suspected, probable and confirmed cases were reported by the Region of the Americas [85] in the same year. Europe reported 51 cases of ZIKV infection, all of them being imported. There were no reported cases in Portugal in 2019 [86].

People become infected with ZIKV mainly through the bite of mosquitoes of the *Aedes* genus; nevertheless, vertical transmission can also occur – which may lead to congenital Zika syndrome [83, 84].

The CDC and the WHO advocate for breastfeeding in ZIKV infected mothers, because the risk of transmission is far outweighed by the benefits of breastfeeding [83, 84].

### Dengue Virus

Dengue Virus (DENV) is a mosquito-borne RNA virus responsible for a flu-like syndrome with fever and hematological alterations [87, 88].

The WHO estimates a global incidence of 100-400 million DENV infections annually [88]. In 2018 there were 2,033 confirmed cases of DENV infection reported in Europe, of which 14 were reported in Portugal – coming to a rate of 0.1 per 100,000 population in this country [89]. A record number of cases was reported in 2019, with the Region of the Americas alone reporting 3.1 million cases [88].

Transmission of DENV occurs primarily through the bite of an infected *Aedes* mosquito, although vertical transmission can also occur [11, 88, 90].

Breastfeeding is regarded as acceptable for DENV infected mothers [11, 90].

### Severe Acute Respiratory Syndrome Coronavirus 2

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) is a newly emergent virus responsible for Coronavirus disease 2019 (COVID-19), a respiratory tract infection with potential endothelial cell involvement across vascular beds of different organs. Most of the infected people usually have mild symptoms such as fever, fatigue and dry cough and recover without the need for special treatment. However, around 14% of patients become seriously ill and, consequently, require hospitalization with oxygen support. Older people and those with comorbidities are at increased risk of severe disease, which can entail acute respiratory disease syndrome and shock [91-96].

On December 31<sup>st</sup> of 2019, the WHO China Country Office received reports of pneumonia of unknown cause identified in the city of Wuhan. It was later discovered that these cases were due to SARS-CoV-2. Globally, COVID-19 attained over 100,000 cases on March 6<sup>th</sup>, 2020, and on March 11<sup>th</sup> the WHO characterized COVID-19 as a pandemic. On April 4<sup>th</sup> there were over 1 million cases in the world, and this number doubled to 2 million by April 17<sup>th</sup>. COVID-19 was responsible for over 100,000 deaths by April 12<sup>th</sup> [97, 98].

Mother to child transmission of SARS-CoV-2 *in utero* is uncertain at this point; however, postnatal transmission can occur via respiratory droplets. Although SARS-CoV-2 RNA particles have been detected in breast milk, the WHO states that available data is insufficient to conclude that mothers can transmit the virus via breastfeeding [91, 93, 99-101].

Most health authorities consider direct breastfeeding an acceptable option for SARS-CoV-2 infected mothers [91-93, 100, 102-107]. However, the exact recommendations on feeding modality and mother-child separation options vary between agencies.

The WHO, the United Nations Population Fund and the United Nations Children's Fund recommend direct breastfeeding for COVID-19 affected mothers along with appropriate respiratory and hand hygiene measures. If the mother cannot breastfeed due to severe illness, freshly expressed breast milk should be fed to the infant – safeguarding appropriate hygiene measures. The mother-infant pair should stay together [91-93, 107].

The CDC recommends shared decision making between the mother and healthcare professionals

on whether to separate an infected mother from her newborn and when to decide how to feed the infant. When deciding on the separation of the mother-child pair, it should be taken into consideration the clinical condition of both the parties and the mother's desire to direct breastfeed, among other factors. Whatever feeding modality, it should be accompanied by appropriate respiratory and hand hygiene measures and, if the mother decides to express her breast milk, a healthy caregiver should feed it to the newborn [100, 102].

In line with the CDC's recommendations, other agencies endorse case by case decision making, while stating that direct breastfeeding and joined mother-child management are preferred and hygienic measures should be ensured [103-106].

### Strengths and limitations

This narrative review aggregates existing evidence regarding the recommendations for breastfeeding in the context of several viral infections, which can facilitate consult by health professionals. Consequently, this paper can prevent vital time losses in searching for different information sources, giving health professionals more time to better care for their patients.

The subject of this review is exceedingly relevant for Portuguese health professionals due to the high prevalence and/or high burden of disease of the discussed infections. Henceforth, compiling evidence on this subject matter has the potential to serve plenty of health professionals.

For some of the reviewed infections, there were few sources providing recommendations on whether to support or contraindicate breastfeeding in the setting of those specific maternal infections. Hence, further studies are needed to support better the evidence behind some of the recommendations found by this review.

With increasing interest in newborn health by the scientific community, new evidence regarding the reviewed pathogens and their likelihood of transmission via breastfeeding might surface in the future. This new information may or may not alter the recommendations made by health authorities worldwide, which could outdate portions of this review.

Regarding SARS-CoV-2: newly available information is updated daily, which leads to official recommendations evolving likewise. As a result, the official agency statements used as a reference by this review may be outdated by the time of publication.

### Conclusion

Breastfeeding is the normative standard for infant feeding and nutrition because of the well documented short- and long-term medical and neurodevelopmental advantages, although some circumstances, such as maternal infections, can warrant its contraindication.

After a comprehensive literature search, it was found that maternal infection with HIV, HTLV or EBOV contraindicates breastfeeding. Additionally, in specific circumstances, HSV, VZV and HCV maternal infections can also contraindicate breastfeeding. For the other viruses reviewed in the present study – which were CMV, HAV, HBV, HDV, HEV, Influenza, Rubella, ZIKV, DENV and SARS-CoV-2 – breastfeeding is regarded as acceptable.

In order to support breastfeeding mothers with the correct prescriptions and ensure the best possible health care for both mother and infant, the awareness of the actual infectious contraindications should be an essential component of education and training for all contact healthcare professionals, such as obstetricians, pediatricians or family medicine doctors.

### Declaration of interest

The Authors certify that they have no financial or personal relationships and activities that might lead to a conflict of interest. The Authors received no financial support for the research, authorship, and publication of this article.

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