

SARS-CoV-2 infections among neonates born to women with SARS-CoV-2 infection: maternal, pregnancy and birth characteristics

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Short Report

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Abstract

Background: Multiple reports have described neonatal SARS-CoV-2 infection, including likely *in utero* transmission and early postnatal infection. Most neonatal infections reported to date have been asymptomatic or mild disease; however, severe cases, including respiratory failure requiring intensive care unit admission, have been described.

Objectives: To describe maternal, pregnancy and infant characteristics among neonates born to women with SARS-CoV-2 infection during pregnancy by neonatal SARS-CoV-2 testing results.

Methods: Using aggregated data from the Surveillance for Emerging Threats to Mothers and Babies Network (SET-NET) from March 29, 2020–August 6, 2021, we identified neonates who were: 1) born to women who were SARS-CoV-2 positive by RT-PCR at any time during their pregnancy, and 2) tested for SARS-CoV-2 by RT-PCR during the birth hospitalization.

Results: Among 25,896 neonates of mothers with SARS-CoV-2-infection, 3,381 (13%) underwent PCR testing. One hundred thirty-six neonates (4%) were PCR-positive. Neonates testing positive were born to both symptomatic and asymptomatic women, and 95% were born to women with infection identified \leq with 14 days of delivery.

Conclusions: While perinatal SARS-CoV-2 infection was uncommon among neonates born to women with SARS-CoV-2 infection during pregnancy, nearly all cases of neonatal infection occurred in pregnant women infected around the time of delivery. These findings underline the need for infection prevention and control measures in delivery and outpatient pediatric settings, as well as counselling for persons who acquire COVID-19 during pregnancy about potential risk to their neonates. Moreover, pregnant people and those wanting to become pregnant should be vaccinated against COVID-19 in order to protect themselves and their infants.

Synopsis

Study question

We sought to describe maternal, pregnancy and infant characteristics among neonates born to women with SARS-CoV-2 infection during pregnancy by infant SARS-CoV-2 testing results at birth.

What's already known?

Multiple reports have described perinatal SARS-CoV-2 infection, including likely *in utero* transmission and early postnatal infection. Most neonatal infections reported to date have been asymptomatic or mild disease; however, severe cases, including respiratory failure requiring intensive care unit admission, have been described.

What this study adds?

Among 25,896 neonates of mothers with SARS-CoV-2 infection, 3,381 (13%) underwent PCR testing with reported results. One hundred thirty-six neonates (4%) were PCR-positive and were born to both symptomatic and asymptomatic women. Nearly all PCR-positive neonates (95%) were born to women with infection identified ≤ 14 days of delivery.

Background

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection can lead to serious coronavirus disease 2019 (COVID-19) in pregnant women, is associated with preterm birth, and poses a potential risk of transmission to the neonate.¹⁻³ Multiple reports have described perinatal infection, including likely *in utero* transmission and early postnatal infection.^{3,4} Most neonatal infections reported to date have been asymptomatic or mild disease; however, severe cases, including respiratory failure requiring intensive care unit (ICU) admission, have been described.⁵ The American Academy of Pediatrics (AAP) and the Centers for Disease Control and Prevention (CDC) recommend all neonates born to women with suspected or confirmed COVID-19 be tested for SARS-CoV-2 by real-time reverse transcription polymerase chain reaction (RT-PCR).^{6,7} However, data describing factors associated with infection among exposed neonates are limited. We sought to describe maternal, pregnancy and infant characteristics among neonates born to women with SARS-CoV-2 infection during pregnancy by neonatal SARS-CoV-2 testing results.

Methods

Cohort Selection

The Surveillance for Emerging Threats to Mothers and Babies Network (SET-NET) is a collaboration between CDC and state, local, and territorial health departments to conduct linked-longitudinal surveillance of pregnant women and their infants to understand the effects of emerging and reemerging threats, including COVID-19.⁸ Pregnant women with laboratory confirmed SARS-CoV-2 infection from January 20 to December 31, 2020, are retrospectively ascertained through reporting of pregnancy in COVID-19 surveillance and cross-matching of COVID-19 surveillance data with local data systems that contained data on births to assess pregnancy status. The data are then enhanced through a variety of supplemental data sources at the jurisdiction level including, but not limited to, vital statistics, prenatal screening data, administrative datasets, electronic laboratory reporting, and maternal and neonatal medical record review. The aggregated SET-NET data contain variables on maternal demographics and prenatal history, maternal SARS-CoV-2 infection (e.g., timing of infection relative to pregnancy, severity), neonatal characteristics (e.g., gestational age, SARS-CoV-2 testing), among others. This activity was reviewed by CDC and conducted consistent with applicable federal law and policy.⁹

Exposure

Using aggregated SET-NET data compiled through August 6, 2021, we identified neonates who were: 1) born to women who were SARS-CoV-2 RT-PCR positive at any time during their pregnancy, and 2) tested for SARS-CoV-2 by RT-PCR during the birth hospitalization. For neonates with extended hospitalization at birth (>14 days) or whose date of discharge was unknown, only SARS-CoV-2 tests conducted ≤ 14 days following birth were included in order to focus on infections from perinatal transmission, rather than community transmission.

Statistical analysis

We describe neonates by SARS-CoV-2 testing. We focused on SARS-CoV-2 positive neonates and described maternal and birth characteristics, including maternal demographics, maternal COVID-19 disease severity,¹⁰ timing of maternal infection relative to delivery (determined by date of first positive SARS-CoV-2 or symptom onset, if testing date was missing) and pregnancy complications (e.g., preeclampsia). We assessed neonatal characteristics including gestational age and birthweight. We also described these characteristics among neonates who were tested by SARS-CoV-2 RT-PCR following birth but who tested negative. Because negative results are not reported consistently to all jurisdictions, the group of test-negative neonates are not representative of all neonates testing negative. Therefore, we did not perform statistical comparisons between neonates testing positive and negative for SARS-CoV-2. Nevertheless, the SET-NET data offer a glimpse of the current state of perinatal SARS-CoV-2 RT-PCR testing of neonates, and neonates with negative results are included here for context.

Results

During March 29, 2020–August 6, 2021, 20 jurisdictions with neonatal testing data available reported on 25,896 liveborn neonates born to 25,487 pregnant women with SARS-CoV-2 infection (Figure). Of liveborn neonates, 22,515 (86.9%) had no SARS-CoV-2 testing data available, 19 (0.1%) were tested but had indeterminate or unknown results reported, and 3,362 (13.0%) had positive or negative SARS-CoV-2 RT-PCR results reported. The proportion of neonates known to be tested for SARS-CoV-2 increased with maternal trimester of infection, with testing being performed for 1.3% (43/3424), 2.6% (207/7,817), and 22.4% (3,112/13,918) of neonates born to women with first, second and third trimester infection, respectively. The median time from maternal SARS-CoV-2 infection to delivery was 75 days (IQR:20-143) among neonates not known to be tested and one day (IQR: 0-9) among those tested.

Of the 3,362 neonates with test results, 3,226 had only negative RT-PCR results reported, and 136 (4.0%) had at least one positive RT-PCR result, representing 0.5% [136/25,896] of livebirths reported. Of these 136 neonates, 90 (66.2%) had only positive RT-PCR results and 46 (33.8%) had both positive and negative results. Of the latter group, 20 neonates tested negative one day before testing positive and nine neonates

tested positive one day before testing negative. Four neonates had a positive and a negative PCR on the same day.

Maternal demographics and underlying conditions are summarized in the Table. The most frequent maternal race/ethnicity was Hispanic or Latina. Of SARS-CoV-2 positive neonates with date of maternal infection reported (n=133), 95.5% were born to women with either initial positive testing or symptom onset occurring ≤ 14 days before delivery. Six infected neonates were born to women with initial positive SARS-CoV-2 testing >14 days before delivery. Three of these women remained SARS-CoV-2 positive within two days prior to delivery. The percent positivity among neonates tested for SARS-CoV-2 was 0.9% (6/644), 3.2% (10/317), 4.6% (19/409), and 5.0% (98/1967) for those born to women with infection diagnosed >14 days, 7-14 days, 3-6 days and 0-2 days before delivery. Of neonates testing positive whose maternal disease severity was known (n=85), 42 (49.4%) were born to mothers reported to be asymptomatic at time of COVID-19 diagnosis.

Among the 136 neonates testing positive for SARS-CoV-2-positive, 54.1% were female, 6.9% were small for gestational age ($<10^{\text{th}}$ percentile for sex and gestational age using the INTERGROWTH-21st), and 33 (24.3%) were born preterm (<37 weeks gestation), including 8.1% (11/136) born moderate to extremely preterm (<34 weeks). Among neonates born at ≥ 37 weeks, percent SARS-CoV-2 positivity was 3.8% (103/2,698), compared to 6.0% (33/546) positivity among neonates born preterm. Timing of RT-PCR testing was available for 135 of the neonates with SARS-CoV-2 infection: eight (5.9%) neonates were first tested on the day of birth, 103 (76.3%) on the second day of life (DOL), and 20 (14.8%) on the third DOL. The timing of RT-PCR testing was similar for neonates testing negative.

Comment

Principal findings

SARS-CoV-2 infection among neonates born to women with COVID-19 during pregnancy was uncommon, occurring in 4.0% of neonates known to be tested for the virus. However, this is likely an overestimate because negative test results are less frequently reported to health departments; the true percentage lies between 4.0% and 0.5% (the total neonates testing PCR-positive among all livebirths). While uncommon, neonatal infection was more frequent among neonates born to mothers diagnosed with COVID-19 close to delivery (<7 days) and among neonates born preterm (<37 weeks). Neonatal positivity occurred regardless of maternal symptom status.

Strengths of the study

SET-NET is one of the largest cohorts of pregnant women with laboratory confirmed SARS-CoV-2 infections in the U.S. The mother baby linked longitudinal surveillance allows for case identification of infection during pregnancy and follow-up to the birth hospitalization using existing data sources including laboratory reporting.

Limitations of the data

Limitations of our analysis include the inability to assess route of SARS-CoV-2 transmission (e.g., *in utero*, peripartum, postnatal), given lack of immunoglobulin-M serology and RT-PCR testing data on sterile specimens (e.g., blood).¹¹ We were also not able to assess infection prevention and control (IPC) measures implemented during delivery hospitalization, which may vary. Lastly, testing practices of both pregnant women and their neonates likely varied throughout the course of the pandemic, by facility, and by maternal or neonatal characteristics (e.g., symptom status, ICU admission).¹²

Interpretation

Previous studies of pregnant women with SARS-CoV-2-infection have suggested higher prevalence of preterm birth, and potentially other adverse outcomes, compared to pregnant women without infection or national baseline estimates.^{2,13} However, much remains unknown about the frequency and risk factors of transmission of SARS-CoV-2 from a pregnant person to their fetus or neonate. Our findings that neonates with positive SARS-CoV-2 testing were born to both symptomatic and asymptomatic women underline the need for IPC measures in delivery and outpatient pediatric settings, as well as counselling for persons who acquire COVID-19 during pregnancy about potential risk to their neonates.

Identification of neonates with SARS-CoV-2 infection will be influenced by testing practices. Although these data are not representative of all perinatal testing practices, they indicate that RT-PCR SARS-CoV-2 testing of neonates born to women with SARS-CoV-2 infection during pregnancy primarily occurred for women with third trimester infection, especially for women with infection identified within 14 days of delivery. These testing patterns are consistent with the idea that transmission from mother to neonate through respiratory droplets is most likely to occur during the mother's infectious period.¹⁴ Nearly all neonates born to women with infection occurring more than 14 days prior to delivery tested negative; one possible additional explanation is protection against SARS-CoV-2 infection by transplacental transfer of maternal antibodies,¹⁵ but further studies are needed.

Conclusion

Previous studies have demonstrated that risk of postnatal transmission from a mother infected with SARS-CoV-2 to neonate is low when appropriate IPC is followed.³ The AAP and CDC recommend that mothers with COVID-19 utilize appropriate IPC measures (e.g., masks, hand hygiene) when rooming in with their infants,^{6,7} even if the mother is asymptomatic. Neonates born to women with COVID-19 should be tested for SARS-CoV-2,^{6,7} particularly those born to women with infection identified close to delivery or who are born preterm. Future studies that compare infected with SARS-CoV-2 infection to a representative sample of neonates without infection are needed to identify risk factors for neonatal SARS-CoV-2 infection and other neonatal adverse outcomes. Additionally pregnant people and those wanting to become pregnant should be vaccinated against COVID-19 in order to protect themselves and their infants.¹⁶

Declarations

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Conflict of Interest Disclosures: All authors have no conflicts of interest to disclose.

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References

1. Zambrano LD, Ellington S, Strid P, et al. Update: Characteristics of Symptomatic Women of Reproductive Age with Laboratory-Confirmed SARS-CoV-2 Infection by Pregnancy Status – United States, January 22–October 3, 2020. *MMWR Morb Mortal Wkly Rep*. Published online 2020. doi:10.15585/mmwr.mm6944e3

2. Woodworth KR, Olsen EO, Neelam V, et al. Birth and Infant Outcomes Following Laboratory-Confirmed SARS-CoV-2 Infection in Pregnancy – SET-NET, 16 Jurisdictions, March 29–October 14, 2020. *MMWR Morb Mortal Wkly Rep*. Published online 2020. doi:10.15585/mmwr.mm6944e2
3. Walker KF, O'Donoghue K, Grace N, et al. Maternal transmission of SARS-COV-2 to the neonate, and possible routes for such transmission: A systematic review and critical analysis. *BJOG An Int J Obstet Gynaecol*. 2020;127(11). doi:10.1111/1471-0528.16362
4. Fenizia C, Biasin M, Cetin I, et al. Analysis of SARS-CoV-2 vertical transmission during pregnancy. *Nat Commun*. 2020;11(1):5128. doi:10.1038/s41467-020-18933-4
5. Raschetti R, Vivanti AJ, Vauloup-Fellous C, Loi B, Benachi A, De Luca D. Synthesis and systematic review of reported neonatal SARS-CoV-2 infections. *Nat Commun*. 2020;11(1). doi:10.1038/s41467-020-18982-9
6. American Academy of Pediatrics. FAQs: Management of Infants Born to Mothers with Suspected or Confirmed COVID-19. Published September 2020. Accessed August 26, 2021. <https://services.aap.org/en/pages/2019-novel-coronavirus-covid-19-infections/clinical-guidance/faqs-management-of-infants-born-to-covid-19-mothers/>
7. Centers for Disease Control and Prevention. Evaluation and Management Considerations for Neonates At Risk for COVID-19. Published December 2020. Accessed August 26, 2021. <https://www.cdc.gov/coronavirus/2019-ncov/hcp/caring-for-newborns.html>
8. Woodworth KR, Reynolds MR, Burkel V, et al. A Preparedness Model for Mother–Baby Linked Longitudinal Surveillance for Emerging Threats. *Matern Child Health J*. 2021;25(2):198-206. doi:10.1007/s10995-020-03106-y
9. 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

10. Galang RR, Newton SM, Woodworth KR, et al. Risk factors for illness severity among pregnant women with confirmed severe acute respiratory syndrome coronavirus 2 infection – Surveillance for Emerging Threats to Mothers and Babies Network, 29 state, local, and territorial health departments, March 29, 2020 -March 5, 2021. *Clin Infect Dis.* 2021 Jul 15;73(Suppl 1):S17-S23. doi: 10.1093/cid/ciab432.

11. World Health Organization. Definition and Categorization of the Timing of Mother-to-Child Transmission of SARS-CoV-2.; 2012. Accessed August 26, 2021. <https://www.who.int/publications/i/item/WHO-2019-nCoV-mother-to-child-transmission-2021.1>

12. Palmsten K, Vazquez-Benitez G, Kharbanda EO. Point: Uncertainty about estimating the risks of COVID-19 during pregnancy. *Paediatr Perinat Epidemiol.* 2021:00:1-3. <https://doi.org/10.1111/ppe.12773>

13. Allotey J, Stallings E, Bonet M, et al. Clinical manifestations, risk factors, and maternal and perinatal outcomes of coronavirus disease 2019 in pregnancy: living systematic review and meta-analysis. *BMJ.* 2020;370:m3320. Published 2020 Sep 1. doi:10.1136/bmj.m3320

14. Quilty BK, Clifford S, Hellewell J, Russell TW, Kucharski AJ, Flasche S, Edmunds WJ. Quarantine and testing strategies in contact tracing for SARS-CoV-2: a modelling study. *Lancet Public Health* 2021; 6(3): e175-e183. [https://doi.org/10.1016/S2468-2667\(20\)30308-X](https://doi.org/10.1016/S2468-2667(20)30308-X)

15. Flannery DD, Gouma S, Dhudasia MB, et al. Assessment of Maternal and Neonatal Cord Blood SARS-CoV-2 Antibodies and Placental Transfer Ratios. *JAMA Pediatr.* 2021;175(6):594–600. doi:10.1001/jamapediatrics.2021.0038

16. Centers for Disease Control and Prevention. COVID-19 Vaccines While Pregnant or Breastfeeding. Updated August 11, 2021. Accessed August 27, 2021. <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations/pregnancy.html>

Table

Table. Maternal demographics, maternal disease characteristics, and neonate characteristics by neonate SARS-CoV-2 real-time polymerase chain reaction (RT-PCR) test results – SET-NET, 20 jurisdictions^a, March 29, 2020 – August 6, 2021

	Neonate RT-PCR test results (N=3,362)	
	Positive	Negative
n (%)	136 (4%)	3,226 (96%)
Maternal characteristics		
Age in years	N=120	N=2,966
Median (IQR)	29.1 (24.4-34.3)	29.0 (24.7-33.8)
<25	35 (29.2%)	785 (26.5%)
25-34	57 (47.5%)	1,606 (54.1%)
≥35	28 (23.3%)	575 (19.4%)
<i>Not reported, n (%)</i>	<i>16 (11.8%)</i>	<i>260 (8.1%)</i>
Race/ethnicity	N=120	N=3080
Hispanic or Latina	65 (54.2%)	1464 (47.5%)
Black, non-Hispanic	17 (14.2%)	517 (16.8%)
White, non-Hispanic	32 (26.7%)	847 (27.5%)
Multiple or other race, non-Hispanic	6 (5%)	252 (8.2%)
<i>Not reported, n (%)</i>	<i>16 (11.8%)</i>	<i>146 (4.5%)</i>
Underlying conditions		
	N=121	N=2895
Any underlying condition ^b	58 (47.9%)	1343 (46.4%)
	N=113	N=2476
Hypertensive disorders of pregnancy ^c	17 (15.0%)	326 (13.2%)
Trimester of maternal infection		
	N=135	N=3208
First	0 (0%)	43 (1.3%)
Second	1 (0.7%)	203 (6.3%)
Third	134 (99.3%)	2962 (92.3%)
<i>Not reported, n (%)</i>	<i>1 (0.7%)</i>	<i>18 (0.6%)</i>

Timing of mother's first positive RT-PCR test (days prior to delivery)	N=133	N=3204
Median (IQR)	1 (0-3)	1 (0-9)
>14	6 (4.5%)	638 (19.9%)
7-14	10 (7.5%)	307 (9.6%)
3-6	19 (14.3%)	390 (12.2%)
0-2	98 (73.7%)	1869 (58.3%)
<i>Not reported, n (%)</i>	<i>4 (2.9%)</i>	<i>22 (0.7%)</i>
Maternal disease severity ^d	N=85	N=1753
Asymptomatic	42 (49.4%)	732 (41.8%)
Mild	28 (32.9%)	674 (38.4%)
Moderate/severe	9 (10.6%)	252 (14.4%)
Critical	6 (7.1%)	95 (5.4%)
<i>Not enough information, n (%)</i>	<i>51 (37.5%)</i>	<i>1473 (45.7%)</i>
Delivery type	N=132	N=2958
Vaginal	72 (54.5%)	1863 (63%)
Cesarean	60 (45.5%)	1095 (37%)
<i>Not reported, n (%)</i>	<i>4 (2.9%)</i>	<i>268 (8.3%)</i>
Infant characteristics		
Gestational age at birth	N=136	N=3108
Median weeks (IQR)	38.7 (37.1-39.6)	39.0 (37.6-40.0)
Term (≥ 37 wks)	103 (75.7%)	2595 (83.5%)
Preterm (<37 wks)	33 (24.3%)	513 (16.5%)
Late preterm (34-36 wks)	22 (16.2%)	347 (11.2%)
Moderate to extremely preterm (<34 wks)	11 (7.4%)	166 (4.6%)
<i>Not reported, n (%)</i>	<i>0 (0%)</i>	<i>111 (3.4%)</i>
Neonate Sex	N=135	N=3224
Female	73 (54.1%)	1579 (49%)
Male	62 (45.9%)	1645 (51%)

<i>Not reported, n (%)</i>	1 (0.7%)	2 (0.1%)
Birthweight		
	N=131	N=2762
Low birthweight (<2500 g)	18 (13.7%)	319 (11.5%)
	N=130	N=2502
Small for gestational age ^e	9 (6.9%)	192 (7.7%)
<i>Not reported, n (%)</i>	6 (4.4%)	724 (22.4%)
Neonatal intensive care unit admission	N=122	N=2495
Admitted during birth hospitalization	42 (34.4%)	577 (23.1%)
<i>Not reported, n (%)</i>	8 (6.2%)	628 (20.1%)
Day of first RT-PCR test following birth, in days of life	N=135	N=3192
1	8 (5.9%)	189 (5.9%)
2	103 (76.3%)	2357 (73.8%)
3	20 (14.8%)	490 (15.4%)
≥4	4 (3%)	156 (4.9%)

^a Including California [excluding Los Angeles County], Georgia, Houston, Kansas, Los Angeles County, Massachusetts, Maryland, Michigan, Minnesota, Missouri, Nebraska, Nevada, New Jersey, New York [excluding New York City], North Dakota, Pennsylvania [excluding Philadelphia], Puerto Rico, Tennessee, Vermont, and Washington

^bIncludes cardiovascular disease, chronic hypertension, chronic lung disease, diabetes mellitus (type 1 or type 2), immunosuppression, obesity (body mass index ≥ 30 kg/m²).

^cInclusive of preeclampsia, eclampsia, or HELLP (hemolysis, elevated liver enzymes and low platelet) syndrome. Does not include chronic hypertension. Hypertensive disorders of pregnancy were only considered underlying conditions for women with third trimester infection.

^dCategories of disease severity were based on modified National Institute of Health and World Health Organization criteria as described in Galang et al⁹. Women were considered asymptomatic if reported as having an absence of symptoms using a symptom status variable rather than solely absence of individual symptoms reported. Criteria were applied to classify severity using submitted data including symptoms, intensive care unit admission, invasive ventilation, use of COVID-19 therapies, complications associated with COVID-19, and death.

^eDefined as weight <10th percentile for sex (presumed female if missing) and gestational age using the INTERGROWTH-21st online percentile calculator <http://intergrowth21.ndog.ox.ac.uk>. Some gestational ages were reported in completed weeks only (rather than in weeks and days).

Figures

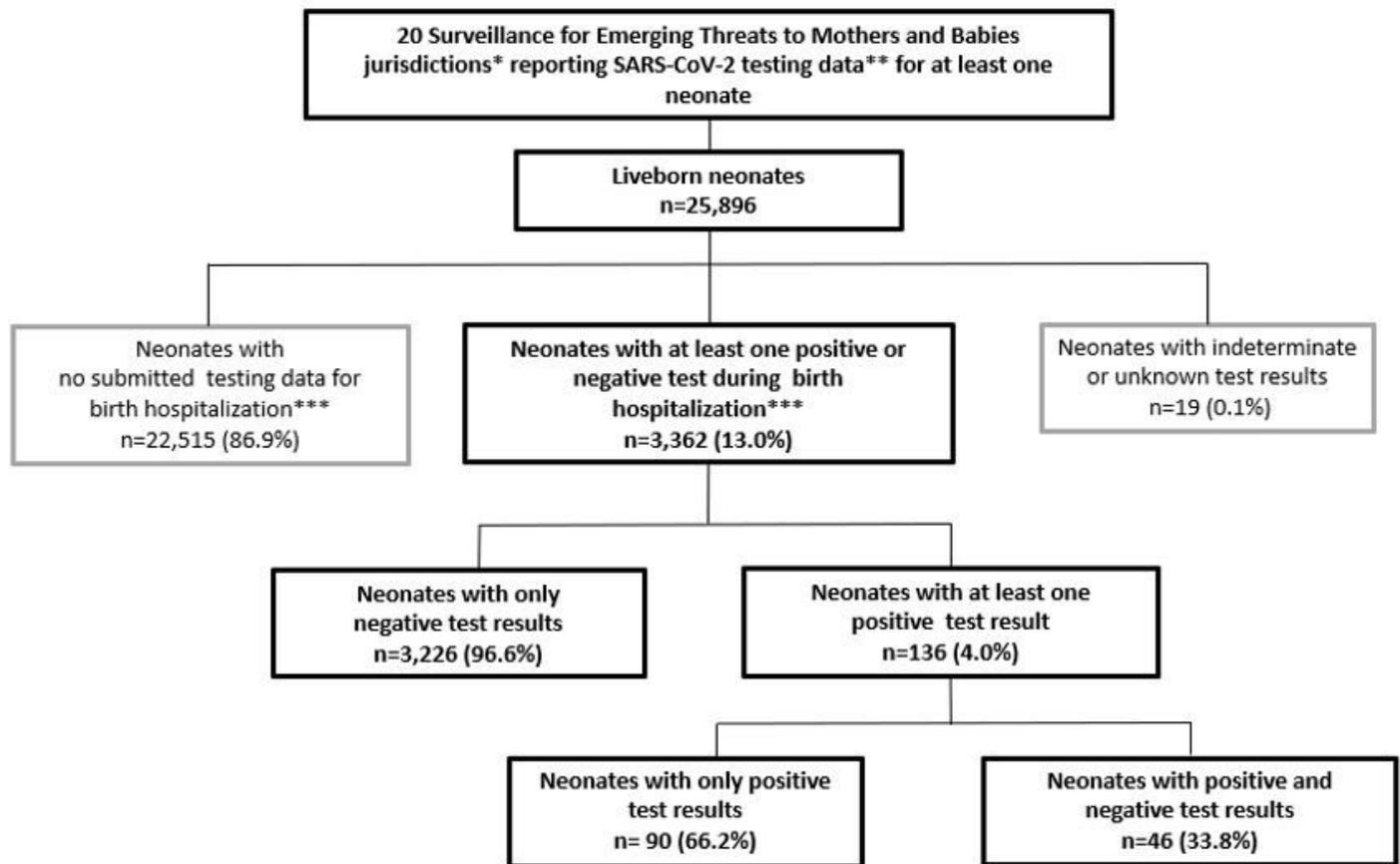


Figure 1

* 20 jurisdictions reporting SARS-CoV-2 lab data for at least one neonate: California [excluding Los Angeles County], Georgia, Houston, Kansas, Los Angeles County, Massachusetts, Maryland, Michigan, Minnesota, Missouri, Nebraska, Nevada, New Jersey, New York [excluding New York City], North Dakota, Pennsylvania [excluding Philadelphia], Puerto Rico, Tennessee, Vermont, Washington** All testing data herein was SARS-CoV-2 by real-time reverse transcription polymerase chain reaction (RT-PCR) *** The birth hospitalization period included only SARS-CoV-2 tests conducted ≤ 14 days following birth.