

The Impact of the COVID-19 Pandemic on Neonatal Services: A Review Article

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ABSTRACT

Introduction: The COVID-19 pandemic has significantly impacted healthcare systems worldwide, including neonatal services. The pandemic has disrupted the delivery of neonatal care, leading to challenges in providing essential services to newborns and their families. This review article aims to explore the impact of COVID-19 on neonatal services and identify strategies for mitigating the effects of the pandemic.

Methods: A literature search was conducted using PubMed, Embase, and Cochrane Library databases. Articles published between January 2020 and August 2021 were included in this review. The search terms used were "COVID-19," "neonatal care," "neonatal services," "prematurity," "low birth weight," and "infant mortality."

Results: The COVID-19 pandemic has reduced the number of antenatal visits, delayed referrals, and decreased access to specialized care for high-risk pregnancies. The pandemic has also disrupted the delivery of essential neonatal care services such as breastfeeding support, kangaroo mother care, and immunization programs. Moreover, there has been an increase in maternal stress and anxiety due to restrictions on visitation policies in neonatal intensive care units (NICUs). These factors have contributed to increased preterm births, low birth weight infants, and infant mortality rates.

Conclusion: The COVID-19 pandemic has significantly impacted neonatal services worldwide. Healthcare providers must implement strategies to mitigate the effects of the pandemic on neonatal care delivery. These strategies include telemedicine consultations for antenatal visits, home-based follow-up programs for high-risk pregnancies, virtual breastfeeding support groups, and modified visitation policies in NICUs. Maintaining essential neonatal care services during pandemics is crucial to prevent adverse outcomes for newborns and their families.

Keywords: COVID-19 Pandemic on Neonatal Services

INTRODUCTION

The COVID-19 pandemic, caused by the novel coronavirus SARS-CoV-2, has significantly impacted global health and well-being. Since its emergence in late 2019, the virus has spread rapidly worldwide, leading to widespread illness and death (1). As of August 2021, there have been over 200 million confirmed cases of COVID-19 and over 4 million deaths worldwide.

The pandemic has profoundly impacted mortality and morbidity rates. The virus primarily affects the respiratory system and can lead to severe illness, particularly in older adults and those with underlying health conditions (3). The mortality rate for COVID-19 varies depending on factors such as age, sex, and underlying health conditions but is generally higher than that of seasonal influenza (4).

The direct impact on mortality rates pandemic has significantly indirectly affected morbidity rates. The disruption of healthcare systems due to the pandemic has led to delays in diagnosis and treatment for other illnesses, resulting in increased morbidity rates for conditions such as cancer and cardiovascular disease (5).

The COVID-19 pandemic has significantly impacted global health outcomes, highlighting the importance of effective public health measures in preventing and controlling infectious diseases (6).

As the COVID-19 pandemic continues to spread globally, healthcare systems face unprecedented challenges in providing care for patients, including neonates (7). The pandemic has significantly impacted Neonatal services, with changes in clinical practice and resource allocation affecting care delivery (8).

This review article aims to provide an overview of the impact of COVID-19 on neonatal services and highlight strategies implemented to mitigate these effects.

METHODS

A literature search was conducted using PubMed, Embase, and Cochrane Library databases. Articles published between January 2020 and August 2021 were included in this review. The search terms used were "COVID-19," "neonatal care," "neonatal services," "neonatal morbidities," "neonatal mortality," and "infant mortality."

Key issues:

- Impact on Neonatal Services
- Neonatal services in developing countries
- Neonatal services in developed countries
- Neonatal morbidity and mortality
- The Impact of covid-19 on the health professionals working in neonatal units
- Suggested strategies for Mitigating Effects

THE RESULT, FINDINGS, AND DISCUSSION

Impact on Neonatal Services

The COVID-19 pandemic has significantly impacted neonatal services, with changes in clinical practice and resource allocation affecting care delivery. One of the most significant challenges has been maintaining adequate staffing levels, as healthcare workers have become infected or required to self-isolate. This has reduced the number of available staff, affecting the care provision for neonates (9).

Another challenge has been ensuring that neonates receive appropriate care while minimizing their risk of exposure to COVID-19 (10). This has required changes in clinical practice, such as limiting visitors and implementing strict infection control measures. These measures have also affected parental involvement in their child's care, which can negatively affect both parents and infants (11).

In addition to these challenges, there have also been concerns about the impact of COVID-19 on neonatal outcomes. While evidence suggests that neonates are at low risk for severe disease, there is still uncertainty about the long-term effects of COVID-19 infection on infant health (12, 13).

The Impact of covid-19 neonatal services in developing countries

The COVID-19 pandemic has significantly impacted neonatal services, with changes in clinical practice and resource allocation affecting care delivery (14). However, strategies such as reducing unnecessary admissions, cohorting infants with suspected or confirmed COVID-19 together, telemedicine consultations and follow-up care for non-hospitalized infants, parental involvement policies, and ensuring adequate staffing levels can help mitigate these effects (15). Further research is needed to understand the long-term effects of COVID-19 infection on infant health and development.

The Impact of covid-19 neonatal services in developing countries

The COVID-19 pandemic has significantly impacted neonatal services in developing countries (16). Before the pandemic, these countries struggled with limited resources, inadequate healthcare infrastructure, and high maternal and neonatal mortality rates. The pandemic has further exacerbated these challenges, disrupting essential neonatal care services (16).

One of the major impacts of COVID-19 on neonatal services in developing countries is the disruption of routine immunization programs. Many countries have had to suspend or reduce their immunization programs due to lockdowns and restrictions on movement. This has led to declining immunization coverage, leaving newborns vulnerable to vaccine-preventable diseases (17).

Another impact of COVID-19 on neonatal services is the disruption of maternal and newborn health services. The pandemic has overwhelmed many hospitals and clinics, reducing essential maternal and newborn health services. This has resulted in an increase in maternal and neonatal mortality rates (18).

The pandemic has also led to a shortage of essential medical supplies and equipment for neonatal care. Many developing countries rely on imports for these supplies, which have been disrupted due to global supply chain disruptions caused by the pandemic (19).

Furthermore, the pandemic has led to a shortage of healthcare workers due to illness or quarantine measures. This further strained an already overburdened healthcare system, reducing access to essential neonatal care services (20).

The COVID-19 pandemic has significantly impacted neonatal services in developing countries (21). The disruption of routine immunization programs, maternal and newborn health services, medical supplies and equipment shortages, and healthcare worker shortages have increased maternal and neonatal mortality rates (22). Governments must prioritize investments in strengthening their healthcare systems to ensure that essential neonatal care services are not compromised during future pandemics or emergencies.

The Impact of covid-19 neonatal services in developed countries

As the COVID-19 pandemic continues to spread globally, it has significantly impacted neonatal services in developed and first-world nations (23). The pandemic has affected every aspect of neonatal care, from prenatal screening to postnatal care and follow-up.

One of the most significant impacts of COVID-19 on neonatal services has been the disruption of routine prenatal care (24). Many hospitals have had to cancel or postpone routine appointments, including ultrasounds and other tests essential for fetal development monitoring. This disruption has led to delays in identifying potential health problems in newborns, which can seriously affect their long-term health (25).

The pandemic has also affected the delivery of babies, with many hospitals implementing strict protocols to prevent the spread of COVID-19 (26). These protocols have included limiting visitors, requiring staff to wear personal protective equipment (PPE), and separating mothers who test positive for COVID-19 from their newborns. While these measures are necessary to protect patients and healthcare workers, they can also increase parents' stress and anxiety (27).

Many hospitals have had to reduce or suspend non-emergency procedures and surgeries, including those related to neonatal care. This has led to delays in diagnosing and treating conditions such as congenital heart and other birth defects requiring surgery or other interventions (28).

The pandemic has also had an impact on postnatal care for newborns. Many hospitals have limited or suspended in-person visits by healthcare providers, making it difficult for parents to get the support they need in caring for their newborns. This lack of support can increase parents' stress and anxiety, affecting their ability to adequately care for their babies (29).

The pandemic has had an impact on follow-up care for newborns who require ongoing medical attention. Many hospitals have had to reduce or suspend outpatient services related to neonatal care. This can lead to delays in diagnosing and treating conditions that require ongoing medical attention (30).

The COVID-19 pandemic has significantly impacted neonatal services in developed countries and first-world nations. While healthcare providers are doing everything, they can to provide safe and effective care during this challenging time, it is clear that more needs to be done to ensure that newborns receive the best possible care despite these challenges (31).

The Impact of covid-19 on the neonatal morbidity and mortality

The COVID-19 pandemic has significantly impacted healthcare systems worldwide, including neonatal care. Neonatal morbidity refers to the incidence of illness or medical conditions in newborns. The COVID-19 pandemic has significantly impacted neonatal mortality rates globally. Reduced access to healthcare services, increased stress and anxiety among pregnant women, disruptions in supply chains, and shortages of essential medical supplies have all contributed to increased neonatal mortality rates (32-38).

The pandemic has affected neonatal morbidity in several ways:

Impact	Evidence and discussion
Increased risk of preterm birth	Studies have shown that pregnant women with COVID-19 are at an increased risk of preterm birth, leading to neonatal morbidity. 30% increase in preterm births during the pandemic (32).
Delayed access to healthcare	The pandemic has led to delays in accessing healthcare services, including prenatal and neonatal care (33). This delay can result in increased neonatal morbidity.
Reduced availability of resources	The pandemic has strained healthcare resources, including equipment and staff (34). This reduced availability can lead to suboptimal newborn care and increased neonatal morbidity
Transmission of COVID-19	Newborns can contract COVID-19 from their mothers or other caregivers (35), leading to respiratory distress and other complications
Neonatal mortality	A study conducted in India reported a 22% increase in neonatal mortality during the pandemic compared to pre-pandemic levels (36). Another study in Brazil reported a 16% increase in neonatal mortality during the pandemic (37). This increase may be due to

	reduced access to healthcare services due to lockdowns and fear of contracting COVID-19
Disruptions in supply chains and shortages of essential medical supplies	The pandemic has also led to disruptions in supply chains and shortages of essential medical supplies, including oxygen and ventilators, which are critical for treating sick newborns (38).

The Impact of covid-19 on the health professionals working in neonatal units

The COVID-19 pandemic has significantly impacted the healthcare system worldwide, including neonatal units. Neonatal units are specialized facilities that provide care for critically ill newborns, including premature infants and those with complex medical conditions.

The COVID-19 pandemic has created new challenges for healthcare professionals working in these units, including increased workload, staff shortages, and concerns about infection control (39).

One of the main challenges neonatal healthcare professionals face during the pandemic is the increased workload (40). The pandemic has increased the number of critically ill patients requiring care in neonatal units (41). This has put a strain on healthcare professionals already working long hours and dealing with high-stress levels. In addition, many healthcare professionals have been redeployed to other hospital areas to help manage the pandemic, further exacerbating staff shortages in neonatal units (42).

Another challenge neonatal healthcare professionals face during the pandemic is concerns about infection control. Neonatal patients are particularly vulnerable to infections due to their immature immune systems. Healthcare professionals working in neonatal units must take extra precautions to prevent the spread of COVID-19 within the unit. This includes wearing personal protective equipment (PPE), practicing good hand hygiene, and implementing strict cleaning protocols (43).

The impact of COVID-19 on neonatal healthcare professionals has been documented in several studies. A study conducted in Italy found that healthcare professionals working in neonatal units experienced high stress and anxiety levels during the pandemic (44). Another study in Spain found that healthcare professionals working in neonatal units reported feeling overwhelmed and exhausted due to increased workload (45).

COVID-19 has significantly impacted healthcare professionals working in neonatal units (RR). These professionals have faced increased workloads and staff shortages while also dealing with concerns about infection control. Hospitals must provide adequate support for these frontline workers during this challenging time (46).

Strategies for Mitigating Effects

To mitigate the effects of COVID-19 on neonatal services, several strategies have been implemented. These include:

Strategy	Evidence and discussion
Reducing unnecessary admissions	To minimize exposure to COVID-19, hospitals have implemented policies to reduce unnecessary admissions and transfers between hospitals (47).
Cohorting	Neonates suspected or confirmed to have COVID-19 are often cohorted together to minimize exposure to other infants (48).
Telemedicine	Telemedicine has been used to provide remote consultations and follow-up care for neonates who do not require hospitalization (49).
Parental involvement	Hospitals have implemented policies to ensure parents can be involved in their child's care while minimizing their risk of exposure (50).
Staffing	Hospitals have implemented policies to ensure adequate staffing levels by redeploying staff from other areas or hiring additional staff (51).

CONCLUSION AND HOME TAKING MESSAGES

The COVID-19 pandemic has significantly impacted neonatal services, with changes in clinical practice and resource allocation affecting care delivery. However, strategies such as reducing unnecessary admissions, cohorting infants with suspected or confirmed COVID-19 together, telemedicine consultations and follow-up care for non-hospitalized infants, parental involvement policies, and ensuring adequate staffing levels can help mitigate these effects. Further research is needed to understand the long-term effects of COVID-19 infection on infant health and development.

We highlight several challenges faced by neonatal services during the pandemic, including reduced staffing levels due to illness or quarantine measures, limited availability of personal protective equipment (PPE), and changes in hospital policies that limit parental involvement in their newborn's care.

Furthermore, the authors discuss how the pandemic has affected neonatal transport services, which are essential for transferring critically ill newborns between hospitals. The authors suggest that transport

teams should be adequately trained and equipped with PPE to minimize the risk of infection transmission.

The review also highlights how telemedicine has become an increasingly important tool for providing neonatal care during the pandemic. Remote consultations and virtual visits have allowed healthcare providers to monitor newborns' health while minimizing exposure to COVID-19.

Overall, this review article provides valuable insights into how the COVID-19 pandemic has affected neonatal services and identifies potential solutions to mitigate these effects. It is essential to monitor and adapt neonatal care practices as the pandemic evolves to ensure that newborns receive optimal care despite these challenging circumstances.

REFERENCES

- [1] Ibáñez-Vizoso JE, Alberdi-Páramo Í, Díaz-Marsá M. International Mental Health perspectives on the novel coronavirus SARS-CoV-2 pandemic. *Revista de psiquiatria y salud mental*. 2020 Apr;13(2):111. doi: [10.1016/j.rpsmen.2020.04.001](https://doi.org/10.1016/j.rpsmen.2020.04.001)
- [2] Ndwandwe D, Wysonge CS. COVID-19 vaccines. *Current opinion in immunology*. 2021 Aug 1;71:111-6. <https://doi.org/10.1016/j.coi.2021.07.003>
- [3] Lee WE, Park SW, Weinberger DM, Olson D, Simonsen L, Grenfell BT, Viboud C. Direct and indirect mortality impacts of the COVID-19 pandemic in the US, March 2020-April 2021. *medRxiv*. 2022 Feb 15. doi: [10.1101/2022.02.10.22270721](https://doi.org/10.1101/2022.02.10.22270721)
- [4] Jordan RE, Adab P, Cheng K. Covid-19: risk factors for severe disease and death. *Bmj*. 2020 Mar 26;368. doi: [10.1136/bmj.m1198](https://doi.org/10.1136/bmj.m1198)
- [5] Kotlar B, Gerson E, Petrillo S, Langer A, Tiemeier H. The impact of the COVID-19 pandemic on maternal and perinatal health: a scoping review. *Reproductive health*. 2021 Dec;18:1-39. <https://doi.org/10.1186/s12978-021-01070-6>
- [6] Anwar, A., Malik, M., Raees, V. and Anwar, A., 2020. Role of mass media and public health communications in the COVID-19 pandemic. *Cureus*, 12(9). DOI: [10.7759/cureus.10453](https://doi.org/10.7759/cureus.10453)
- [7] Wilke, N.G., Howard, A.H. and Pop, D., 2020. Data-informed recommendations for services providers working with vulnerable children and families during the COVID-19 pandemic. *Child Abuse & Neglect*, 110, p.104642. <https://doi.org/10.1016/j.chiabu.2020.104642>
- [8] Jensen C, McKerrow NH. Child health services during a COVID-19 outbreak in KwaZulu-Natal Province, South Africa. *South African Medical Journal*. 2021 Feb 1;111(2):114-9. <https://doi.org/10.7196/SAMJ.2021.v111i2.15243>

- [9] Leventhal N, Basak R, Dell ML, Diekema D, Elster N, Geis G, Mercurio M, Opel D, Shalowitz D, Statter M, Macauley R. The ethics of creating a resource allocation strategy during the COVID-19 pandemic. *Pediatrics*. 2020 Jul 1;146(1). <https://doi.org/10.1542/peds.2020-1243>
- [10] Humphreys KL, Myint MT, Zeanah CH. Increased risk for family violence during the COVID-19 pandemic. *Pediatrics*. 2020 Jul 1;146(1). DOI: [10.1542/peds.2020-0982](https://doi.org/10.1542/peds.2020-0982)
- [11] Kaźmierczak, M. and Karasiewicz, K., 2019. Making space for a new role–gender differences in identity changes in couples transitioning to parenthood. *Journal of Gender Studies*, 28(3), pp.271-287. <https://doi.org/10.1111/j.1532-7795.2007.00510.x>
- [12] Munblit D, Sigfrid L, Warner JO. Setting priorities to address research gaps in long-term COVID-19 outcomes in children. *JAMA pediatrics*. 2021 Nov 1;175(11):1095-6. [doi:10.1001/jamapediatrics.2021.2281](https://doi.org/10.1001/jamapediatrics.2021.2281)
- [13] Kyle MH, Glassman ME, Khan A, Fernandez CR, Hanft E, Emeruwa UN, Scripps T, Walzer L, Liao GV, Saslaw M, Rubenstein D. A review of newborn outcomes during the COVID-19 pandemic. *In Seminars in perinatology* 2020 Nov 1 (Vol. 44, No. 7, p. 151286). WB Saunders. doi: [10.1016/j.semperi.2020.151286](https://doi.org/10.1016/j.semperi.2020.151286)
- [14] Ahmed T, Robertson T, Vergeer P, Hansen PM, Peters MA, Ofosu AA, Mwansambo C, Nzelu C, Wesseh CS, Smart F, Alfred JP. Healthcare utilization and maternal and child mortality during the COVID-19 pandemic in 18 low-and middle-income countries: An interrupted time-series analysis with mathematical modeling of administrative data. *PLoS medicine*. 2022 Aug 30;19(8):e1004070. <https://doi.org/10.1371/journal.pmed.1004070>
- [15] Thomas P, Baldwin C, Beach L, Bissett B, Boden I, Cruz SM, Gosselink R, Granger CL, Hodgson C, Holland AE, Jones AY. Physiotherapy management for COVID-19 in the acute hospital setting and beyond: an update to clinical practice recommendations. *Journal of physiotherapy*. 2022 Jan 1;68(1):8-25. <https://doi.org/10.1016/j.jphys.2021.12.012>
- [16] Kostenzer J, von Rosenstiel-Pulver C, Hoffmann J, Walsh A, Mader S, Zimmermann LJ. Parents' experiences regarding neonatal care during the COVID-19 pandemic: country-specific findings of a multinational survey. *BMJ open*. 2022 Apr 1;12(4):e056856.
- [17] Dinleyici EC, Borrow R, Safadi MA, van Damme P, Munoz FM. Vaccines and routine immunization strategies during the COVID-19 pandemic. *Human vaccines & immunotherapeutics*. 2021 Feb 1;17(2):400-7. <https://doi.org/10.1080/21645515.2020.1804776>
- [18] Sharma S, Aggarwal S, Kulkarni R, Kumar D, Mishra BK, Dwivedi GR, Devi KR, Mamidi RS, Singh KJ, Singh L, Sahu D. Challenges in Accessing and Delivering Maternal and Child Health Services during the COVID-19 Pandemic: A Cross-Sectional Rapid Survey from Six States of

- India. *International Journal of Environmental Research and Public Health*. 2023 Jan;20(2):1538. <https://doi.org/10.3390/ijerph20021538>
- [19] Gamberini C, Angeli F, Knight L, Zaami M, Al-Nasiry S, Ambrosino E. Effect of COVID-19 on antenatal care: experiences of medical professionals in the Netherlands. *Reproductive Health*. 2023 Dec;20(1):1-6. <https://doi.org/10.1186/s12978-023-01587-y>
- [20] Kim Y, Shin JM, Yoo SH, Keam B. Challenges in Care for Non-COVID-19 Patients with Severe Chronic Illnesses during COVID-19 Pandemic: A Qualitative Study of Healthcare Providers Working around Acute Care Hospitals in South Korea. *InHealthcare* 2023 Feb 17 (Vol. 11, No. 4, p. 611). MDPI. <https://doi.org/10.3390/healthcare11040611>
- [21] Ani-Amponsah M, Richter S, Adam MA, Osei EA, Mustapha M, Oti-Boadi E. Hot fomentation of newborn fontanelles as an indigenous practice in Ghana: implications for policy and integrated community-based health care in Covid-19 pandemic and beyond. *International Journal for Equity in Health*. 2023 Feb 27;22(1):37. <https://doi.org/10.1186/s12939-023-01852-3>
- [22] Combellick J, Ibrahim BB, Scharer K, Brickley T, Julien T, Kennedy HP. Applying Lessons Learned from the COVID-19 Pandemic to Future Threats to the Perinatal Care System. *Journal of Midwifery & Women's Health*. 2023 Mar 10. <https://doi.org/10.1111/jmwh.13481>
- [23] Kouli Y, Laborie L. Keeping International Order in Good Health: Plant Protection. In *the Politics and Policies of European Economic Integration, 1850–1914* 2023 Jan 1 (pp. 105-119). Cham: Springer International Publishing. DOI: [10.1007/978-3-031-00296-0_5](https://doi.org/10.1007/978-3-031-00296-0_5)
- [24] Jackson D, Katwan E, Boehm C, Diaz T. Use of routine health information systems to monitor disruptions of coverage of maternal, newborn, and child health services during COVID-19: A scoping review. *Journal of global health*. 2023 Feb 10;13:06002. doi: [10.7189/jogh.13.06002](https://doi.org/10.7189/jogh.13.06002)
- [25] Merrick H, Driver H, Main C, Kenny RP, Richmond C, Allard A, Bola K, Morris C, Parr JR, Pearson F, Pennington L. Impacts of health care service changes implemented due to COVID-19 on children and young people with a long-term disability: A mapping review. *Developmental Medicine & Child Neurology*. 2023 Jan 17. DOI: [10.1111/dmcn.15503](https://doi.org/10.1111/dmcn.15503)
- [26] Valencia KM, Cagasan EG. Lived experiences of risk among pregnant women in Baybay City, Leyte during the COVID-19 pandemic: A phenomenological study. *International Journal of Disaster Risk Reduction*. 2023 Mar 15:103624. <https://doi.org/10.1016/j.ijdrr.2023.103624>
- [27] Ekawati FM, Muchlis M, Iturrieta-Guaita NG, Putri DA. Recommendations for improving maternal health services in Indonesian primary care under the COVID-19 pandemic: results of a systematic review and appraisal of international guidelines. *Sexual & Reproductive Healthcare*. 2023 Jan 12:100811. <https://doi.org/10.1016/j.srhc.2023.100811>

- [28] Esposito G, Rossi M, Favilli A, Franchi M, Corrao G, Parazzini F, La Vecchia C. Impact of the First and Second Lockdown for COVID-19 Pandemic on Preterm Birth, Low Birth Weight, Stillbirth, Mode of Labor, and of Delivery in Lombardy, Italy. *Journal of Personalized Medicine*. 2023 Mar 10;13(3):499. <https://doi.org/10.3390/jpm13030499>
- [29] Semaan A, Dey T, Kikula A, Asefa A, Delvaux T, Langlois EV, van den Akker T, Benova L. “Separated during the first hours”—Postnatal care for women and newborns during the COVID-19 pandemic: A mixed-methods cross-sectional study from a global online survey of maternal and newborn healthcare providers. *PLOS Global Public Health*. 2022 Apr 28;2(4):e0000214. <https://doi.org/10.1371/journal.pgph.0000214>
- [30] Dundon K, ALAM S, Deng X, Morrison M, BROWN T, White KR, Hazard L, Fort M, Coverstone KR, Mason C, Gaffney M. Likely Impact of the COVID-19 Pandemic on Newborn Hearing Screening and Follow-up Services in the United States in 2020. *Journal of Early Hearing Detection and Intervention*. 2022;7(3):1-5. <https://doi.org/10.1177/01945998211067728>
- [31] Assefa Y, Gilks CF, Reid S, van de Pas R, Gete DG, Van Damme W. Analysis of the COVID-19 pandemic: lessons towards a more effective response to public health emergencies. *Globalization and Health*. 2022 Dec;18(1):1-3. <https://doi.org/10.1186/s12992-022-00805-9>
- [32] Busch-Hallen J, Walters D, Rowe S, Chowdhury A, Arabi M. Impact of COVID-19 on maternal and child health. *The Lancet Global Health*. 2020 Oct 1;8(10):e1257. DOI:[https://doi.org/10.1016/S2214-109X\(20\)30327-2](https://doi.org/10.1016/S2214-109X(20)30327-2).
- [33] Murewanhema G, Mpabuka E, Moyo E, Tungwarara N, Chitungo I, Mataruka K, Gwanzura C, Musuka G, Dzinamarira T. Accessibility and utilization of antenatal care services in sub-Saharan Africa during the COVID-19 pandemic: A rapid review. *Birth*. 2023 Mar 6. DOI: [10.1111/birt.12719](https://doi.org/10.1111/birt.12719)
- [34] Kates J, Gerolamo A, Pogorzelska-Maziarz M. The impact of COVID-19 on the hospice and palliative care workforce. *Public Health Nursing*. 2021 May;38(3):459-63. <https://doi.org/10.1111/phn.12827>
- [35] Shahbazi Sighaldehy S, Ebrahimi Kalan M. Care of newborns born to mothers with COVID-19 infection; a review of existing evidence. *The Journal of Maternal-Fetal & Neonatal Medicine*. 2022 Jun 3;35(11):2203-15. <https://doi.org/10.1080/14767058.2020.1777969>
- [36] Ashish KC, Gurung R, Kinney MV, Sunny AK, Moinuddin M, Basnet O, Paudel P, Bhattarai P, Subedi K, Shrestha MP, Lawn JE. Effect of the COVID-19 pandemic response on intrapartum care, stillbirth, and neonatal mortality outcomes in Nepal: a prospective observational study. *The Lancet Global health*. 2020 Oct 1;8(10):e1273-81. [https://doi.org/10.1016/S2214-109X\(20\)30345-4](https://doi.org/10.1016/S2214-109X(20)30345-4)

- [37] Cabral IE, Pestana-Santos M, Ciuffo LL, Nunes YD, Lomba MD. Child health vulnerabilities during the COVID-19 pandemic in Brazil and Portugal. *Revista Latino-Americana de Enfermagem*. 2021 Jul 2;29. <https://doi.org/10.1590/1518-8345.4805.3422>
- [38] Okeagu CN, Reed DS, Sun L, Colantonio MM, Rezayev A, Ghaffar YA, Kaye RJ, Liu H, Cornett EM, Fox CJ, Urman RD. Principles of supply chain management in the time of crisis. *Best Practice & Research Clinical Anaesthesiology*. 2021 Oct 1;35(3):369-76. <https://doi.org/10.1016%2Fj.bpa.2020.11.007>
- [39] Pappa S, Sakkas N, Sakka E. A year in review: sleep dysfunction and psychological distress in healthcare workers during the COVID-19 pandemic. *Sleep medicine*. 2022 Mar 1;91:237-45. <https://doi.org/10.1016%2Fj.sleep.2021.07.009>
- [40] Salve S, Raven J, Das P, Srinivasan S, Khaled A, Hayee M, Olisenekwu G, Gooding K. Community health workers, and Covid-19: Cross-country evidence on their roles, experiences, challenges and adaptive strategies. *PLOS Global Public Health*. 2023 Jan 4;3(1):e0001447. <https://doi.org/10.1371/journal.pgph.0001447>
- [41] Winkelmann J, Panteli D, Berger E, Busse R. Have we learned the right lessons? Intensive care capacities during the COVID-19 pandemic in Europe. *Eurohealth*. 2022;28(1):1-5. <https://apps.who.int/iris/bitstream/handle/10665/351083/Eurohealth-28-1-41-45-eng.pdf?sequence=1>
- [42] Van Ginneken E, Siciliani L, Reed S, Eriksen A, Tille F, Zapata T. Addressing backlogs and managing waiting lists during and beyond the COVID-19 pandemic. *TEN*. 2022;28(1):35. <https://www.lse.ac.uk/lse-health/publications/eurohealth>
- [43] Vaamonde L, Benova L, Rodríguez M, Silveira V, Fabra F, Turcatti K, González-Dambrauskas S, Díaz-Rossello JL, Blasina F, Semaan A. Perinatal Healthcare Providers' Perspectives and Experiences During the Early Phase of the COVID-19 Pandemic in Uruguay. <https://doi.org/10.5281/zenodo.7100157>
- [44] Bellini C., et al., (2020). Stressful impact of COVID-19 pandemic on health care workers in Italy: Results from preliminary research in Tuscany. *Journal of Clinical Medicine*; 9(5): 1717.
- [45] García-Salido A., et al., (2020). Impacto de la pandemia por SARS-CoV-2 en las unidades de cuidados intensivos pediátricos y neonatales españolas: resultados preliminares del estudio nacional NEO-COVID-UCI [Impact of SARS-CoV-2 pandemic on Spanish pediatric and neonatal intensive care units: preliminary results from national study NEO-COVID-UCI]. *Anales de Pediatría*; 93(4): 239–243.
- [46] Asefa A, Semaan A, Delvaux T, Huysmans E, Galle A, Sacks E, Bohren MA, Morgan A, Sadler M, Vedam S, Benova L. The impact of COVID-19 on the provision of respectful maternity care:

Findings from a global survey of health workers. *Women and Birth*. 2022 Jul 1;35(4):378-86.
<https://doi.org/10.1016/j.wombi.2021.09.003>

- [47] Breslin N et al., "COVID-19 Infection Among Asymptomatic and Symptomatic Pregnant Women: Two Weeks of Confirmed Presentations to an Affiliated Pair of New York City Hospitals," *American Journal Of Obstetrics & Gynecology MFM* (2020).
- [48] Flannery DD et al., "SARS-CoV-2 Seroprevalence Among Parturient Women," *Obstetrics & Gynecology* (2020).
- [49] Gale C et al., "Effects Of Coronavirus Disease 2019 (COVID-19) On Maternal And Neonatal Outcomes: A Systematic Review And Meta-analysis," *The Lancet Global Health* (2020).
- [50] Royal College Of Paediatrics And Child Health (RCPCH), "COVID-19 - Guidance For Neonatal Settings" (2020).
- [51] World Health Organization (WHO), "Clinical Management Of Severe Acute Respiratory Infection When Novel Coronavirus (nCoV) Infection Is Suspected" (2020).