Revista Brasileira de Enfermagem
REBEn

SUPPLEMENTARY EDITION 2
CORONAVIRUS/COVID-19

REVIEW

Prevention and control measures for neonatal COVID-19 infection: a scoping review

Medidas de prevenção e controle de infecção neonatal por COVID-19: revisão de escopo

Medidas de prevención y control para la infección neonatal de COVID-19: revisión del alcance

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How to cite this article:
Freitas BMBM, Alves MDSM, Gaíva MAM. Prevention and control measures for neonatal COVID-19 infection: a scoping review. Rev Bras Enferm. 2020;73(Suppl 2):e20200467. doi: http://dx.doi.org/ 10.1590/0034-7167-2020-0467

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Submission: 05-01-2020 **Approval:** 05-24-2020

ABSTRACT

Objective: to identify with the literature the measures to prevent and control neonatal infection by COVID-19. **Methods:** a scope review carried out by searching for studies in databases and institutional health websites. The final sample was 25 articles. **Results:** among the main measures are the use of masks by suspected or infected people in contact with healthy newborns, hand hygiene before and after each care and feeding as well as the tools used for milking. It is indispensable to use personal protective equipment by health professionals in neonatology services to maintain a private room for infected newborns or to use physical barriers. Early diagnosis and timely case management is essential to reduce virus transmissibility. **Conclusions:** the research contributed to elucidate health and nursing actions in preventing and controlling neonatal infection by COVID-19.

Descriptors: Newborn; Communicable Diseases; Disease Prevention; Infection Control; Review.

RESUMO

Objetivo: identificar junto à literatura as medidas de prevenção e controle de infecção neonatal por COVID-19. **Métodos:** revisão de escopo, realizada mediante busca de estudos em bases de dados e sites institucionais de saúde. A amostra final foi de 25 publicações. **Resultados:** dentre as principais medidas, destacam-se o uso de máscaras por pessoas suspeitas ou infectadas no contato com neonatos saudáveis, a higienização das mãos antes e após cada cuidado e mamada assim como dos utensílios utilizados para ordenha. É indispensável o uso dos equipamentos de proteção individual pelos profissionais de saúde nos serviços de neonatologia e a manutenção de quarto privativo para neonatos infectados ou uso de barreiras físicas. O diagnóstico precoce e manejo oportuno dos casos é fundamental para a redução da transmissibilidade do vírus. **Conclusões:** a pesquisa contribuiu para elucidação das ações de saúde e enfermagem na prevenção e controle de infecção neonatal por COVID-19.

Descritores: Recém-Nascidos; Doenças Transmissíveis; Prevenção de Doença; Controle de Infecções; Revisão.

RESUMEN

Objetivo: identificar con la literatura las medidas para la prevención y el control de la infección neonatal por COVID-19. **Métodos:** revisión del alcance, realizada mediante la búsqueda de estudios en bases de datos y sitios web de salud institucional. La muestra final fue de 25 publicaciones. **Resultados:** entre las principales medidas, destacan el uso de máscaras por personas sospechosas o infectadas en contacto con recién nacidos sanos, la higiene de las manos antes y después de cada cuidado y alimentación, así como las herramientas utilizadas para ordeñar. Es esencial utilizar equipos de protección personal por parte de profesionales de la salud en los servicios de neonatología y mantener una habitación privada para los recién nacidos infectados o el uso de barreras físicas. El diagnóstico temprano y el manejo oportuno de los casos es esencial para reducir la transmisibilidad del virus. **Conclusiones:** la investigación contribuyó a dilucidar las acciones de salud y enfermería en la prevención y control de la infección neonatal por COVID-19.

Descriptores: Recién Nacido; Enfermedades Transmisibles; Prevención de Enfermedades; Control de Infecciones; Revisión.

INTRODUCTION

At the end of 2019, a disease caused by a new strain of coronavirus - severe acute respiratory syndrome by coronavirus 2 (SARS-CoV-2) was discovered by a Chinese physician. This infection, designated as COVID-19 by the World Health Organization in February 2020, causes severe respiratory symptoms and fatal victims[1]. In March 2020 it was declared a pandemic, and it has surprised by its potential to infect humans, becoming an international public health emergency[2]. The first cases of viral infection emerged in Wuhan, capital of Hubei, China. Later, COVID-19 spread to more than 140 countries, including Brazil[1,3]. In Brazil, on June 08, 2020, there were 707,412 confirmed cases and 37,134 deaths, corresponding to a lethality of 5.2% [4].

Patients with COVID-19 have flu-like symptoms, with persistent cough, fever, shortness of breath and difficulty breathing, similar to Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS). Since it is a new pathogen, people of all ages have no immunity to the virus and are generally susceptible to infection. Virosis infects from newborn (NBs) to the elderly[3]. Elderly individuals and people living with chronic comorbidities are the ones with the most complications and mortality[5].

Regarding NBs, there is still little information about the clinical presentations of COVID-19. Studies indicate that the disease's manifestations are less severe in children than in adult patients, and that infants younger than one year old have more serious complications than older children[6-8]. NBs deserve special attention since their immune system is still immature, making them more susceptible to infection, in addition to the possibility of mother-to-child transmission[9].

Transmission of the virus to NBs can occur either through direct contact through exposure to respiratory droplets from infected persons or indirect contact with surfaces in the immediate environment or with objects used in the infected person[10-11]. It appears that there is still a lot to know about transmissibility of COVID-19, treatment and other conditions related to neonates, so investigations are underway worldwide.

Prevention and control of neonatal infection is essential in health services, especially since this is a population with immunological immaturity and considered at risk. Health and nursing care aim to: prevent the occurrence of COVID-19; prepare health services for early detection and management of cases; organize a rapid and effective response; contribute with a coordinated response to control the pandemic; and reduce the environmental effect of these infections or their management[12].

Hence, it is reiterated the need for knowledge about prevention and control measures for neonatal COVID-19 infection by nurses and other health professionals during obstetric and neonatal care, in order to promote updated and evidence-based care. With strict prevention and control strategies, it will be possible to minimize the impact of the pandemic on the neonatal population.

OBJECTIVE

To identify with the literature the measures to prevent and control neonatal infection by COVID-19.

METHOD

Ethical aspects

As this is a review study, the reliability and fidelity of the information contained in the selected articles was guaranteed. These aspects were ensured through adequate referencing and rigor in the treatment and presentation of data.

Type of study

This is a scope review, which allows a more comprehensive review of a theme and map the evidence available in a particular area of interest, identifying gaps in the researched knowledge base and bringing together various study designs. This type of review is important to obtain an overview of the existing evidence about any health event, especially when it emerges. The Preferred Reporting Items for Systematic Reviews and Meta-Analyzes Extension for Scoping Reviews (PRISMA-ScR)[13] recommendations were followed for this review report.

Methodological procedure

The six stages planned to develop this type of study have been followed: (1) elaboration of the research question; (2) identification of relevant studies; (3) selection of studies; (4) data mapping; (5) collection, synthesis and description of the findings; and (6) dissemination of the results[13].

From the research question "What is the available evidence on the measures to prevent and control neonatal infection by COVID-19?", the followard elements were defined according to the mnemonic P - Population, C - Concept and C - Context[13] (P (NBs); C (COVID-19/SARS-CoV-2) and C (prevention and control)).

Data source

The National Library of Medicine (MEDLINE/PubMed), Current Nursing and Allied Health Literature (CINAHL), SCOPUS and Web of Science have been selected for search. Then, to ensure a thorough search, the controlled [Descriptors in Health Science (DeCS), Medical Subject Headings (MeSH) and CINAHLHeadings] and non-controlled descriptors were identified (keywords).

Data collection and organization

The controlled and uncontrolled descriptors were synthesized according to PCC strategy and their combinations were used to build the strategies as shown in Chart 1. The database search was carried out from March 30 to 31, 2020.

As an inclusion criterion, we opted for articles that included NBs as a concept and COVID-19/SARS-CoV-2 as context of prevention and control. The sources of information included primary research, reviews, expert opinions (communication, perspectives, editorials, consensus) and technical briefing/notes, in English, Spanish or Portuguese, without time limits. Articles that did not answer the research question and duplicates were excluded.

Chart 1 - Search engine and quantity of articles retrieved from different databases, Brazil, 2020

Database (Total texts)	Crossing-descriptors	Selected articles
MEDLINE (219)	"infant, newborn" OR "neonate" AND "disease prevention" AND "SARS-CoV-2" OR "Wuhan coronavirus" OR "the new coronavirus" OR "COVID-19" OR "severe acute respiratory syndrome coronavirus 2 "	13
CINAHL (88)	"infants or baby or newborn or neonate" AND "disease prevention" AND "covid-19 or coronavirus or 2019-ncov or sars-cov-2 or cov-19" OR "wuhan coronavirus or novel coronavirus" OR "the new coronavirus" OR "severe acute respiratory syndrome coronavirus 2"	0
Scopus (24)	"infant, newborn" OR "neonate" AND "SARS-CoV 2" OR "wuhan coronavirus" OR "the new coronavirus" OR "covid-19" OR "severe acute respiratory syndrome coronavirus 2"	5
Web of Science (1.536)	"infant, newborn" OR "neonate" AND "disease prevention" AND "SARS-CoV-2" OR "Wuhan coronavirus" OR "the new coronavirus" OR "COVID-19" OR "severe acute respiratory syndrome coronavirus 2 "	1
Total		19

Figure 1 shows the flow diagram of the article selection. We have also consulted the websites of Centers for Disease Control and Prevention, of the World Health Organization, of the Ministry of Health, of the Brazilian Society of Pediatric Nurses (*Sociedade Brasileira de Enfermeiros Pediatras*) and of the Brazilian Society of Pediatrics (*Sociedade Brasileira de Pediatria*), with inclusion of six briefing/technical notes on the theme, considering them as articles in other sources.

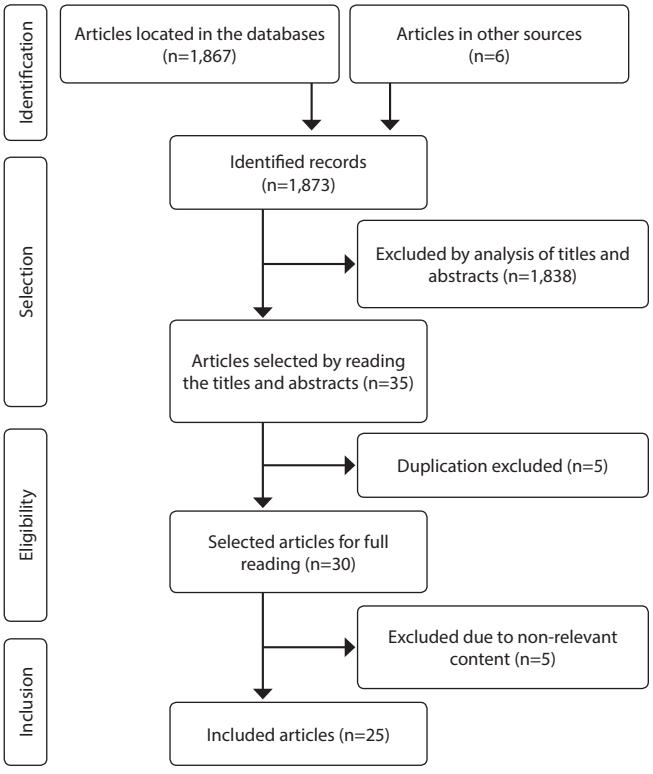

Figure 1 - Flow diagram of the article selection, Brazil, 2020

In the fourth stage, the articles were mapped using data collection indicators designated by title, type of study, country of origin and prevention and control measures.

Data analysis

The results were submitted to content descriptive analysis, using analytical tables that synthesized the key information of the studies, interpreting and withstopping the productions, to describe the available evidence that answered the guiding question.

RESULTS

Twenty-five articles were included, 19 of which were identified in the databases and six on the websites of official government agencies, professional societies and health control institutions, all published in 2020. Most articles are about expert opinions (n=10; 41.6%), whether through consensus, communications, editorials and others; and are from China (n=15; 62.5%).

Article data are described in Chart 2, in which some characteristics are identified such as title, type of study and country of origin.

Chart 3 shows the measures to prevent and control neonatal infection in mothers with suspected or confirmed COVID-19 during delivery, breastfeeding and postpartum neonatal care.

In Chart 4, in turn, measures for the prevention and control of neonatal infection during NB care are presented.

Chart 2 - Presentation of the research results, Brazil, 2020

Study	Title	Type of study	Country
P1	Systematic review of COVID-19 in children shows milder cases and a better prognosis than adults[14]	Systematic review	Sweden
P2	A Case Report of Neonatal 2019 Coronavirus Disease in China[15]	Case report	China
P3	Chinese expert consensus on the perinatal neonatal management for the prevention and control of the 2019 novel coronavirus infection (First edition)[16]	Opinion of experts	China
P4	An Analysis of 38 Pregnant Women with COVID-19, Their Newborn Infants, and Maternal-Fetal Transmission of SARS-CoV-2: Maternal Coronavirus Infections and Pregnancy Outcomes[17]	Opinion of experts	USA
P5	Expert consensus for managing pregnant women and neonates born to mothers with suspected or confirmed novel coronavirus (COVID-19) infection[18]	Opinion of experts	China
P6	Clinical analysis of 10 neonates born to mothers with 2019-nCoV pneumonia[19]	Retrospective cross-sectional study	China
P7	Potential Maternal and Infant Outcomes from Coronavirus 2019-nCoV (SARS-CoV-2) Infecting Pregnant Women: Lessons from SARS, MERS, and Other Human Coronavirus Infections[20]	Opinion of experts	USA

To be continued

Chart 2 (concluded)

Study	Title	Type of study	Country
P8	Management strategies of neonatal jaundice during the coronavirus disease 2019 outbreak[21]	Review study	China
P9	New coronavirus: new challenges for pediatricians[22]	Opinion of experts	China
P10	Proposal for prevention and control of the 2019 novel coronavirus disease in newborn infants[9]	Opinion of experts	China
P11	Managing neonates with respiratory failure due to SARS-CoV-2[8]	Opinion of experts	France
P12	SARS-CoV-2 infection in children: Transmission dynamics and clinical characteristics[6]	Opinion of experts	China
P13	Neonatal Early-Onset Infection With SARS-CoV-2 in 33 Neonates Born to Mothers With COVID-19 in Wuhan, China[23]	Cohort study	China
P14	Antibodies in Infants Born to Mothers With COVID-19 Pneumonia[24]	Retrospective cross-sectional study	China
P15	Coronavirus disease (COVID-19) and neonate: What neonatologist need to know[25]	Review study	China
P16	Impact of COVID-19 infection on pregnancy outcomes and the risk of maternal-to-neonatal intrapartum transmission of COVID-19 during natural birth[26]	Case report	China
P17	Clinical and CT features in pediatric patients with COVID-19 infection: Different points from adults[27]	Retrospective cross-sectional study	China
P18	Clinical characteristics of novel coronavirus disease 2019 (COVID-19) in newborns, infants and children[28]	Opinion of experts	China
P19	A contingency plan for the management of the 2019 novel coronavirus outbreak in neonatal intensive care units[29]	Opinion of experts	China
P20	Interim considerations for infection prevention and control of coronavirus disease 2019 (COVID-19) in inpatient obstetric healthcare settings[30]	Briefing	USA
P21	Pregnancy & Breastfeeding[11]	Briefing	USA
P22	For Child Care Programs That Remain Open[31]	Briefing	USA
P23	*Nota Técnica Nº 06/2020 – Atenção à Saúde do RN no Contexto da Infecção pelo Novo Coronavírus (SARS-CoV2)*[32]	Technical note	Brazil
P24	*Nota técnica referente aos cuidados da equipe de enfermagem obstétrica, neonatal e pediátrica diante de caso suspeito ou confirmado de COVID-19*[33]	Technical note	Brazil
P25	*Prevenção e Abordagem da Infecção por COVID-19 em mães e RN, em Hospitais-Maternidades*[34]	Alert note	Brazil

Note: USA - United States of America.

Chart 3 - Infection prevention and control measures neonatal mothers with suspected or confirmed COVID-19 during delivery, breastfeeding and postpartum neonatal care, Brazil, 2020

Focus of attention	Prevention and neonatal control measures by COVID-19	Study
During delivery	Delivery rooms or operating rooms must be specially prepared, preferably with negative pressure.	P10, P14
	Delivery rooms must be prepared with personal protective equipment, disinfectant solution and quick hand sanitizer.	P3
	Health professionals must use all the individual protection equipment recommended during service such as cap, safety glasses or visor type face shield, long sleeve disposable cloak, gloves, N95 masks, among others.	P3, P10, P14, P15, P24
	Pregnant women should use a surgical mask as a precautionary measure during labor.	P5, P14
	The choice of delivery mode and the time of delivery should be individualized based on obstetric indications.	P1, P3, P4, P5, P6, P7, P12, P16, P18, P21
	In the case of cesarean section, operating rooms must have positive pressure off.	P24
	Skin-to-skin contact after delivery should be discontinued.	P3, P23, P24, P25
	Timely umbilical cord clamping is recommended.	P23, P25
	NBs should be cleaned and dried immediately after delivery.	P5
	Neonatal resuscitation in NBs should be performed according to recommendations in neonatology using personal protective equipment.	P5, P10, P15
	The presence of an asymptomatic companion and non-home contact with people with flu-like syndrome or proven respiratory infection is recommended.	P24
	It is suggested that samples of swab pharyngeal, peripheral and cord blood, amniotic fluid, breast milk and placental tissue be stored for investigation.	P2
Breastfeeding	Breastfeeding should be postponed until NBs receive hygiene care and preventive measures for contamination by SARS-CoV2.	P10, P20, P21, P22, P23, P24
	Breastfeeding should be encouraged.	P20, P21, P23, P24
	When breastfeeding their children, women should use a face mask and clean their hands and utensils used for the extraction and supply of breast milk, before and after contact with each feeding.	P20, P21, P23, P24, P25
Neonatal postpartum care	Keep NBs in a private room for 14 days after birth and monitor them for clinical and laboratory manifestations of the infection.	P3, P5, P6, P9, P10, P13, P14, P15, P20, P25
	Precautions for joint accommodation consist of maintaining a minimum distance of one meter between the mother's bed and the NB's crib.	P24, P25

To be continued

Chart 3 (concluded)

Focus of attention	Prevention and neonatal control measures by COVID-19	Study
Neonatal postpartum care	Private accommodation with NBs is suggested, and distance of 1 meter between the mother's bed and the NB's crib must be respected or using physical barriers to maintain distance.	P20, P23
	Isolation of mothers with their babies should be done on a case-by-case basis, using shared decision-making between them and the staff.	P20
	Mothers and families should be made aware of the importance of hand hygiene and the use of a face mask in care of NBs and the importance of social distancing.	P18, P22
	Visits should be restricted to parents or legal guardians for these patients, as long as they do not have a suspicious condition or are confirmed for COVID-19 or have home contact with a person with the flu syndrome. It is strongly recommended that grandparents do not visit their grandchildren.	P24, P25
	Diagnostic and treatment equipment for suspected or confirmed NBs with the infection, such as a stethoscope and thermometer, for instance, must be for individual use.	P3, P8, P24,
	Strict disinfection protocol should be adopted in environments with NBs suspected or confirmed by the disease.	P15
	Strict hand hygiene in care for NBs suspected or confirmed by the disease should be maintained.	P22
	Hand wash is important before and after changing diapers as well as using a glove (if possible) and dispose of it in an appropriate place.	P20, P22, P24
	It is suggested to temporarily postpone elective follow-up appointments at the outpatient clinic of NB follow-up in the hospital.	P24
	Search for alternatives for monitoring NBs after discharge, such as online consultation in order to avoid exposure to the virus. If an injury is identified in NBs, it should be taken to the hospital as soon as possible.	P8
	When transporting a NB with suspicion or confirmation of COVID-19, the ambulance spaces must be strictly closed and isolated, and the car must be provided with protective equipment, disinfectant solution and alcohol gel for the hands. The ambulance must be disinfected before and after transfer.	P3

Chart 4 - Measures to prevent and control neonatal infection by COVID-19 during care for NBs, according to care by the health staff and the hospitalization sector, Brazil, 2020

Focus of attention	Neonatal prevention and control measures by COVID-19	Study
Staff care	Droplet and contact precautions should be instituted during hospitalization of NBs with the use of the respective PPE such as caps, safety glasses and protective clothing, gloves, cloak, surgical mask, among others.	P3, P10, P15, P19, P20, P24

To be continued

Chart 4

Focus of attention	Neonatal prevention and control measures by COVID-19	Study
Staff care	Adoption of standard precautionary measures for aerosols in all procedures that can produce them, such as endotracheal intubation, non-invasive ventilation, manual ventilation before intubation, bronchoscopy, among others.	P2, P3, P10, P20, P22, P25
	The staff must adopt strict hand hygiene before and after assisting NBs.	P15
	A minimum number of people working in the isolation of suspected or confirmed NBs should be selected.	P10, P15
	It is recommended that the discussion at the bedside be suspended by the staff providing assistance, as well as any and all collective activities carried out at the Neonatal Unit.	P23
Hospitalization sector	In shared accommodation between hospitalized healthy mothers, whose distance between beds in the binomial does not obey at least one meter, visits and the presence of companions should be suspended to avoid agglomerations.	P23, P24, P25
	The neonatal sector should be divided into transition, quarantine and general wards during the pandemic.	P3
	Implementation of social distancing strategies, covering the mouth when coughing or sneezing with disposable tissues, intensifying the cleaning and disinfection efforts of objects and equipment for NB care are essential.	P12, P22
	When receiving a NB with suspected COVID-19 infection, the investigation should be carried out based on family and clinical history and tested in case of exposure to infected people, regardless of their symptoms.	P9, P11
	SARS-CoV-2 positive neonates should be isolated and clinically monitored for 14 days, but this does not necessarily require admission to the NICU.	P3, P5, P6, P9, P10, P11, P13, P15, P20
	Pressure rooms or rooms in which the exhaust is filtered through high-efficiency particulate air filters for infants with confirmed infection should be used.	P10, P15
	There must be a minimum distance of one meter between incubators, common cribs and/or heated cribs.	P24
	Objects for personal use of NBs with suspicion or confirmation by COVID-19 should not be shared with others in the hospitalization area, including toys in pediatrics.	P12, P20, P23
	Symptomatic parents or home contacts of a person with the virus should not enter the NICU/coNICU until the SARS-CoV-2 transmission period has ended (14 days).	P24, P25
	Professionals should not talk at the bedside and should avoid collective activities carried out in the sector.	P23

To be continued

Chart 4 (concluded)

Focus of attention	Neonatal prevention and control measures by COVID-19	Study
Hospitalization sector	Hospital waste produced during the care of NBs with suspected or confirmed COVID-19 must be collected in a double-layer infectious waste bag and treated with a chlorine-containing preparation for at least 10 minutes and then disposed of in the same way as the waste infectious hospital.	P3, P19
	Terminal disinfection of the patient's room should preferably be done using atomization with hydrogen peroxide or a preparation spray containing chlorine.	P3, P19, P20

Note: NICU - Neonatal Intensive Care Unit; coNICU - Conventional Neonatal Intermediate Care Unit.

DISCUSSION

From the results, it was possible to verify that the publications on the measures of prevention and control of neonatal infection by COVID-19 are still incipient. There are few original studies developed so far, and the majority are from China, the first country to identify the disease. Obviously, this is because the disease is recent. Thus, in order to guide health professionals regarding such measures, Centers for Disease Control and Prevention (CDC), the Ministry of Health (MoH), the Brazilian Society of Pediatrics (*Sociedade Brasileira de Pediatria*, abbreviated SBP), the Brazilian Society of Pediatric Nurses (*Sociedade Brasileira de Enfermeiros Pediatras*, abbreviated SOBEP), and the Brazilian Association of Midwives and Midwifery Nurses (*Associação Brasileira de Obstetrizes e Enfermeiros Obstetras*, abbreviated ABENFO) also published guiding materials, such as those selected in this review.

Initially, the NBs of mothers with a history of virus infection between 14 days before delivery and 28 days after delivery or the NBs directly exposed to those infected (including family members, caregivers, staff and visitors), regardless of whether they have symptoms[7,9,16,27,35].

Therefore, the sectors of obstetrics and neonatology should jointly assess maternal and fetal conditions and choose the best time, route of delivery and place for delivery of pregnant women with suspected or confirmed SARS-CoV-2[16]. According to researchers, if pregnant women can be successfully treated, pregnancies should be allowed to continue until term. The mode of delivery should be based on the usual obstetric indications as there is no clear benefit of cesarean section in women with COVID-19[18].

Some researchers show uncertainties regarding the vertical transmission of the virus[14-16,18,20,22], which refers to the passage of a pathogen from the mother to the baby before and after birth. Specifically, it includes transmission via germ cells or placental blood during pregnancy, via the birth canal during delivery and during postpartum breastfeeding[19]. However, other studies have not identified this type of transmission of SARS-CoV-2 from infected mothers to their children[17,19,23-24,26].

For CDC, the findings so far suggest that there is no evidence of vertical transmission of SARS-CoV-2 from mothers infected to NBs[11,30]. Therefore, it is believed that transmission of the virus to NBs occurs mainly through respiratory droplets, close contact with infected people (caregivers, family members and visitors), infections acquired in hospitals and exposure to sources of infection in public places[6,11,19-20]. P12 points out that the new coronavirus can also be transmitted by contact with contaminated objects[6]. Soon, SARS-CoV2 can be transmitted by droplet, aerosol, and contact[33].

Furthermore, a negative pressure room for labor is recommended, whenever possible, prepared together with an isolation protection device, to minimize the damage to mothers and NBs[16,18,20]. Pregnant women with suspected infection should wear a surgical mask as a precautionary measure for transmission of the virus during labor[18].

In the event of the need for resuscitation of these neonates, professionals should rely on the standard Neonatal Resuscitation Program (NRP), paying attention to the use of personal protective equipment (PPE) such as cap, safety glasses or face shield, long-sleeve disposable cloak, gloves, N95 masks, among others[16,25,33]. These standard precautionary measures for aerosols should be practiced in all procedures that can produce aerosols, such as endotracheal intubation, non-invasive ventilation, manual ventilation before intubation, bronchoscopy, among others[9,16,29-31].

Some researchers, considering the possibility of vertical transmission, advise against the late cord clamping[16,18], in these cases should be performed with immediate clamping, considered as the one performed within one minute after birth[36]. However, MoH[32] and SBP[33] advise timely umbilical cord clamping even in these cases, probably because it considers that the diverse benefits of this practice outweigh the possible risks, still unknown.

Neonates born to mothers with suspected or confirmed COVID-19 should be cleaned and dried immediately after delivery[18], isolated and tested early for the disease[16], and skin-to-skin contact is advised against[16,18,25,32,34] for better control of COVID-19. Routinely, in Brazil, skin-to-skin contact between mother and baby is one of the precautions recommended by MoH[36] and by SBP[37] for NBs in the first minutes of life due to its diverse benefits. However, these agencies reaffirm that this practice should be suspended in cases of neonates born to mothers with suspected or confirmed COVID-19[32,34].

Although many researchers[9,16,18] do not recommend breastfeeding in situations of risk or confirmation of the disease, CDC[11], MoH[32], SOBEP and ABENFO[33] consider that, until then, there is insufficient evidence of vertical transmission of SARS-CoV-2 to NBs from infected mothers and that breast milk is the best source of nutrition for NBs. Therefore, they recommend that breastfeeding be maintained, as long as mothers and NBs are in good clinical condition and that all preventive measures are followed during the act. When breastfeeding, mothers should put on a surgical mask and clean their hands and breastfeeding tools before and after each feeding[11,30,33]. Another option is for mothers to offer expressed breast milk to NBs to establish and maintain milk supply, adopting the followard recommendations: hand wash before touching the breast milk pump or container for its storage, properly cleaning the pump and utensils used after each use and if possible someone else should offer the pumped milk to the baby[11].

It should be noted that, after birth, screening of suspected puerperal women is crucial for determining the decision to separate her or not from her baby. This should be done on a case-by-case basis, through shared decision-making between the family and the health staff[30]. Isolation of neonates born to

infected or suspected mothers should last at least 14 days, unless infection with SARS-CoV-2 is ruled out[18,29]. If separation is not carried out, other measures to reduce the risk of mother-to-baby transmission can be implemented, including the use of physical barriers between mother and baby[30], maintaining a minimum distance of one meter between the maternal bed and the crib of NBs[32], implementation of strict infection control measures, with the use of a surgical mask for contact with NBs and adequate hand hygiene before and after contact[24,32].

In the case of maternal isolation, there may be anxiety from parents and maternal depression and, therefore, the family should receive emotional support from an interprofessional staff. All situations must be reported and fully understood by parents/guardians[9,16,18]. Furthermore, the presence of a companion for the mother is suggested, as long as asymptomatic and that is not home contact of people with flu syndrome or respiratory infection confirmed by SARS-CoV-2[32].

It is proposed to screen puerperal women and their NBs, including swab pharyngeal, peripheral blood, placental tissue after delivery, amniotic fluid, umbilical cord blood and breast milk, for in-depth studies and continuous monitoring in future generations[15]. Additional sample types (e.g., feces, urine) can be collected and stored[16] .

If, after the birth of NBs, the test of the suspected mother is negative, they can be treated routinely by the joint accommodation's health staff. However, if the test is positive, the case should be treated according to the management of the diagnosed NBs. If babies have clinical symptoms of suspected virus, they should be admitted to the neonatal unit for diagnosis of COVID 19 and additional treatment[16]. It should be noted that, according to P11, neonatal respiratory failure can result from a wide variety of causes, which is why NBs admitted to the health unit should only be tested when there is reasonable suspicion[8].

Since clinical manifestations of SARS-CoV-2 infection in neonates are mostly nonspecific, such as fever, cough, runny nose, vomiting and respiratory effort[6,14,27] and, relatively mild[7,24,27], it is essential that health professionals monitor the NBs of mothers with suspected or confirmed COVID-19, both clinically and laboratorially for better infection control. Thus, it is necessary to closely monitor vital signs, respiratory and gastrointestinal symptoms[16,18]. However, the disease can be asymptomatic.

The relevance of nursing's performance stands out, not only because of their technical capacity, but also because they constitute the largest number of professionals in the health field, and are the only professional category that is with patients 24 hours a day[38]. This happens especially in neonatology, in which patients are totally dependent on nursing staff care.

Some researchers disagree on the need for hospitalization of the infected neonate at the NICU. While some argue that all NBs suspected or laboratory confirmed with the new coronavirus should be admitted to the NICU[29], others claim that they should be isolated and clinically monitored, but that they do not necessarily require admission to the NICU[8]. In case of admission, it is recommended, if possible, to separate an area for NB admission to mothers with suspected or confirmed cases [33]. It is proposed to suspend the discussion at the bedside by the health staff that provides assistance, as well as any and all collective activities carried out in the sector. Symptomatic patients or home contacts of people with the flu syndrome should not enter the ICU/coNICU until the SARS-CoV-2 transmission period has ended (14 days)[32].

If a cohort of patients is instituted at the ICU, it is strongly recommended to establish a specific staff for COVID-19 treatment, composed of neonatologist/pediatrician, neonatologist/pediatric nurse, nursing technicians, physiotherapist, hygiene collaborator and laboratory collaborator. This strategy prevents spread of microorganisms among patients hospitalized. It is also important to respect the minimum distance of one meter between incubators, common cots and/or heated cots[33].

Even if NBs are not admitted to the NICU, is expected to be kept in private beds. Diagnostic and treatment equipment, such as a stethoscope and thermometer, for instance, must be individual. To enter and leave the isolation ward, there should be appropriate protocol for hand hygiene and use of PPE[16,21,33]. Preferably, the isolation ward must be equipped with an isolated air cycle system, with negative pressure[9].

The strategies to be implemented during the care of NBs suspected or infected by the new coronavirus include use of PPE (cap, safety glasses or face shield, disposable long-sleeved cloak with elastic or mesh cuffs, with weight minimum of 30 g/m^2, and with mooring on the back, gloves and surgical masks); signage at the entrance; strict hand hygiene; daily cleaning and disinfection of the environment; provision of PPE for the entire health staff; improved additional contact precautions and precautions against respiratory droplets that include patient equipment; restricted visits by parents/family; change of cloak and glove after the procedures and open of the window regularly to change the air; and hand wash before and after changing diapers, using a glove (if possible) and disposing it in appropriate place[9,16,30-31,33,35].

The room of these neonates cannot be used by other patients until they are properly disinfected. If this patient shares a room with other NBs before being diagnosed, all ward members should be isolated. The terminal disinfection of the patient's room should preferably be done using atomization with hydrogen peroxide or a preparation spray containing chlorine[16,30,35]. Hospital waste produced during care for infected NBs should be collected in a double-layer infectious waste bag and treated with a chlorine-containing preparation for at least 10 minutes and then disposed of in the same way as infectious hospital waste[16,35].

Considering the need to transport NBs, the spaces in the ambulance must be strictly closed and isolated, and the car must be provided with PPE, disinfectant solution and alcohol gel for the hands. The ambulance must be disinfected before and after transferring patients. In addition, accompanying health staff members must wear PPE[16].

To prevent spread of COVID-19 among neonates, some other actions must be performed by professionals, such as covering their mouths when coughing or sneezing with disposable tissues and cleaning and disinfecting objects and toys routinely[31]. Objects for personal use by these patients should not be shared with others in the hospitalization area, including toys[33].

When a NB is admitted to health units, if their parents or legal guardians present a suspected or confirmed condition for COVID-19 or have home contact with a person with the flu syndrome, they must maintain isolation at home for 14 days,

being prevented from attending the unit during that period. If the aforementioned occurs, neonates must be followed at the health unit by other asymptomatic parents and other than home contact of a person with flu syndrome or respiratory infection confirmed by SARS-CoV-2[33].

During the pandemic, new care strategies must be adopted to ensure the full growth and development of NBs, considering the measures to prevent and control COVID-19. Nurses, during the assistance to non-hospitalized NBs with suspicion of the disease, must collect their epidemiological history, from families, caregivers and visitors during the 14 days prior to the clinical manifestations and also measure their body temperature routinely[21-22].

It is important to understand the role of NBs in the dynamics of outbreak transmission as they can become a significant diffuser in the outbreak. Thus, it is necessary to raise awareness among the general population, reinforce infection control measures and carry out family health management[28].

Study limitations

In this review, most of the measures disclosed are limited to previous experiences with outbreaks by other coronaviruses in adults and children, since research is still incipient in relation to the subject. We opted to include the gray literature to ensure a greater body of knowledge, considering the opinion of experts and guidelines from MoH and other national and global health institutions.

Contributions to nursing and health

The plural role of nurses and their leadership position in the staff places them as a protagonist in combating disease transmission. Given of the country's current epidemiological scenario, this review is essential for mapping together with nursing literature the measures to prevent and control neonatal infection by COVID-19, which can guide the nursing care provided by nurses and subsidize future research. We need to pay attention to the protection and control measures against neonatal COVID-19 infection, listed by nurses and other health professionals during obstetric and neonatal care, which will likely be modified as new evidence appears and clinical experience with the new coronavirus accumulates. Therefore, nurses and other health professionals must continually update their knowledge and skills in preventing and controlling COVID-19 in neonatology to minimize the impacts on Brazilian public health.

CONCLUSION

This study contributes to the body of knowledge of nurses and other health professionals regarding the main measures for preventing and controlling neonatal infection by COVID-19. It is believed that, through strict compliance with these actions, it is possible to reduce the implications of this pandemic for NBs. The measures found in this review are aimed at assisting NBs from the delivery room to hospitalization, either in units of joint accommodation, coNICU, NICU, as well as in Primary Health Care. Among the main measures found, the use of surgical masks by infected people in contact with healthy NBs stands out, hand hygiene before and after each care and each feeding, and also hygiene of the tools used in milking the breasts, essential care to be developed in partnership with families. It is indispensable to use personal protective equipment by health professionals in obstetrics, neonatology and Primary Health Care services. During hospitalization, it is necessary to maintain a private room for infected neonates or to use physical barriers. It is noteworthy that early diagnosis and timely management of cases are essential to reduce transmissibility.

REFERENCES

1. World Health Organization. WHO Director-General's remarks at the media briefing on 2019-nCoV on 11 February 2020 [cited 2020 Mar 30]. Available from: https://www.who.int/dg/speeches/detail/who-director-general-s-remarks-at-the-media-briefing-on-2019-ncov-on-11-february-2020
2. Baig AM, Khaleeq A, Ali U, Syeda H. Evidence of the COVID-19 Virus Targeting the CNS: Tissue Distribution, Host–Virus Interaction, and Proposed Neurotropic Mechanisms. ACS Chem Neurosci. 2020;11(7):995–998. doi:10.1021/acschemneuro.0c00122
3. Deng C. The global battle against SARS-CoV-2 and COVID-19. Int J Biol Sci. 2020;16(10):1676–1677. doi: 10.7150/ijbs.45587
4. Ministério da Saúde. Painel de casos de doença pelo coronavírus 2019 (COVID-19) no Brasil pelo Ministério da Saúde - Atualizado em: 18:30 08/06/2020. [cited 2020 Jun 09]. Available from: https://covid.saude.gov.br/
5. Agência Nacional de Vigilância Sanitária (ANVISA). Nota técnica VIMS/GGTES/ANVISA nº 04/2020. Orientações para serviços de saúde: medidas de prevenção e controle que devem ser adotadas durante a assistência aos casos suspeitos ou confirmados de infecção pelo novo coronavírus (SARS-CoV-2). Brasília, 2020. [cited 2020 Abr 16]. Available from: http://portal.anvisa.gov.br/documents/33852/271858/Nota+T%C3%A9cnica+n+04-2020+GVIMS-GGTES-ANVISA/ab598660-3de4-4f14-8e6f-b9341c196b28
6. Cao Q, Chen YC, Chen CL, Chiu CH. SARS-CoV-2 infection in children: Transmission dynamics and clinical characteristics. J Formos Med Assoc. 2020;119(3):670-673. doi: 10.1016/j.jfma.2020.02.009
7. Dong Y, Mo X, Hu Y, Qi X, Jiang F, Jiang Z, Tong S. Epidemiology of COVID-19 Among Children in China. Pediatrics. 2020;145(6):e20200702. doi: 10.1542/peds.2020-0702
8. Luca D. Managing neonates with respiratory failure due ta SARS-CoV-2. Lancet Child Adolesc Health. 2020;4: e8. doi:10.1016/S2352-4642(20)30073-0
9. Li F, Feng ZC, Shi Y. Proposal for prevention and control of the 2019 novel coronavirus disease in newborn infants. Arch Dis Child Fetal Neonatal Ed. 2020;0(0):F1. doi: 10.1136/archdischild-2020-318996

10. World Health Organization (WHO). Modes of transmission of the COVID-19 virus - Scientific brief. 29 March 2020. 2020 [cited 2020 Mar 17]. Available from: https://www.who.int/news-room/commentaries/detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations

11. Centers for Disease Control and Prevention. Coronavirus Disease 2019 (COVID-19). Pregnancy & Breastfeeding. 2020 [cited 2020 Mar 26]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/prepare/pregnancy-breastfeeding.html#anchor_1584169983

12. World Health Organization (WHO). Infection prevention and control of epidemic- and pandemic-prone acute respiratory infections in health care. WHO Guidelines. 2014 [cited 2020 Mar 17]. Available from: https://apps.who.int/iris/handle/10665/112656

13. Peters MDJ, Godfrey C, McInerney P, Munn Z, Tricco AC, Khalil, H. Chapter 11: Scoping Reviews (2020 version). In: Aromataris E, Munn Z (Editors). Joanna Briggs Institute Reviewer's Manual, JBI, 2020 [cited 2020 Mar 30]. Available from: https://reviewersmanual.joannabriggs.org/

14. Ludvigsson JF. Systematic review of COVID-19 in children shows milder cases and a better prognosis than adults. Acta Paediatr. 2020;00:1-8. doi:10.1111/apa.15270

15. Wang S, Guo L, Chen L, Liu W, Cao Y, Zhang J, Feng L. A Case Report of Neonatal 2019 Coronavirus Disease in China. Clin Infect Dis. 2020;XX(XX):1-5. doi: 10.1093/cid/ciaa225

16. Wang L, Shi Y, Xiao T, Fu J, Feng X, Mu D, Feng Q, Hei M, Hu X, Li Z. et al. Chinese expert consensus on the perinatal and neonatal management for the prevention and control of the 2019 novel coronavirus infection (First edition). Ann Transl Med. 2020;8(3):47. doi: 10.21037/atm.2020.02.20

17. Schwartz DA. An Analysis of 38 Pregnant Women with COVID-19, Their Newborn Infants, and Maternal-Fetal Transmission of SARS-CoV-2: Maternal Coronavirus Infections and Pregnancy Outcomes. Arch Pathol Lab Med In-Press. 2020. doi: 10.5858/arpa.2020-0901-SA

18. Chen D, Yang H, Cao Y, Cheng W, Duan T, Fan C, Fan S, Feng L, Gao Y, He F. et al. Expert consensus for managing pregnant women and neonates born to mothers with suspected or confirmed novel coronavirus (COVID-19) infection. Int J Gynaecol Obstet. 2020;149:130-136. doi: 10.1002/ijgo.13146

19. Zhu H, Wang L, Fang C, Peng S, Zhang L, Chang G, Xia S, Zhou W. Clinical analysis of 10 neonates born to mothers with 2019-nCoV pneumonia. Transl Pediatr. 2020;9(1):51-60. doi: 10.21037/tp.2020.02.06

20. Schwartz DA, Graham AL. Potential Maternal and Infant Outcomes from (Wuhan) Coronavirus 2019-nCoV Infecting Pregnant Women: Lessons from SARS, MERS, and Other Human Coronavirus Infections. Viruses. 2020;12(2). pii: E194. doi: 10.3390/v12020194

21. Ma XL, Chen Z, Zhu JJ, Shen XX, Wu MY, Shi LP, Du LZ, Fu JF, Shu Q. Management strategies of neonatal jaundice during the coronavirus disease 2019 outbreak. World J Pediatr. 2020. doi: 10.1007/s12519-020-00347-3.

22. Chen ZM, Fu JF, Shu Q. New coronavirus: new challenges for pediatricians. World J Pediatr. 2020. doi: 10.1007/s12519-020-00346-4

23. Zeng H, Xu C, Fan J, Tang Y, Deng Q, Zhang W, Long X. Antibodies in Infants Born to Mothers With COVID-19 Pneumonia. JAMA. 2020;26. doi: 10.1001/jama.2020.4861

24. Zeng L, Xia S, Yuan W, Yan K, Xiao F, Shao J, Zhou W. Neonatal Early-Onset Infection With SARS-CoV-2 in 33 Neonates Born to Mothers With COVID-19 in Wuhan, China. JAMA Pediatr. 2020;26. doi: 10.1001/jamapediatrics.2020.0878

25. Lu Q, Shi Y. Coronavirus disease (COVID-19) and neonate: What neonatologist need to know. J Med Virol. 2020:1–4. doi: 10.1002/jmv.25740

26. Khan S, Peng L, Siddique R, Nabi G, Xue M, Liu J, Han G. Impact of COVID-19 infection on pregnancy outcomes and the risk of maternal-to-neonatal intrapartum transmission of COVID-19 during natural birth. Infect Control Hosp Epidemiol. 2020:1-9. doi: 10.1017/ice.2020.84

27. Xia W, Shao J, Guo Y, Peng X, Li Z, Hu D. Clinical and CT features in pediatric patients with COVID-19infection: Different points from adults. Pediatric Pulmonology. 2020;1–6. doi: 10.1002/ppul.24718

28. Hong H, Wang Y, Chung H, Chen C. Clinical characteristics of novel coronavirus disease 2019 (COVID-19) in newborns, infants and children. Pediatr Neonatol. 2020;61:131-132. doi: 10.1016/j.pedneo.2020.03.001

29. Wang J, Shi Y. Managing neonates with respiratory failure due ta SARS-CoV-2 - Authors' reply. Lancet Child Adolesc Health. 2020;4(4):e9. doi: 10.1016/S2352-4642(20)30072-9

30. Centers for Disease Control and Prevention. Coronavirus Disease 2019 (COVID-19). Interim considerations for infection prevention and control of coronavirus disease 2019 (COVID-19) in inpatient obstetric healthcare settings. 2020 [cited 2020 Abr 02]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/inpatient-obstetric-healthcare-guidance.html.

31. Centers for Disease Control and Prevention. Coronavirus Disease 2019 (COVID-19). For Child Care Programs That Remain Open. 2020 [cited 2020 Abr 02]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/guidance-for-childcare.html

32. Ministério da Saúde. Secretaria de Atenção Primária à Saúde. Departamento de Ações Programáticas Estratégicas. NOTA TÉCNICA Nº 6/2020-COCAM/CGCIVI/DAPES/SAPS/MS. Atenção à saúde do recém-nascido no contexto da infecção pelo novo coronavírus. Brasília: Ministério da Saúde, 2020 [cited 2020 Mar 26]. Available from: http://www.mpgo.mp.br/portal/arquivos/2020/03/30/22_34_25_489_SEI_MS_0014134779_Nota_T%C3%A9cnica_Atencao_ao_RN_durante_COVID.pdf

33. Sociedade Brasileira de Enfermeiros Pediatras e Associação Brasileira de Obstretrizes e Enfermeiros Obstetras. Nota técnica referente aos cuidados da equipe de enfermagem obstétrica, neonatal e pediátrica diante de caso suspeito ou confirmado de COVID-19. SOBEP/ABENFO: 2020.

34. Sociedade Brasileira de Pediatria (SBP). Nota de alerta- Prevenção e abordagem da infecção por COVID-19 em mães e recém-nascidos, em hospitais-maternidades. Rio de Janeiro: 2020 [cited 2020 Mar 26]. Available from: https://www.sbp.com.br/fileadmin/user_upload/22412b-Nota_Alerta_PrevenAbordagem_infeccao_COVID19_maes-RN_em_HospMatern.pdf

35. Wang J, Qi H, Bao L, Li F, Shi Y. A contingency plan for the management of the 2019 novel coronavirus outbreak in neonatal intensive care units. Lancet Child Adolesc Health. 2020; 4(4):P258-259. doi: 10.1016/S2352-4642(19)30426-2

36. Ministério da Saúde. Comissão Nacional de Incorporação de Tecnologias no SUS (CONITEC). Diretriz Nacional de Assistência ao Parto Normal: Relatório de recomendação. CONITEC, Brasília, DF: 2016 [cited 2020 Abr 27]. Available from: http://conitec.gov.br/images/Consultas/2016/Relatorio_Diretriz-PartoNormal_CP.pdf

37. Sociedade Brasileira de Pediatria (SBP). Nascimento seguro. Documento científico. Departamento científico de neonatologia. 2018[cited 2020 Abr 27]; 3:1-9. Available from: https://www.sbp.com.br/fileadmin/user_upload/Neonatologia_-_20880b-DC_-_Nascimento_seguro__003_.pdf

38. Conselho Federal de Enfermagem. Cofen publica nota de esclarecimento sobre o Coronavírus (COVID-19). 2020 [cited 2020 Abr 27]. Available from: http://www.cofen.gov.br/cofen-publica-nota-de-esclarecimento-sobre-o-coronavirus-covid-19_77835.html