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## International comparison of guidelines for managing neonates at the early phase of the SARS-CoV-2 pandemic

Anna Lavizzari<sup>1</sup>, Claus Klingenberg<sup>2,3</sup>, Jochen Profit<sup>4,5</sup>, John A.F. Zupancic<sup>6,7</sup>, Alexis S. Davis<sup>4</sup>, Fabio Mosca<sup>1,8</sup>, Eleanor J Molloy<sup>9,10,11,12</sup>, Charles C Roehr<sup>13,14</sup>.

The International Neonatal COVID-19 Consortium includes the above-named authors and collaborators, Dirk Bassler (Zurich, Switzerland), John Burn-Murdoch (The Financial Times, London, UK), Olivier Danhaive (Brussels, Belgium), Jonathan Davis (Perth, Australia), Walusa Assad Gonçalves Ferri (Sao Paulo, Brazil), Hans Fuchs (Freiburg i. B., Germany), Haiyan Ge (Shijiazhuang, China), Amit Gupta (Oxford, United Kingdom), Munish Gupta (Boston, USA), Astri Lang (Oslo, Norway), Anton van Kaam (Amsterdam, The Netherlands), Victor Javier Lara Díaz and Rodolfo Treviño-Pérez (Monterrey, Mexico), Daniel Helkey<sup>4,5</sup>, Sahil Tembulkar<sup>4,5</sup>, Gonzalo Luis Mariani (Buenos Aires, Argentina), Lars Naver (Stockholm, Sweden), Atul Patel (Nairobi, Kenya), Prakeshkumar Shah (Toronto, Canada), Tomasz Szczapa (Poznan, Poland), Maximo Vento (Valencia, Spain), Sven Wellmann (Regensburg, Germany), Shmuel Zangen (Ashkelon, Israel).

1. Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, NICU, Milan, Italy
2. Department of Paediatric and Adolescent Medicine, University Hospital of North Norway, Tromsø, Norway
3. Paediatric Research Group, Department of Clinical Medicine, UiT- The Arctic University of Norway, Tromsø, Norway
4. Division of Neonatal and Developmental Medicine, Department of Pediatrics, Stanford University School of Medicine, Palo Alto, CA
5. California Perinatal Quality Care Collaborative, Palo Alto, CA
6. Department of Neonatology, Beth Israel Deaconess Medical Center, Boston, MA
7. Division of Newborn Medicine, Harvard Medical School, Boston, Boston, MA
8. Department of Clinical Sciences and Community Health, University of Milan, Milan, Italy.
9. Paediatrics, Academic Centre, Children's Hospital Ireland (CHI) at Tallaght, Trinity College, the University of Dublin, Dublin, Ireland
10. Trinity Translational Medicine Institute, St James' Hospital, Dublin, Ireland
11. Neonatology, Coombe Women and Infants' University Hospital, Dublin, Ireland
12. Neonatology, CHI at Crumlin, Dublin, Ireland

13. Newborn Services, John Radcliffe Hospital, Oxford University Hospitals NHS Foundation Trust, Oxford, United Kingdom
14. National Perinatal Epidemiology Unit, Nuffield Department of Population Health, University of Oxford, Oxford, United Kingdom

**Correspondence to:**

Anna Lavizzari,

Fondazione IRCCS Cà Granda Ospedale Maggiore Policlinico

Dipartimento Donna-Bambino-Neonato, Neonatal Intensive Care Unit

Via Commenda 12, 20135 Milan,

ITALY

Phone: +02 5503 2907; +39 320 87 15 095

Email: anna.lavizzari@gmail.com; anna.lavizzari@policlinico.mi.it

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**Impact:**

- 1. What is the key message of your article?** At the rapid onset of the COVID19 pandemic, all countries presented protocols in place for managing infants at risk of COVID19, with a certain degree of variations among regions
- 2. What does it add to the existing literature?** A detailed review of ad hoc guidelines is presented, similarities and differences are highlighted.
- 3. What is the impact?** We provide a broad overview of currently applied recommendations highlighting the need for international context-relevant coordination.

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**ABSTRACT**

**Background:** The COVID-19 pandemic threatens global newborn health. We describe the current state of national and local protocols for managing neonates born to SARS-CoV-2 positive mothers.

**Methods:** Care providers from neonatal intensive care units on six continents exchanged and compared protocols on the management of neonates born to SARS-CoV-2 positive mothers. Data collection was between March 14-21 2020. We focused on central protocol components including triaging, hygiene precautions, management at delivery, feeding protocols and visiting policies

**Results:** Data from 20 countries were available. Disease burden varied between countries at the time of analysis. In most countries, asymptomatic infants were allowed to stay with the mother and breastfeed with hygiene precautions. We detected discrepancies between national guidances in particular regarding triaging, use of personal protection equipment, viral testing and visitor policies. Local protocols deviated from national guidance.

**Conclusion:** At the start of the pandemic, lack of evidence-based guidance on the management of neonates born to SARS-CoV-2 positive mothers has led to ad hoc creation of national and local guidance. Compliance between collaborators to share and discuss protocols was excellent and may lead to more consensus on management, but future guidance should be built on high-level evidence, rather than expert consensus.

**INTRODUCTION**

In December 2019, a new severe disease caused by coronavirus 2 (SARS-CoV-2) emerged in Wuhan, China, creating a global pandemic of unprecedented magnitude.(1) By April 2, 2020 over 1,000,000 cases of COVID-19 have been reported in more than 200 countries, resulting in more than 52,000 deaths.(2) COVID-19 appears to have the greatest impact on seniors and those with significant co-morbidities.(3)

SARS-CoV-2 infection in children appears to be less common and less severe compared with adults.(4 -6) Few cases of neonatal COVID-19 have been reported to date and little is known regarding route of infection, clinical presentation, management and outcome.(7)(8) Reassuringly, vertical transmission of SARS-CoV-2 appears rare, consistent with other coronavirus infections.(7, 9) In the few reported infants with possible vertical transmission the clinical course was mild.(5, 8, 10) Answers are missing to a number of pressing questions, including the significance of vertical and horizontal transmission for the newborn, route and timing of horizontal transmission, the role of breastfeeding, prediction of infant disease severity, the effectiveness of preventive measures to protect infants and health care workers (HCW), as well as the potential side effects of such measures. Nonetheless, HCW must act to protect patients and families in the face of uncertainty. The aforementioned questions are of utmost importance for organizing an effective and efficient health system response for mothers and infants, while protecting HCW and limited resources. Yet, in the absence of high-quality evidence, pragmatic solutions need to be found.(11)

We compare the experiences and practical recommendations from international, national, and local guidelines on the management of newborn infants born to SARS-CoV-2 suspected or positive mothers. Common to all efforts are the lack of objective data and limited published reports on effective management at the time guidelines were devised. This report reflects possible management options at a specific point in time and future work will supercede the presented guidance. We aim to highlight the state of coordinated guideline-informed approaches to the pandemic while extracting lessons for future pandemic preparedness.

## **METHODS**

On March 10, 2020, a core group of experts in neonatal intensive care from Italy, Norway, the United States (US), Ireland and the United Kingdom (UK), began to share local guidance on the management of babies born to mothers with COVID-19. Initially, protocols from Chinese units were requested from professional contacts, followed by further invitation of key professionals, in the following referred to as collaborators, who were identified via societal databases (European Society for Paediatric Research, Society for Pediatric Research and American Academy of Pediatrics, and personal contacts). We aimed to secure global representation through a wide selection of national backgrounds, including low-and-middle-income countries. Collaborators shared national epidemiological data on disease prevalence and provided national and local guidelines on the management of neonates born to COVID-19 suspected or positive mothers. When local guidelines were provided, they reflected practice at the collaborators' institution, but were not necessarily representative of national guidelines.

A convenience sample of twenty-three experts from twenty-one countries were approached via email with a structured questionnaire. Collaborators were surveyed between March 14-21, 2020. We focused on the following aspects of management:

organization of hospital triaging and centralization of care (sequestering patients in designated hospitals or wards); hygiene management, including use of personal protective equipment (PPE) in the delivery room (DR) and the NICU with a specific focus on aerosol-generating procedures (AGP); clinical pathways for asymptomatic infants, those delivered vaginally or by cesarean section and those inborn or outborn; approaches to breastfeeding; diagnostic testing; family access to the NICU; and psychological support for families and health care workers.

Data was analyzed in Microsoft Excel (Microsoft Redmond, Washington, U.S.).

## RESULTS

The epidemiological burden of COVID-19 differs markedly between countries. By March 21, 2020, Italy and China were the two most severely affected countries, while eight countries reported fewer than 10 deaths (for more detail see Supplemental Table S1). The availability of local and national guidelines for neonatal management varied considerably amongst collaborators. Half of the institutions adopted national guidelines, and the remainder relied on local guidelines. Reasons for not adopting national guidelines included: unavailable at the time of the survey, difficult application or disagreement with national guidelines, and lack of granularity of national guidelines. Means for triaging actively laboring SARS-CoV-2 positive mothers were considered in all guidelines. Interventions included transfer to specific hospitals or hospital sites, for example designated isolation rooms on delivery suites (DS). Guidelines regarding centralization of care for symptomatic and/or SARS-CoV-2 positive infants varied widely (Table 1). More consistency was observed with regard to PPE, which was universally recommended during neonatal management in the delivery room (Table 2). Isolation procedures in the NICU varied, with the majority of respondents suggesting isolation for

infants in single rooms. When conducting AGP such as non-invasive respiratory support, most guidelines recommended isolation in closed incubators. However, only a few institutions had an explicit respiratory support plan for infected and/or symptomatic patients. Most national or local guidelines suggested that an asymptomatic infant could stay with the mother to breastfeed, with the exception of China, and, in part, Ireland and the US. Breastfeeding COVID-19 positive mothers were to be supplied with material clearly explaining hygienic precautions. Most guidelines recommend viral testing of all infants born to COVID-19 positive mothers but a few countries restricted testing to symptomatic infants (Table 3). For viral testing, nasopharyngeal swabs (NPS) were most commonly advised. In Table 4, we present data on infant feeding, visitation arrangements, and considerations for psychological care for parents/caregivers. Guidelines from several countries included detailed descriptions of recommended psychological care; however, the content varied. Very few guidelines mentioned psychological care for parents or HCW affected by COVID-19.

**DISCUSSION**

We performed an analysis of the early, quasi *ad hoc* process of national and local guidelines developed for managing neonates born to SARS-CoV-2 positive mothers during the month of March 2020. Our pragmatic international survey includes guidance from twenty countries on six continents. Many similarities, but also striking differences, became apparent. At the early stage of the pandemic, guidelines from the World Health Organization (WHO) or national authorities may have been difficult to implement in different local contexts, or had left several, relevant aspects of newborn care undefined, necessitating the formulation of pragmatic local recommendations. We have observed the constant growth in the evidence-base for managing infants born to COVID-19 positive mothers alongside the changing interpretation of the available data. Thus, already existing guidelines are being adapted in a non-predictable pattern. Common to all is the likelihood that guidelines will continue to evolve over the coming weeks according to the best available evidence. Until sufficiently evidence-based guidelines are in place, international recommendations and national protocols need to be adapted to the local settings.

The progression of international and national guidance since the writing of this paper illustrates how knowledge gained and shared by reputable institutions world-wide has entered guidelines. On March 13<sup>th</sup>, the WHO published an interim guidance on clinical management of COVID-19, “Caring for infants and mothers”.(12) At that time, available evidence suggested no vertical transmission, and in small case series from China samples from amniotic fluid, genital tract, cord blood, and breastmilk from COVID-19 infected mothers were negative for SARS-CoV-2. (9, 13-15) The Royal College of Obstetricians and Gynaecologists (RCOG) in the UK published their first guidance “Coronavirus (COVID-19) infection and pregnancy” even before the WHO on the 9<sup>th</sup> of March. Since then, there have

been regular updates, and the 5<sup>th</sup> version appeared on the 28<sup>th</sup> of March, reflecting the rapidly evolving knowledge in this area.(16)

An issue of primary interest for neonatologists is the DR management of infants born to mothers with suspected or confirmed SARS-CoV-2 infection. The limited literature concerning the risk of vertical transmission of SARS-CoV-2 as well as for related viruses causing severe respiratory illness, SARS-CoV and MERS-CoV, indicates a low risk.(6, 7) The first reports on postnatal COVID-19 disease in newborns from China have also been reassuring. (5, 8) Many experts suggest that the contagious potential of the newborn infants themselves immediately after birth is very low. Nevertheless, an anxiety persists as the DR setting represents a contagious area due to maternal COVID-19 disease and due to possible contact with maternal fecal flora containing virus and transmitted to the baby at delivery. Therefore, all international, national, and local guidelines presented in our current report recommended caution during deliveries, including isolation room and the need for PPE, and have made no distinction in managing cesarean and vaginal deliveries.

One of our most pertinent findings concerned the guidance on the controversial topic of mother-infant-separation, i.e. whether a COVID-19 positive mother and her asymptomatic infant should be separated right after birth in order to prevent postnatal horizontal disease transmission, through contact or respiratory droplets. In China, this seems to be routine practice and infants are usually fed formula.(17) In contrast, both WHO and RCOG recommend that babies may stay with the mother if she is able to care for the infant, and breastfeeding is recommended.(12, 16) The interim guidance from the Center of Disease Control (CDC) in the US takes an intermediate standpoint on this topic and suggests that “whether and how to start or continue breastfeeding should be determined by the mother in

coordination with her family and healthcare providers. A mother with confirmed or suspected COVID-19 should take all possible precautions to avoid spreading the virus to her infant, including washing her hands before touching the infant and wearing a face mask, if possible, while feeding at the breast".(18) In our study, the majority of national or local guidelines allowed the mother to stay with her asymptomatic infant after birth, and supported breastfeeding with hygiene precautions. These countries/hospitals most likely considered that the benefits of breastfeeding and early infant bonding outweigh the potential risks of postnatal transmission and in most cases mild respiratory disease in infants. The exceptions were China where separation was recommended, Ireland where separation was suggested but maternal decision to room-in with precautions was also available, the US where the CDC suggests "consider temporary separation", and Israel where a COVID-19 positive mother and her COVID-19 negative child should be separated.

Isolation and personal protection practices were quite consistent across countries. Although neonates are not typically considered capable of generating infectious airborne particles, airborne precautions are recommended for AGPs for infants with SARS-CoV-2 infection.(19) NICUs from most countries reported the use of PPE for neonatal resuscitation for newborns of mothers who are suspected or confirmed COVID-19 positive. This is to protect HCW from maternal aerosolization in the second stage of labor or from the potential contamination and aerosolization that may occur during neonatal resuscitation. Recommendations for protection did not differ for infants in need of immediate intensive care after vaginal or caesarean delivery. The notable exceptions were Norway and Sweden, who consider infants after vaginal or caesarean delivery not likely or very unlikely to be contagious if immediately separated from the mother, for example due to preterm delivery or acute asphyxia, owing to the lack of demonstrated vertical transmission. For potentially contagious infants in the NICU, countries were also quite consistent in attempting to care for infants in incubators, in

isolation or, if available, in negative pressure rooms (particularly in those with aerosolizing respiratory support), and HCW wearing PPE. One NICU from Brazil limits non-invasive respiratory support, favoring intubation instead, which is aligned with recommendations for adult management of COVID-19 associated acute respiratory syndrome. Several countries use filters in their equipment to minimize aerosolization. Given the shortage of PPE, equipment, and physical space to isolate infants, many countries employ efforts to limit their use, such as cohorting of patients, limiting staff access, and ending isolation as soon as feasible based on testing. A careful balance must be achieved between protecting HCW and other patients from infection while minimizing PPE wastage in low risk patients. Continued data collection will reveal the true risk posed by newborns to transmit SARS-CoV-2 infection.

Guidelines in most countries suggest performing viral testing of all neonates born to COVID-19 positive mothers, regardless of symptoms. A few countries recommend testing only symptomatic infants. The purpose of testing may be to explain symptoms in infants with respiratory pathology and to end isolation measures in asymptomatic infants tested negative on two separate occasions. Obtaining NPS on asymptomatic infants may result in false negatives, and the optimal timing of testing is unclear,(20) a potential argument for not testing asymptomatic infants. In contrast, it has been suggested that all infants presenting with possible COVID-19 respiratory symptoms should be tested after 72 hours of age to avoid potential false negative results and tested again on day 5 before declaring non-infected.(20) However, the timing of testing is still controversial.(8)

In response to the pandemic, all countries reported a restricted regimen for family access to the NICU.(21) The majority of hospitals limited access to the NICU to only one parent at a time, wearing a surgical mask and under strict hygiene precautions. All strictly prohibited the

entrance of symptomatic visitors. At the time of the survey, only Australia had not yet limited parental NICU access, possibly reflecting a different disease burden at the time (Figure 1). In China and Poland, by contrast, the restriction to parental access also extended to mothers. Limitations in parent-infant contact may have significant adverse consequences on infants' neurobehavioral development and family psychological well-being. Nevertheless, the dire risk of contracting SARS-CoV-2 led to unanimous agreement for prioritizing patients and HCW safety over family-centered care. All countries though recognized the need for psychological support for families. The medical uncertainties related to COVID-19 are amplified in pediatric patients due to the lower rate and severity of cases compared with adult patients, and lack of follow-up data. To date, neither the WHO nor other international organizations recommended a specific follow up for infants developing COVID-19.(12) Only a few countries have already put in place a structured follow up, highlighting the need for more information about the disease course in infancy.

It is heartening that this sample of guidelines agreed in several domains, but we also found multiple areas in which recommendations diverged between local and national guidance, or between countries. The reasons for such inconsistency in practice can generally be grouped into two categories, both of which are more pronounced during the COVID-19 pandemic. First, the interpretation of evidence may differ between organizations conducting literature review. This will be particularly evident when evidence is lacking, of poor quality, or only indirectly applicable, as is the case with a novel viral disease. Standardization of care is still likely to improve outcomes even in such a situation, but the choice of which potentially better practices to implement is much more arbitrary in the absence of high-quality data. Second, countries and institutions develop guidelines with close consideration of the context in which they will be applied. The same intervention may be highly effective in one setting, but of less

use in another. Relevant context in the case of COVID-19 might include the feasibility of implementation given supply chain disruptions and personnel availability, the background prevalence of disease and the degree of central control and regionalization of a health care system, which facilitates the dissemination and adoption of recommendations at the frontline.

The scenario of a global viral (influenza) pandemic had been predicted for decades,(22) but when it happened with this new coronavirus, the neonatal health care community was relatively unprepared. However, rarely was the need for robust guidelines on disease management so immediately needed as in these times. Likewise, to date, concerted efforts to combat global pandemics have rarely been put to the test at such intensity. Specific efforts are ramping up to better understand this specific pandemic, but the need for a systematic effort to create an international structure for disaster preparedness is evident. Such a structure could provide important epidemiologic and quality of care information, including for example, disease incidence, and diagnostic and therapeutic approaches. It could also serve as a rapidly mobilized trials network. Existing quality improvement networks, such as the Vermont Oxford Network, have started organizing an audit platform (VON SONPM Covid-19 Impact Audit) to assess and track the impact of Covid-19 in neonatal units around the world (Jeffrey Horbar, personal communication April 1, 2020).

This study should be viewed in light of its design. We managed to collect granular data on guidelines from 20 countries in 6 continents early in the pandemic. However, not all respondents had available or applied national guidelines, and their responses thus reflected local rather than national practice. COVID-19 guidelines reported in this study reflect a single timepoint early in the pandemic with countries at different stages as illustrated in Figure 1. Thus, variation in response may not reflect different practice but simply different

timing and it is possible that responses centered by pandemic stage would further converge. However, given socio-political, cultural, health system, and resource capacity differences across countries, we think that convergence would remain incomplete. Finally, we did not inquire regarding each institution's volume of suspected or known COVID-19 positive mothers or infants, which may influence local response readiness. However, given the early pandemic stage in most countries, few respondents had significant patient volume.

### **Conclusions**

This paper establishes both similarities and differences in the management of newborns at the early stage of this pandemic. Guidelines and evidence are rapidly evolving with rapid generation of new knowledge.<sup>(23)</sup> However, many aspects of COVID-19 still lack clarifying evidence, particularly for the population of newborn infants. Generous and high-level international collaboration across the specialty of neonatology will promote best-practice guidelines for the care of infants, and offers a path forward beyond the immediate needs during this pandemic.

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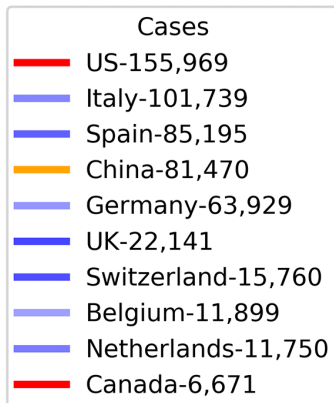
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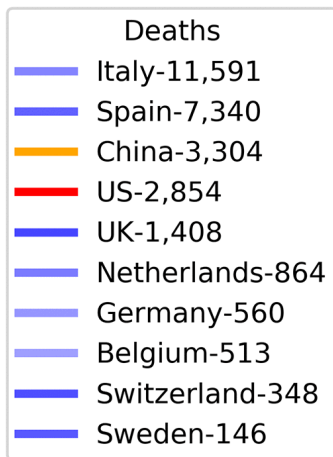
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**Figure Legends**

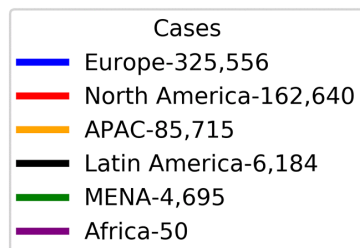
Main Figure 1a. Cases by country



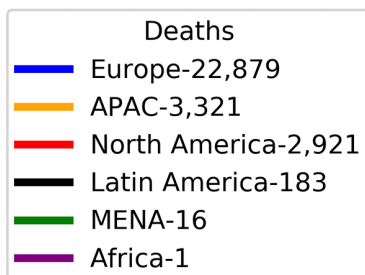
Main Figure 1b. Deaths by country



Main Figure 1c. Cases by region



Main Figure 1d. Deaths by region



**Table 1. Hospital organization of patients' flow and centralization of care**

Country	Obstetrical emergency triaging and isolation	Organization of separate services for outpatient clinic	Centralization of care to identified tertiary centers: pregnant women	Centralization of care to identified tertiary centers: neonatal
Argentina	Yes	Yes	Yes	Yes
Australia (WA)	Yes	Yes	No	No
Belgium	Yes	Yes	Preferred	Yes
Brazil	Yes	Yes	Yes	Yes
Canada	Yes	Yes	No	No
China	Yes	Yes	Yes	Yes
Germany	Yes	Yes	No (under discussion)	No (under discussion)
Ireland	Yes	Yes	No	No
Israel	Yes	Yes	Yes	No
Italy	Yes	Yes	Yes	Yes
Kenya	No	No	No	No
Mexico	No countrywide Yes locally	No countrywide Yes locally	No countrywide Yes locally	No countrywide Yes locally
The Netherlands	No*	No**	No	No
Norway	No*	No**	No	No
Poland	Yes	Yes	Yes	Yes
Spain	Yes	Yes	Preferred	Preferred
Sweden	No	Yes	No	No
Switzerland	Yes	Yes	Yes §	Yes
UK	Yes	Yes**	No	Yes
US - CDC	Yes	Not specified	Not specified	Not specified
US - Boston	Yes	Yes	Yes	Yes
US - Palo Alto	Yes	Yes	No	No
<b>Total (%)****</b>	<b>17 (77%)</b>	<b>17 (77%)</b>	<b>10 (45%)</b>	<b>10 (45%)</b>

WA, Western Australia; § Standard regionalization of care; \* Special rooms for (suspected) COVID-19 positive pregnant women; \*\* Outpatient clinics by telephone if possible for all patients; \*\*\* Neonatal networking webinar, initiated by the California Maternal and Perinatal Quality Care Collaboratives. \*\*\*\* Total based on 20 countries

**Table 2. Delivery room and NICU management**

Country	Resuscitation in the delivery room	Infants in need of immediate intensive care - Vaginal delivery (VD)	Infants in need of immediate intensive care - Cesarean delivery (CS)	Infants treated in CPAP, PPV, or MV
Argentina	Wearing PPE. COVID-19 dedicated rooms. DCC.	Wearing PPE. Transport in dedicated incubators.	Wearing PPE. Transport in dedicated incubators.	Closed if possible
Australia (WA)	Wearing PPE. Same room as mother	Wearing PPE	Wearing PPE	Closed
Belgium	Wearing PPE. Dedicated rooms	Wearing PPE Transport in dedicated incubators	Wearing PPE Transport in dedicated incubators	Closed positive pressure
Brazil	Wearing PPE. Minimum number of care providers involved. Dedicated rooms (suspected or confirmed). Resuscitation in the delivery suite. No DCC	Wearing PPE. Transport in dedicated incubators	Wearing PPE. Transport in dedicated incubators	Closed PPV (but not firm) Mechanical suction
Canada	Wearing PPE. Suggested no DCC. One physician. SSC immediately after birth - allowed if parents insist	Wearing PPE	Wearing PPE	Closed available the experience
China	Wearing PPE. No DCC. Preferably in negative pressure rooms	Wearing PPE	Wearing PPE. Inform neonatal team 30 minutes	Isolated number

			before emergency CS	
Germany	Wearing PPE	Wearing PPE	Wearing PPE	Closed filters b
Ireland	Wearing PPE	Wearing PPE	Wearing PPE	Closed
Israel	Wearing PPE, COVID-19 dedicated rooms	Wearing PPE,	Wearing PPE	Closed closed-
Italy	Wearing PPE, Same room as mother, COVID-19 dedicated rooms. Suggested no DCC. No SCC after birth	Wearing PPE. Transport in dedicated incubators	Wearing PPE. Transport in dedicated incubators	Closed availab the exp support PPE
Kenya	Wearing PPE	Wearing PPE	Wearing PPE	Isolation
Mexico	Limited hygiene precautions – possibly contagious (low risk)	Wearing PPE	Wearing PPE	Closed Individ
The Netherlands	Wearing PPE, in some in COVID-19 dedicated rooms	Wearing PPE	Wearing PPE	Closed bay) ro intubat oxygen
Norway	Wearing PPE	Limited hygiene precaution – possibly contagious (low risk)	No precautions. Considered not contagious	Closed
Poland	Wearing PPE	Wearing PPE	Wearing PPE	Closed
Spain	Wearing PPE	Wearing PPE	Wearing PPE	Closed respirat
Sweden	Resuscitation outside delivery. Standard hygiene if resuscitation outside the delivery room	Standard hygiene. Single room if possible. Initially considered not contagious	Standard hygiene. Single room if possible. Considered not contagious	PPE for
Switzerland	Wearing PPE	Wearing PPE	Wearing PPE	Incubat pressur
UK	Stabilization/resuscitation outside the delivery suite. Level-1 PPE (partial) for infant handling immediately after delivery, full PPE when potential for aerosol exposure	Level-1 PPE	Level-1 PPE	Isolation (nasal h expirato
US - CDC	Wearing PPE	Wearing PPE	Wearing PPE	Wearin
US - Boston	Wearing PPE. Transport in specified incubators	Wearing PPE. Transport in dedicated incubators	Wearing PPE. Transport in dedicated incubators	If no re If respi or singl
US - Palo Alto	Wearing PPE (airborne + mask); filter used for PPV equipment	Incubators; those not requiring resp. support in droplet + eyewear precautions	Incubators; those not requiring resp. support in droplet + eyewear precautions	Closed

AGP; aerosol generating procedures = non-invasive respiratory support (e.g., nasal high flow therapy and continuous positive airway pressure); DCC, delayed cord clamping; nHFT, nasal high flow therapy; PPE, personal protective equipment; PPV, positive pressure ventilation; SSC, skin-to-skin contact; WA, Western Australia

**Table 3. Clinical Pathway for asymptomatic infants, inborn/outborn, testing and other diagnostic, follow up**

Country	Asymptomatic infants	Baby admitted after contact with mother /parent or outborn	Testing	Cultur other c
Argentina	Stay with mother. Breast-feeding allowed. Strict hygiene precautions	Contact isolation only if mother positive or highly suspicious	Only symptomatic infants	NPS

Australia (WA)	Stay with mother. Breast-feeding allowed. Strict hygiene precautions	Dependant on clinical status. <i>Mild symptoms</i> , isolated in a single room, close monitoring. Once well, discharge and 14 days isolation. If baby <i>unwell</i> , isolated in negative pressure room (if available) or single room (if available), otherwise consider cohorting. Closed incubator, with droplet precautions. Wearing PPE	All	NPS
Belgium	Stay with mother. Breast-feeding allowed. Strict hygiene precautions. Keep distance (1.5 m) between crib and mother	If mother moderately-severely ill: infant hospitalized in step down unit or NICU. Isolation until tested; continued for 14 days if negative; cohorting possible if positive	All	NPS x If resp CXR, C
Brazil	Stay with mother. Breast-feeding allowed. Hygiene precautions. Keep distance (2 m) between crib and mother	Same as asymptomatic babies	Only symptomatic infants	Both in NPS
Canada	Stay with mother. Breast-feeding allowed. Hygiene precautions	Parents positive or suspected – follow same as considered positive (closed incubators, isolation rooms, PPE). Parents negative – routine care. Until results come back – same precaution as positive	All	Deliver blood. Newbo If resp. Sepsis NPS fo and oth viruses
China	Isolation room	Negative pressure rooms, isolation in single rooms	All	NPS or tract sp stools
Germany	Stays with mother. Breast-feeding allowed. Hygiene advice	Wearing PPE and isolation until discharge. Mother allowed for breast-feeding	All	Both in NPS x
Ireland	Separation recommended and give EBM but can room with mother if separation is refused, in which case baby placed in incubator and all handling breast-feed with PPE donned. Remove baby temporarily if AGP	Separation recommended and give EBM but can room with mother if separation is refused, in which case baby placed in incubator and all handling breast-feed with PPE donned. Remove baby temporarily if AGP	All	NPS
Israel	Stay with mother if both positive and well. If negative to positive mother – separation or rooming-in according to mother's request	If asymptomatic, can stay with mother in dedicated room. If unwell will stay at dedicated room in NICU	All	NPS x hours a
Italy	Stay with mother. Breast-feeding allowed. Hygiene precautions	Wearing PPE until the baby is tested negative, closed incubator, isolation room (negative pressure room if available)	All	Deliver amniot Newbo Outbor CXR if
Kenya	Stay with mother. Breast-feeding allowed. Strict hygiene	Isolation room, PPE	All	NPS

	precautions			
Mexico	Stay with mother. Breast-feeding allowed. Hygiene precautions	Wearing PPE. Mother and infant tested for virus. Incubator, isolation. Breast-feeding withheld until negative results	All	NPS CXR if
The Netherlands	Stay with mother after delivery (at home or in hospital) unless needing other care. Breast-feeding allowed. Hygiene precautions	Consider positive for COVID-19 until tested negative. PPE	Only symptomatic infants	NPS
Norway	Stay with mother. Breast-feeding allowed. Hygiene precautions	Strict hygiene precaution – considered contagious. PPE	Only symptomatic infants	
Poland	Newborn isolated from the mother during hospitalization, expressed breast milk provided	Incubator, isolation room. PPE	All	NPS
Spain	Stay with mother. Breast-feeding allowed. Hygiene precautions.	Incubator. Isolation room. PPE	All	NPS. Sepsis sympto CXR
Sweden	Stay with mother. Breast-feeding allowed. Hygiene precautions	Strict hygiene precaution – Considered contagious. PPE	All	NPS
Switzerland	Stay with mother. Breast-feeding allowed. Hygiene precautions	PPE until the baby is tested negative	All	Deliver placent fluid
UK	Stay with mother. Breast-feeding allowed. Hygiene precautions	PPE until the baby is tested negative. Incubator. Isolation room	Only symptomatic infants on admission to unit	Only fo neonat
US - CDC	PPE for caregivers. Consider temporary separation. Rooming in is an option, with separate caregiver and physical barrier such as curtains if possible. Continue while mother on transmission precautions	Not specified	Maternal NPS x 2	Not sp
US - Boston	Same as CDC	If no respiratory support: PPE including surgical mask, eye protection, gown, gloves	Case-by-case in consultation with IDS, based on symptoms and maternal status	Case-b consul on sym matern
US - Palo Alto	Same as CDC	PICU or pediatric acute care COVID cohort unit in single room; negative pressure if on respiratory support, closed door with droplet + eyewear if acute care	Case-by-case in consultation with IDS, based on symptoms and maternal status	NPS

AGP, aerosol generating procedures; CBC, complete blood count; CDC, Center for Disease Control; CXR, chest x-ray; EBM, expressed breast milk; FU, follow-up; NPS, nasopharyngeal swab; IDS, Infectious Disease Service; PPE, personal protective equipment; WA, Western Australia

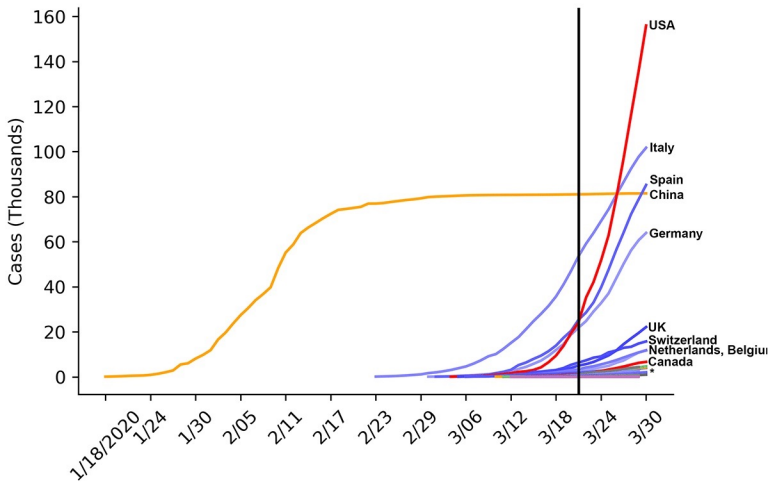
**Table 4. Breast-feeding, family access restrictions in NICU and other measures**

Country	Breastmilk/Feeding regimen	Other special measures adopted in NICU/nursery
Argentina	Direct breast-feeding with hygiene precautions for asymptomatic mother with suspected infection; Mother's milk by bottle for confirmed cases	Strict contact/respiratory isolation and use of PPE for confirmed and symptomatic cases. Restricted access to the NICU only to parents, one time, all day long. Hygiene precautions. Access forbidden to anybody or presenting COVID-19 symptoms. Transport incubator for transfers. No restriction to skin-to-skin if parents are asymptomatic
Australia (WA)	Hygiene precautions. Face mask, wash hands and breast	No restriction to parental access visiting, except for infants with COVID-19 (only parents)
Belgium	Hygiene precautions. Face mask, wash hands. Promote breast-feeding even in case of mother-infants separation. Fresh expressed breast milk. Container disinfection and separated refrigerator for NICU storage; no specific testing or storage procedure	A separate circuit for COVID-19 patients (resources may vary across centers). Restricted access to NICU: 1 relative allowed. COVID-19 positive mother and relative not allowed. Father admitted if tested negative and after 14-day quarantine (may vary across centers). Visitors with COVID-19 symptoms require negative testing before admission
Brazil	Hygiene precautions. Face mask, wash hands and breast. Promote breast-feeding even in case of mother-infants separation. Fresh EBM, no recommended pasteurization	Visits restricted to only one parent at a time, with limit of stay (2 hours). Hygiene measures and education. Temperature checked for all health care workers; they should bathe in the hospital locker room when they leave the unit. The number of health professionals at NICU will be limited, for examinations and consultations, only one professional
Canada	Hygiene precautions. Face mask, wash hands. EBM	One parent allowed per day can stay as long as they want. Handover via video conference. Social distancing, all healthcare workers to wear a surgical mask. No new recruitment in research projects (avoid research personnel entering the NICU). Access is forbidden to anybody positive or presenting COVID-19 symptoms. No restriction to SSC if parents are asymptomatic
China	Formula milk, breast-feeding discouraged	Neonatal department strictly stratified into transitional, quarantine, living and work areas
Germany	Breast-feeding allowed, hygiene precautions	Restricted access to NICU for positive parents (mother up to 3 times for several hours, the father only once per day). Intercenter variability for research. Most research activities are interrupted
Ireland	Mother has dedicated pump, asked to sanitize parts after each use; clean breasts before pumping and wear PPE while pumping; bottles wiped down by mother and again upon transfer to NICU	Incubator. Single room
Israel	Hygiene precautions. Face mask, wash hands. Pumping allowed with private pump and tube cleaning instructions	Not specified
Italy	Hygiene precautions. Face mask, wash hands. Promote breastfeeding even in case of mother-infants separation. Fresh EBM, no recommended pasteurization. Consider drugs administered to the mother, before deciding on breast-feeding	Only one relative (beside mothers) can access the nursery during predefined opening hours. Restricted access to the NICU only to parents, one at a time, all day long, wearing surgical mask. Hygiene precautions. Access is forbidden to anybody positive or presenting COVID-19 symptoms. No restriction to SSC if parents are asymptomatic. No restriction to research activities if they do not increase the risk of infection
Kenya	Breast-feeding allowed. Hygiene precautions	Restricted access for parents (only level 1). Only mothers allowed for breastfeeding and SSC (level 2). Strict hygiene precautions
The Netherlands	Breast-feeding allowed. Hygiene precautions. EBM as an option, with strict hygiene measures applied	Only parents allowed to visit if no symptoms and not tested positive. No restriction. No other family/friends allowed. If parents have (suspected) COVID-19, they are not allowed to visit the unit
Norway	Hygiene precautions.	Both parents restricted to visit the NICU if the mother is COVID-19 positive

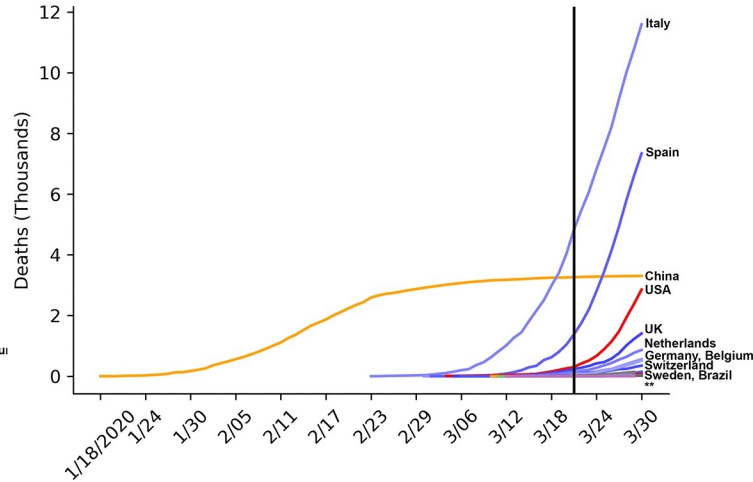
	Face mask, wash hands and breast	(assume partner also positive). Parents allowed to visit after testing negative for 14 days. If possible, try to keep baby with mother in a separate room or NICU. In general, only 1 visitor/parent allowed to stay with the baby in NICU (all infants)
Mexico	Breast-feeding withheld until mother tests negative	Access to the NICU restricted only to parents, one at a time, all day long wearing surgical mask. Supervised hygiene precautions. Access is forbidden to anybody positive or with COVID-19 symptoms
Poland	Mother under investigation – EBM. Mother positive – infant formula may be administered due to organisational issues	Restrict access to all neonatal units: even mothers don't have access, send photos of infants by email daily; mothers can supply expressed breast milk; hospitalized mothers only allowed to access for the time of breastfeeding; if they do not breastfeed they can be present in the NICU for 15 minutes
Spain	Hygiene precautions. Face mask, wash hands and breast	Not specified
Sweden	Hygiene precautions. Promote breastfeeding even in case of mother-infants separation: fresh EBM, no recommended pasteurization	Restricted access to the NICU only to parents, rooming-in. Hygiene precautions. Access is forbidden to anybody positive or presenting COVID-19 symptoms. No restriction to SSC if parents are asymptomatic. Temporal restriction to inclusion of new patients in non-Covid related research activities
Switzerland	Hygiene precautions, face mask, wash hands	Restricted access to the NICU only to parents, one parent at a time, all day long, social distancing of parents within NICU, hygiene precautions. Access is forbidden to anybody positive or presenting COVID-19-like symptoms. No restriction to SSC if parents are asymptomatic
UK	Breast-feeding and formula feeding by the mother permitted. Strict hygiene precautions, mothers wearing a mask while handling baby	One relative only (beside mothers) to come to the hospital during pre-opening hours. Restricted access to the NICU; only one parent. Strict hygiene precautions. No access for anybody testing positive or presenting COVID-19 like symptoms. No SSC in babies on respiratory support. Restrict in-hospital transfer/ surgery on the NICU/ pausing of all non-COVID-19 related research
US - CDC	Preferred: EBM, fed by healthy caregiver with PPE. If mother wishes to breast-feed, hand hygiene and face mask	Not specified
US - Boston	Same as CDC	Visitors restricted to healthy parent or caregiver, with PPE including gloves, face mask, and eye protection
US - Palo Alto	Same as CDC	Labour support person/father cannot accompany the infant to NICU. Mothers can access NICU once ruled out for COVID-19. Hospital access limited to parents only (or another caregiver), and must be healthy. If outborn patient admitted, one parent may stay with the infant and not leave isolation room. Not currently recommending masks for asymptomatic visitors

AGP, aerosol-generating procedures; CBC, complete blood count; CDC, Center for Disease Control; CXR, chest x-ray; EBM, expressed breast milk; FU, follow-up; NPS, nasopharyngeal swab; IDS, infectious disease service; PPE: personal protective equipment; SSC, skin-to-skin contact; WA, Western-Australia.

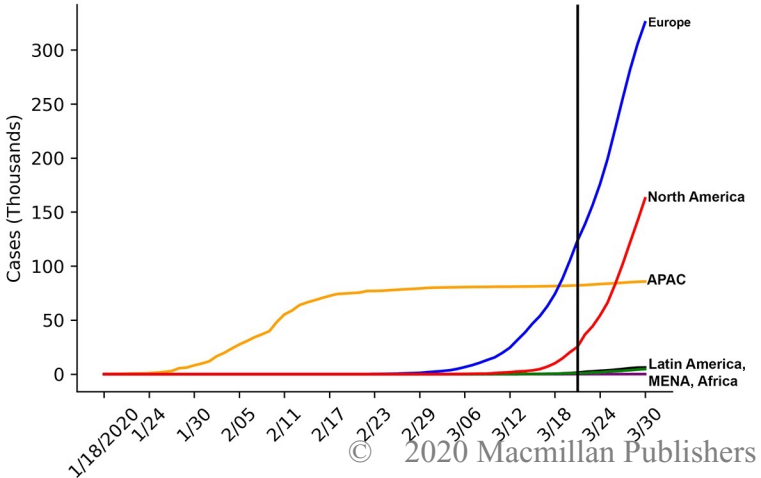
COVID-19 Cases



COVID-19 Deaths



COVID-19 Cases



COVID-19 Deaths

