

Davanzo Riccardo (Orcid ID: 0000-0001-8315-8097)

Breastfeeding and Coronavirus Disease-2019. Ad interim indications of the Italian Society of Neonatology endorsed by the Union of European Neonatal & Perinatal Societies

Riccardo Davanzo^{1,2}, MD, PhD; Guido Moro³, MD; Fabrizio Sandri⁴, MD;
Massimo Agosti⁵, MD; Corrado Moretti⁶, MD; Fabio Mosca⁷, MD

1. Institute for Maternal and Child Health, IRCCS “Burlo Garofolo”, Trieste
2. Technical Panel on Breastfeeding, Ministry of Health, Rome
3. Human Milk Banking Association of Italy (AIBLUD), Milan
4. Neonatal Intensive Care Unit, Maggiore Hospital, Bologna
5. Woman and Child Department, Ospedale Del Ponte, Varese
6. President of Union of European Neonatal and Perinatal Societies; Emeritus Consultant in Pediatrics, Policlinico Umberto I, Sapienza University, Rome
7. President of Italian Society of Neonatology, Milan

Corresponding Author:

Riccardo Davanzo, MD, PhD
Via dei Navali 28, 34143, Trieste, Italy
riccardo.davanzo@gmail.com

Contributor Statement

RD and FM conceived the manuscript. RD and FM wrote the first draft of the manuscript. GM, FS, MA and CM revised the manuscript and provided critical advice.

Conflict of Interest Statement: no competing interest to declare.

Acknowledgments: no specific fund related to the present work

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/mcn.13010

Notice

This is the updated version of a document firstly disseminated on day 28th February 2020. The present version takes into account the scientific data available as of March 28th, 2020. The guidance given is subject to change in the future with the acquisition of further knowledge about the Coronavirus Disease-2019 (COVID-19) pandemic, its perinatal transmission and clinical characteristics of cases of neonatal COVID-19.

Glossary

We would clarify the meanings given to the terms SARS-CoV-2 and COVID-19 in this document.

The term SARS-CoV-2 is taken to mean the viral causative agent responsible for SARS, also called 2019 Wuhan novel coronavirus.

The term SARS is the acronym for Severe Acute Respiratory Syndrome caused by coronavirus.

COVID-19 means the Coronavirus Disease identified at the end of 2019 in the Hubei Region, China.

Accepted Article

Abstract

Breastfeeding and Coronavirus Disease 2019. Ad interim indications of the Italian Society of Neonatology endorsed by the Union of European Neonatal & Perinatal Societies.

The recent COVID-19 pandemic has spread to Italy with heavy consequences on public health and economics. Besides the possible consequences of COVID-19 infection on a pregnant woman and the fetus, a major concern is related to the potential effect on neonatal outcome, the appropriate management of the mother-newborn dyad and finally the compatibility of maternal COVID-19 infection with breastfeeding.

The Italian Society on Neonatology (SIN) after reviewing the limited scientific knowledge on the compatibility of breastfeeding in the COVID-19 mother and the available statements from Health Care Organizations, has issued the following indications that have been endorsed by the Union of European Neonatal & Perinatal Societies (UENPS).

If a mother previously identified as COVID-19 positive or under investigation for COVID-19 is asymptomatic or paucisymptomatic at delivery, rooming-in is feasible and direct breastfeeding is advisable, under strict measures of infection control.

On the contrary, when a mother with COVID-19 is too sick to care for the newborn, the neonate will be managed separately and fed fresh expressed breast milk, with no need to pasteurize it, as human milk is not believed to be a vehicle of COVID-19.

We recognize that this guidance might be subject to change in the future when further knowledge will be acquired about the COVID-19 pandemic, the perinatal transmission of SARS-CoV-2 and clinical characteristics of cases of neonatal COVID-19.

1. Introduction

The recent pandemic caused by a novel coronavirus isolated in Wuhan (Hubei Region, China) at the end of 2019 (SARS-CoV-2)(Sung et al. 2020; Wu, Mc Googan 2020; Ashour, Elkhatib, Rahman & Elshabrawy 2020; Dong et al. 2020; Lai et al. 2020; Zhao et al. 2020) has recently struck Italy with heavy consequences on public health and economics (Remuzzi & Remuzzi 2020). The 28th March 2020 Bulletin of the Italian Civil Protection reports 92,472 cases (Protezione Civile 2020). Among other clinical and public health issues, a major concern is raised by COVID-19 during pregnancy and the possible transmission of the infection from mother to child before, during and after childbirth (ACOG 2020; Rasmussen et al. 2020; CNGOF 2020; Mullins et al. 2020; Quiao 2020; 9-13). Particularly, the option of the joint management of mother and child after childbirth and the safety of breastfeeding are questioned. In order to deal with these issues, an expert panel of the Italian Society of Neonatology (SIN) conducted a review of published literature and developed the present consensus statement, endorsed by the Union of European Neonatal & Perinatal Societies (UENPS).

2. Current knowledge

The SARS-CoV-2 virus spreads mainly from person to person through close contact (0-2 meters), and is transmitted by means of respiratory secretions (droplets) when an infected individual sneezes or coughs (CDCa 2020). The efficiency of SARS-CoV-2 transmission via the enteral route (Gu 2020), through the conjunctival mucosa (Peng 2020), or after contact with contaminated environmental surfaces (Ong et al. 2020; van Doremalen et al. 2020) is still to be defined, but would seem less likely.

It is not yet established if COVID-19 might have a transplacental transmission. Nevertheless, in a similar way to past SARS-CoV-1 (Severe Acute Respiratory Syndrome) and MERS-CoV (Middle East Respiratory Syndrome Coronavirus) epidemics, fetal and neonatal outcome (e.g. prematurity) may depend more on the severity of the maternal infection and on concurrent obstetric diseases, rather than on the SARS-CoV-2 infection from the pregnant woman to the fetus.

In a retrospective study on 9 women with COVID-19 pneumonia during the third trimester of pregnancy, SARS-CoV-2 was not detected in the amniotic fluid, in cord blood, nor in mother's breast milk; moreover, the pharyngeal swab of 6 neonates was also shown to be negative for

SARS-CoV-2 RNA by Real Time-PCR (RT-PCR-RNA)(Chen et al. 2020). According to Chen et al. the placenta of COVID-19 pregnant women who undergo a cesarean section (CS) had no pathological changes and was negative for SARS-CoV-2 RNA (Chen et al. 2020). Two recent articles reported that 3 neonates of COVID-19 mothers showed elevated IgM antibodies to SARS-CoV-2, raising the possibility of a COVID-19 infection acquired in utero (Dong, Tian & He 2020; Zeng, Xu & Fan 2020). Nevertheless, as all 3 neonates were tested negative for RT-PCR-RNA, more evidence is needed before confirming a risk of fetal COVID-19 (Kimberlin, Stagno, 2020)

In conclusion, current knowledge does not support an intrauterine transmission of COVID-19, similar to the SARS-CoV during the 2002-2003 epidemic in Asia (Schwartz & Graham 2020). Consequently, a neonatal COVID-19 might be the result of a transmission acquired by the mother via the respiratory route in the postpartum period rather than antenatally.

Neonatal COVID-19

The possibility of a respiratory infection from common coronaviruses in the neonatal period and in the first year of life had already been observed prior to the current SARS-CoV-2 outbreak (van der Zalm et al. 2009; Jean, Quach, Yung & Semret 2020).

Zhu et al. (2020) has described a cohort of 9 neonates whose mothers had suspected COVID-19. Seven of the nine infants were born after a CS. No information on the type of feeding was provided. All neonates developed respiratory symptoms in the first week of life and received a clinical diagnosis of pneumonia, but their viral test from pharyngeal swabs proved to be negative, thus not corroborating the SARS-CoV-2 etiology. Relatively few COVID-19 neonates have been reported in the scientific literature during the Hubei epidemic (Cao, Chen, Chen & Chiu 2020).

A recent paper from JAMA Pediatrics reports that among 33 neonates of COVID-19 mothers, three presented respiratory symptoms in the first days of life and tested positive for COVID-19 on day 2 after childbirth (Zeng, Xia & Yuan 2020). The only seriously ill neonate in this case series was a 31 weeks gestational age preterm infant.

Although we cannot ignore that a COVID-19 infant might develop a respiratory failure and be admitted to a NICU (Pediatric Committee 2020; De Luca D; Wang et al. 2020), to date, reported cases are usually mild, with a favorable outcome (Cao, Chen, Chen & Chiu 2020; Lu & Shi 2020). Nevertheless, a neonate delivered by a COVID-19 mother requires a complex hospital organization with the provision of an isolated room for mothers and/or neonates and firm implementation of the protective measures against contagion for health professionals

(Wang et al. 2020).

Summarizing, based on the available limited literature, neonatal COVID-19: 1) appears to have a horizontal transmission; and 2) seems to be paucisymptomatic or asymptomatic compared to older age groups.

COVID-19 infection in the first year of life and beyond

Wei et al. have described a series of nine COVID-19 positive infants, aged 56 days to 11 months, with a history of intra-familial transmission and presenting with fever, cough, respiratory secretions, and rhinitis (Wei et al. 2020). Their general health conditions were fair and none required intensive care.

On the basis of current evidence, pediatric COVID-19 appears to be mild or asymptomatic (Cao, Chen, Chen & Chiu 2020; Chan et al. 2020) similarly to the 2002-2003 SARS-CoV epidemic (Shek et al. 2020; Li 2020). This is particularly true for COVID-19 in the first year of life and generally under 10 years of age (Wei et al. 2020; Zhang et al. 2020).

A recent study from China on 2143 children with respiratory symptoms included data on 379 infants; among infants only a minority (22.7 %) tested positive to COVID-19. Although 10.6 % of infants were reported to be severe, the Authors also note that greater severity, over all ages, was found in not confirmed COVID-19 children, possibly due to different etiological agents (Dong et al. 2020). This information should be carefully considered as policies are being instituted requiring maternal separation and precluding breastfeeding on the basis that COVID-19 can cause severe illness. On the contrary, separation might expose infants to a greater risk of infection with other pathogens that are more likely to cause serious illness.

3. Promotion of breastfeeding and integration with infection control measures

Breastfeeding improves the health of mother and child, implies benefits for families and has a positive social and economic impact (Davanzo, Romagnoli, Corsello 2015; Rollins et al. 2016). Based on current scientific knowledge, the breast milk of a COVID-19 mother cannot be considered a transmission vehicle, in a similar way that other known respiratory viral infections cannot be (WHO 2020).

The precautionary indication to COVID-19 mothers for not breastfeeding has been proposed by some Authors (Favre et al. 2020) without sound evidence and clearly ignores the importance of breastfeeding (Binns, Lee, & Low 2020). On the contrary, the current COVID-19 pandemic leads us to combine the promotion of breastfeeding with correct infection control measures, in

order to limit the contagion by droplets and by contact with the respiratory secretions of infected patients (including mothers having just given birth) (CDC 2020).

We can speculate that, similar to the 2002-2003 SARS-Co-V epidemic (Robertson et al. 2020), specific SARS-CoV-2 antibodies pass via the breast milk from the COVID-19 mother to the infant within a few days after the onset of the disease, thus possibly modulating the clinical expression of the infant's infection.

An approach involving the routine separation of the newborn from the COVID-19 mother not only interferes with the mother-child relationship (WHO & UNICEF 2018), but might also be acting too late for a contagion that has already occurred in the pre-symptomatic phase.

4. Currently available directions on the prevention of mother to child transmission

Chinese Pediatrics COVID-19 Working Group. Doctors who recently have dealt with the COVID-19 epidemic in China suggest infant feeding with formula or possibly donor breast milk (Wang et al. 2020). The authors do not provide specific reasons for this choice. In the recommendation of the Chinese experts, presumably unbalanced on the side of caution, there is no information of any overall assessment of the risks of infection compared with those of not breastfeeding.

World Health Organization (WHO). A woman with suspected, probable or confirmed COVID-19 can practice skin to skin contact in the delivery room and exclusively breastfeed her child (WHO 2020). If maternal general health conditions impede direct breastfeeding, she should be encouraged and supported to express breast milk and feed it to her child. A COVID-19 mother must always follow the infection prevention measures. Moreover, the environmental surfaces touched by the mother must be regularly cleaned and disinfected.

United Nations Children's Fund (UNICEF). This Agency does not consider the option of separating mother and neonate, and suggests to continue breastfeeding, with the concurrent adoption of hygiene measures to reduce the possible transmission of the COVID-19 from mother to neonate (UNICEF 2020).

Centers for Disease Control and Prevention (CDC). According to the CDC (CDCb 2020):

- If the mother is under investigation or tests positive for COVID-19, the option of ensuring mothers and neonates cared for in separate rooms should be considered as the first choice. We must observe that the indication by the CDC on the desirable separation of mothers and neonates is not based on an analysis of the impact that this might have on breastfeeding nor the likelihood that this option might result in formula feeding. The risks and benefits of this

separation and the information on the consequences of not starting, continuing or suspending breastfeeding should be shared with the family and with healthcare professionals.

- If a breastfeeding mother and her newborn infant are managed jointly, measures aimed at preventing the transmission of the viral infection should be put in place: avoid kissing the neonate, protect him from adult coughing and respiratory secretions (wear a mask during feeding and intimate contact with the baby), wash hands, in particular before feeding, suspend visits. If the child stays in hospital with the mother in a rooming-in regimen, he will be put to sleep in his cradle at a distance of at least 2 meters from the ill mother; moreover, the use of a physical barrier, such as a curtain between the mother and newborn, may be appropriate.

Royal College of Obstetricians & Gynecologists (RCOG). The RCOG is very clear in advising that mothers and babies should be kept together and consequently questions the Chinese recommendation to routinely separate the newborn from the COVID-19 mother. According to the RCOG, mother and neonate separation should be justified by the poor health conditions of the mother or by the need to provide therapies to the newborn (RCOG 2020). Moreover, the RCOG believes that breastfeeding should be recommended, given that the related benefits for the newborn outweigh the potential risks.

International Society of Ultrasound in Obstetrics & Gynecology (ISUOG). Rooming-in and breastfeeding are an option as far as a mother with COVID-19 is not severely affected (Poon et al. 2020).

Italian National Institute of Health (ISS). In the light of current available scientific data and the protective potential of breast milk, a woman with suspected or confirmed COVID-19, under favorable clinical conditions and according to her desire, should start and continue to breastfeed, directly to the breast or using expressed breast milk (ISS 2020). To reduce the risk of transmission to the child, preventive procedures, such as hand cleaning and the use of a face mask during feeds, are advisable.

Academy of Breastfeeding Medicine (ABM). The hospital management of mothers suspected of or with confirmed COVID-19 must foresee two options: rooming-in or separation between mother and neonate. The choice mainly depends on the general health conditions of the woman and must necessarily involve also mother and family. As an alternative to sucking directly to the breast, expressing breast milk should be considered a safe procedure (ABM 2020).

Provisional indications of Italian Society of Neonatology (SIN) and Union of European Neonatal & Perinatal Societies (UENPS) on the management of mother and neonate during the COVID-19 pandemic.

The provisional directions of SIN and UENPS, coherent with the recommendations made by WHO, UNICEF, ISS, IUOG, RCOG and ABM, are summarized in Table 1.

- Whenever possible, the preferred option is the joint management of the mother and her infant, in order to facilitate their interaction and the beginning of breastfeeding (Figure 1). This choice is defined by the good health status of both the mother and her neonate. Usually, the mother is asymptomatic or paucisymptomatic, previously identified as positive to COVID-19 or under investigation for COVID-19 .
- A mother affected by severe respiratory infection (with fever, coughing and respiratory secretions) and too sick to care for her neonate, should be temporarily separated, pending the result of RT-PCR-RNA test for COVID-19. If the test is positive, mother and child continue to be managed separately; if the test is negative, rooming-in for the dyad is applicable as far as the mother is ready to take care of the neonate.
- At present, the decision about whether or not to separate mother and neonate must be individualized, taking into account the informed consent of the mother, the hospital logistics and possibly the local epidemiological situation of current COVID-19 pandemic.
- In case of separation of mother and neonate, the routine use of breast milk substitutes should be avoided; we rather recommend implementing the expression, transportation and administration of the fresh mother's milk to the neonate.
- Expressed breast milk should not be pasteurized, as it is not believed to be a vehicle of infection, even if it contains SARS-CoV-2. Moreover, pasteurization reduces the biological and immunological value of human milk.
- A premature or sick newborn infant requiring intensive care should be admitted in an isolated area of the Neonatal Intensive Care Unit (NICU) and cared for by a skilled neonatal team wearing an appropriate personal protective equipment (PPE). In this setting, the expressed breast milk of a COVID-19 mother should be transported, processed and administered in accordance to the NICU specific protocol. Present knowledge does not support routine pasteurization of the COVID-19 mother' milk prior to administration to a preterm or sick newborn infant.
- In case of a COVID-19 mother, strict hygiene measures should be adopted to prevent the

possible transmission of the infection by droplets or by contact with respiratory secretions.

- In detail, the room should be isolated, not allowing visits of relatives and friends. The baby's cradle should be placed at a distance of 2 meters from the mother's head and a room divider or a curtain in between mother and neonate can also be used. Certainly, these measures, given the distance and separation from the neonate, will make it more difficult for mothers to feed their babies, particularly after a CS in absence of visitors. Although COVID-19 mothers will rely on hospital staff, this setting might have a negative impact on breastfeeding.
- Moreover, the mother should carefully wash her hands and wear a surgical face mask during breastfeeds and intimate contact with the newborn. There is no need for the mother to use FFP2 or FFP3.
- Lastly, the other hospitalized patients and the healthcare personnel should also be protected.
- The compatibility of breastfeeding with drugs eventually administered to a mother with COVID-19 should be assessed on a case-by-case basis.
- Hospital discharge of a paucisymptomatic COVID-19 mother together with a healthy SARS-CoV-2 negative neonate should be done appropriately. Going home as early as 48 hours after childbirth might be an option only in cases of hospital overload. In most cases, one week hospital stay for surveillance of the newborn and repetition of the pharyngeal swab for SARS-CoV-2 at discharge is preferable.
- At home, according to the organization of the Italian National Health Care System, the neonate is in charge of the family pediatrician. The mother may continue to breastfeed and/or to express breast milk, depending on her health conditions and desire.
- Due to the risk of spreading COVID-19 to ambulatory staff and patients/families, face-to-face meetings should be replaced as far as possible by telephone consultation and/or telemedicine to allow visual clinical assessment of the neonate, to guide parents for infants weighing and to provide lactation advice.
- At 14 days after discharge, the infant should receive a check-up and a pharyngeal swab for SARS-CoV-2.
- Neonatal COVID-19 follow-up can be stopped on the 28th day after discharge, if the pharyngeal swab for SARS-CoV-2 is confirmed negative.

5. Conclusion

This document has been proposed by SIN & UENPS to provide maternity hospitals with management guidance. Given the current pandemic, the Authors aimed to conjugate, as far as possible, an appropriate COVID-19 infection control with the promotion of breastfeeding and the initial mother-infant relationship after childbirth. We recognize that this guidance might be subject to change in the future when further knowledge will be acquired about the COVID-19 pandemic, its perinatal transmission and clinical characteristics of cases of neonatal SARS-CoV-2 infection.

REFERENCES

1. Ashour, H.M., Elkhatib, W.F., Rahman, M.M., Elshabrawy, H.A. (2020). Insights into the recent 2019 Novel Coronavirus (SARS-CoV-2) in light of past human coronavirus outbreaks. *Pathogens*, 4; 9 (3), 186; doi:10.3390/pathogens9030186
2. Binns, C., Lee, M., Low, W.Y. (2016). The Long-Term Public Health Benefits of Breastfeeding. *Asia Pacific Journal of Public Health*, 28(1), 7
14. doi:10.1177/1010539515624964
3. Cao, Q., Chen, Y.C., Chen, C.L., Chiu, C.H. (2020). SARS-CoV-2 infection in children: transmission dynamic and clinical characteristics. *Journal of the Formosan Medical Association*, <https://doi.org/10.1016/j.jfma.2020.02.009>
4. Chan, J.F., Yuan, S., Kok, K.H., To, K.K., Chu, H., Yang, J., ... Yuen, K.Y. (2020). A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *Lancet*, 395:514e23.
5. Chen, H., Guo, J., Wang, C., Luo, F., Yu, X., Zhang, W., ..., Zhang, Y. (2020). Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. *Lancet*, 7;395(10226):809-815. doi: 10.1016/S0140-6736(20)30360-3. Epub 2020 Feb 12.
6. Chen, S., Huang, B., Luo, D.J., Li, X., Yang, F., Zhao, Y., Nie, X, Huang, B.X. (2020)[Pregnant women with new coronavirus infection: a clinical characteristics and placental pathological analysis of three cases]. *Zhonghua Bing Li Xue Za Zhi* .,49(0):E005. doi: 10.3760/cma.j.cn112151-20200225-00138. [Epub ahead of print]
7. Collège National des Gynécologues et Obstétriciens Français (CNGOF). Prise en charge aux urgences maternité d'une patiente enceinte suspectée ou infectée par le coronavirus (COVID-19)-V1 (15/3/2020).

- <http://www.cngof.fr/component/rsfiles/aperçu?path=Clinique/referentiels/COVID-19/COVID-19-CNGOF.pdf>. Accessed on March 24th, 2020
8. Davanzo, R., Romagnoli, C., Corsello, G. (2015). Position Statement on Breastfeeding from the Italian Pediatric Societies. *Italian Journal of Pediatrics*, (41) 80: 1-3
 9. De Luca, D. Managing neonates with respiratory failure due to SARS-CoV-2 (2020). *Lancet Child Adolesc Health*, Published Online March 6. [https://doi.org/10.1016/S2352-4642\(20\)30073-0](https://doi.org/10.1016/S2352-4642(20)30073-0)
 10. Dong, L., Tian, J., He, S. (2020). Possible vertical transmission of SARS-CoV-2 from an infected mother to her newborns. *JAMA*, Published online March 26. doi:10.1001/jama.2020.4621
 11. Dong, Y., Mo, X., Hu, Y., Qi, X., Jiang, F., Jiang, Z., Tong, S. (2020). Epidemiological characteristics of 2143 pediatric patients with 2019 coronavirus disease in China. *Pediatrics*, doi: 10.1542/peds.2020-0702
 12. Favre, G., Pomar, L, Qi, X., Nielsen-Saines, K., Musso, D., Baud, D. (2020). Guidelines for pregnant women with suspected SARS-CoV-2 infection. Correspondence to *The Lancet Infectious Diseases*, doi: [https://doi.org/10.1016/S1473-3099\(20\)30157-2](https://doi.org/10.1016/S1473-3099(20)30157-2)
 13. Gu, J., Han, B., Wang, J. (2020). COVID-19: Gastrointestinal manifestations and potential fecal-oral transmission. *Gastroenterology*, pii: S0016-5085(20)30281-X. doi: 10.1053/j.gastro.2020.02.054.
 14. <http://www.protezionecivile.gov.it/home>. Accessed on March 24th, 2020
 15. <https://www.acog.org/Clinical-Guidance-and-Publications/Practice-Advisories/Practice-Advisory-Novel-Coronavirus2019?IsMobileSet=false>. Accessed on Marh 24th, 2020
 16. <https://www.bfmed.org/abm-statement-coronavirus>. Accessed on March 24th, 2020
 17. <https://www.cdc.gov/coronavirus/2019-ncov/prepare/prevention.html>. Accessed on March 24th, 2020
 18. <https://www.cdc.gov/coronavirus/2019-ncov/hcp/inpatient-obstetric-healthcare-guidance.html> Accessed on March 28th, 2020
 19. <https://www.epicentro.iss.it/coronavirus/pdf/COVID-19-donati-giusti-18-3-20.pdf>. Accessed on March 24th, 2020
 20. <https://www.uenps.eu/wp-content/uploads/2020/03/mascherine-2020.pdf> Accessed on March 24th, 2020
 21. <https://www.unicef.org/stories/novel-coronavirus-outbreak-what-parents-should-know>. Accessed on March 24th, 2020

22. Jean, A., Quach, C, Yung, A., Semret, M. (2013). Severity and outcome associated with human coronavirus OC43 infections among children. *The Pediatric Infectious Disease Journal*. 32(4):325-9. doi: 10.1097/INF.0b013e3182812787.
23. Kimberlin, D.W., Stagno, S. (2020). Can SARS-CoV-2 infections be acquired in utero?. Editorial. *JAMA*. Published online March 26. Doi: 10.1001/jama.2020.4868
24. Lai, C.C., Shih, T.P., Ko, W.C., Tang, H.J., Hsueh, P.R. (2020). Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease-2019 (COVID-19): The epidemic and the challenges. *International Journal of Antimicrobial Agents*, 55(3):105924. doi:10.1016/j.ijantimicag.2020.105924. Epub 2020 Feb 17.
25. Li, A.M., (2005). Severe acute respiratory syndrome (SARS) in neonates and children. *Archives of Diseases in Childhood Fetal and Neonatal Edition*, 90(6):F461-5.
26. Lu, Q., Shi, Y. (2020). Coronavirus disease (COVID-19) and neonate: What neonatologist need to know. *Journal of Medical Virology*, doi: 10.1002/jmv.25740. [Epub ahead of print]
27. Mullins, E., Evans, D., Viner, R.M., O'Brien, P., Morris, E. (2020). Coronavirus in pregnancy and delivery: rapid review. *Ultrasound in Obstetrics & Gynecology*, doi:10.1002/uog.22014
28. Ong, S.W.X., Tan, Y.K., Chia, P.Y., Lee, T.H., Ng, O.T., Wong, M.S.Y., Marimuthu, K. Air, Surface Environmental, and Personal Protective Equipment Contamination by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) from a Symptomatic Patient. *JAMA*, doi: 10.1001/jama.2020.3227. [Epub ahead of print].
29. Pediatric Committee, Medical Association of Chinese People's Liberation Army; Editorial Committee of Chinese Journal of Contemporary Pediatrics (2020). Emergency response plan for the neonatal intensive care unit during epidemic of 2019 novel coronavirus. *Zhongguo Dang Dai Er Ke Za Zhi*, 22(2):91-95.
30. Peng, Y., Zhou, Y. (2020). Is novel coronavirus disease (COVID-19) transmitted through conjunctiva? *Journal of Medical Virology*. doi:10.1002/jmv.25753
31. Poon, L.C., Yang, H., Lee, J.C.S., Copel, J.A., Leung, T.Y., Zhang, Y., ... Prefumo, F. (2020). ISUOG Interim Guidance on 2019 novel coronavirus infection during pregnancy and puerperium: information for healthcare professionals. *Ultrasound in Obstetrics & Gynecology*, doi: 10.1002/uog.22013. [Epub ahead of print]
32. Quiao, J. (2020). What are the risks of COVID-19 infection in pregnant women? *The Lancet*. Published online February 12. doi:10.1016/s0140-6736(20)30365

33. Radonovich, L.J.Jr., Simberkoff, M.S., Perl, T.M. (2019). N95 Respirators vs Medical Masks for Preventing Influenza among Health Care Personnel. A Randomized Clinical Trial. *JAMA*, 322(9): 824–833. Published online 2019 Sep 3. doi: 10.1001/jama.2019.11645: 10.1001/jama.2019.1164
34. Rasmussen, S.A., Smulian, J.C., Lednický, J.A., Wen, T.S., Jamieson, D.J. (2020). Coronavirus Disease 2019 (COVID-19) and Pregnancy: What obstetricians need to know. *American Journal of Obstetrics and Gynecology*, doi: <https://doi.org/10.1016/j.ajog.2020.02.017>.
35. Remuzzi, A., Remuzzi, G. (2020) COVID-19 and Italy: what next? *The Lancet*, Published Online. [https://doi.org/10.1016/S0140-6736\(20\)30627-9](https://doi.org/10.1016/S0140-6736(20)30627-9)
36. Robertson, C.A., Lowther, S.A., Birch, T., Tan, C., Sorhage, F., Stockman, L.,... Bresnitz, E. (2004). SARS and pregnancy: a case report. *Emerging Infectious Diseases Journal*, 10:345-348.
37. Rollins, N.C., Bhandari, N., Hajeebhoy, N., Horton, S., Lutter, C.K., Martines, J.C.,... Victora, C.G. (2016). Lancet Breastfeeding Series Group. Why invest, and what it will take to improve breastfeeding practices? *Lancet*, 387(10017):491-504. doi: 10.1016/S0140-6736(15)01044-2.
38. Royal College of Obstetricians & Gynecologists (2020). Coronavirus (COVID-19) Infection in Pregnancy. Information for healthcare professionals. Version 2: Published Thursday 26 March. <https://www.rcog.org.uk/globalassets/documents/guidelines/2020-03-26-covid19-pregnancy-guidance.pdf>/ Accessed on March 26th, 2020
39. Schwartz, D.A., Graham, A.L. (2020). Potential Maternal and Infant Outcomes from Coronavirus 2019-nCoV (SARS-CoV-2) infecting Pregnant Women: Lessons from SARS, MERS, and Other Human Coronavirus Infections. *Viruses*, 12, 194; doi:10.3390/v12020194
40. Shek, C.C., Ng, P.C., Fung, G.P., Cheng, F.W., Chan, P.K., Peiris, M.J., Lee, K.H., ... Fok, T.F. (2003). Infants born to mothers with severe acute respiratory syndrome. *Pediatrics*, 112(4):e254.
41. Sung, P., Lu, X., Xu, C., Sun W, Pan, B. (2020). Understanding of COVID-19 based on current evidence. *Journal of Medical Virology*, 1-4; doi: 10.1002/jmv.25722
42. van der Zalm, M.M., Uiterwaal, C.S., Wilbrink, B., de Jong, B.M., Verheij, T.J., Kimpen, J.L., van der Ent, C.K. Respiratory pathogens in respiratory tract illnesses during the first year of life: a birth cohort study. *Pediatr Infect Dis J*. 2009 Jun;28(6):472-6.

43. van Doremalen, N., Bushmaker, T., Morris, D.H., Holbrook, M.G., Gamble, A, Williamson, B.N.,...Munster, V.J. (2020). Aerosol and surface stability of HCoV-19 (SARS-CoV-2) compared to SARS-CoV-1. *The New England Journal of Medicine*. doi: 10.1056/NEJMc2004973 (2020).
44. Wang, J., Qi, H., Bao, L., Li, F., Shi, Y. (2020). A contingency plan for the management of the 2019 novel coronavirus outbreak in neonatal intensive care units. *Lancet Child & Adolescent Health*; published online Feb 7. [https://doi.org/10.1016/S2352-4642\(20\)30040-7](https://doi.org/10.1016/S2352-4642(20)30040-7).
45. Wang, L., Shi, Y., Xiao, T., Fu, J., Feng, X., Mu, D., ...Zhou, W. (2020). Working Committee on Perinatal and Neonatal Management for the Prevention and Control of the 2019 Novel Coronavirus Infection. Chinese expert consensus on the perinatal and neonatal management for the prevention and control of the 2019 novel coronavirus infection (First Edition). *Annales of Translational Medicine*, 8(3):47. doi: 10.21037/atm.2020.02.20
46. Wang, S., Guo, L., Chen, L., Liu, W., Cao, Y., Zhang, J., Feng, L. (2020). A case report of neonatal COVID-19 infection in China. *Clinical Infectious Diseases*, pii: ciaa225. doi: 10.1093/cid/ciaa225. [Epub ahead of print]
47. Wei, M., Yuan, J., Liu, Y., Fu, T., Yu, X., Zhang, Z.J. (2020). Novel coronavirus infection in hospitalized infants under 1 year of age in China. *JAMA*, <https://doi.org/10.1001/jama.2020.2131>
48. WHO (2020). Clinical management of severe acute respiratory infections (SARI) when COVID-19 disease is suspected. Interim Guidance. 13 March, Geneva. <https://apps.who.int/iris/bitstream/handle/10665/331446/WHO-2019-nCoV-clinical-2020.4-eng.pdf?sequence=1&isAllowed=y> Accessed on March 24th, 2020
49. WHO, UNICEF (2018). Protecting, promoting, and supporting breastfeeding in facilities providing maternity and newborn services: the revised Baby-friendly Hospital Initiative 2018 Implementation guidance. Department of Nutrition for Health and Development World Health Organization. World Health Organization, Geneva, Switzerland.
50. Wu, Z., McGoogan, J.M. (2020). Characteristics of and Important Lessons from the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases from the Chinese Center for Disease Control and Prevention. *JAMA*, doi:10.1001/jama.2020.2648. [Epub ahead of print] No abstract available.
51. Zeng, L.K., Xia, S., & Yuan, W. (2020). Neonatal early-onset infections with SARS-

CoV-2 in 33 neonates born to mothers with COVID-19 in Wuhan, China. *JAMA Pediatr.*

Published online March 26. Doi:10.001/jamapediatrics.2020.0878

52. Zeng, H., Xu, C., Fan, J., Tang, Y., Deng, Q., Zang, W. & Long, X (2020) Antibodies in infants born to mothers with COVID-19 pneumonia. *JAMA*. Published March 26. doi:10.1001/jama.2020.4861
53. Zhang, Y.H., Lin, D.J., Xiao, M.F., Wang, J.C., Wei, Y., Lei, Z.X., ...Xiang, W. (2020). 2019-novel coronavirus infection in a three-month-old baby *Zhong-hua Er Ke Za Zh*,58(3):182-184. doi: 10.3760/cma.j.issn.0578-1310.2020.03.004.
54. Zhao, S., Lin, Q., Ran, J., Musa, S.S., Yang, G., Wang, W.,...Wang, M.H. (2020). Preliminary estimation of the basic reproduction number of novel coronavirus (2019-nCoV) in China, from 2019 to 2020: A data-driven analysis in the early phase of the outbreak. *International Journal of Infectious Diseases*. 92:214-217. doi: 10.1016/j.ijid.2020.01.050. Epub 2020 Jan 30.
55. Zhu, H., Wang, L., Fang, C., Peng, S., Zhang, L., Chang, G., Xia, S., Zhou, W. (2020). Clinical analysis of 10 neonates born to mothers with 2019-nCoV pneumonia. *Translational Pediatrics*; 9 (1): 51-60

Figure 1. Rooming-in of a mother with COVID-19 together with her neonate. This regimen is applied in case of a asymptomatic or paucisymptomatic mother where droplets passage via coughing is not a concern and the mother is able to take care for the neonate. Graphic processing by Marco Davanzo from an original photo taken at Clinica Mangiagalli, Milan, on March 2020.



Accepted Article

Table 1. Indications on the management of mother and neonate in the perinatal period.

Health status of the mother	Pharyngeal swab for COVID-19 on the MOTHER	Pharyngeal swab for COVID-19 on the NEONATE	Isolation of the MOTHER †	Management of the NEONATE during hospital stay †	Advice on direct breastfeeding	Preventive measures for mother-neonate transmission §
Asymptomatic or paucisymptomatic mother known to be COVID-19 positive	Already done	YES	YES, In an isolated and dedicated area of postpartum ward	In a rooming-in regimen, in an isolated and dedicated area of postpartum ward	YES	YES
COVID-19 paucisymptomatic mother under investigation	Yes	Only if maternal test is positive	YES, In an isolated and dedicated area of postpartum ward, pending result of the lab test	In a rooming-in regimen, in an isolated and dedicated area of postpartum ward, at least until the result of the lab test	YES	YES
Mother with symptoms of respiratory infection (fever, cough and secretions) and too sick to care for the newborn, COVID-19 positive or under investigation	YES or already being done	Only if maternal test is positive	YES, in a dedicated and isolated area of postpartum ward, pending result of the lab test	Neonate isolated and separated from the mother, at least until the result of the lab test. He is placed in a dedicated and isolated area in the Neonatology Unit (if asymptomatic) or in the NICU (if symptomatic; e.g. with respiratory disease)	NO; use of expressed milk.‡ Pasteurization not recommended	YES

Notes

† In addition, adequate protection measures on the part of health care personnel, according to the indication of the Ministry of Health of Italy.†

‡ Mother's fresh milk should be expressed with a dedicated manual or electrical breast pump. The mother should always wash her hands before and after touching bottles and all breast pump parts, following recommendations for proper washing of the breast pump after each use.

§Room divider or curtain, surgical face mask for the mother during breastfeeds and intimate contact with the newborn, careful washing of hands, placing the baby's cradle at a distance of 2 meters from the mother's head, no visits of relatives and friends. No need of the mother to use FFP2 or FFP3 face mask (Radonovich, Simberkoff & Perl 2019; UENPS 2020).