Case of a Preterm Newborn with the Nosocomial Acquisition of COVID-19 Infection in the Neonatal Intensive Care Unit and Contact Tracing

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Baby Girl was born a 1.66 kilogram 33-week preterm appropriate for gestational age female; Weight (27%); head circumference: 29 cm (31%); length: 40 cm (16%) Fenton growth curve, delivered by vertex presentation cesarean section due to maternal indications with worsening chronic hypertension to a 26-year-old Gravida 2 para 1 with one spontaneous abortion, Black Haitian mother who did have prenatal care. The mother was an insulin-dependent diabetes mellitus class F, with a diagnosis of type diabetes at ten years old. Her medical history was also remarkable for chronic hypertension and thalassemia trait. Hepatitis B, serology, HIV nonreactive; Rubella immune. GC and Chlamydia screen were negative; she denied a history of drugs, EtOH, or cigarettes. Maternal medications during antepartum care included Insulin, Labetalol, and Procardia. She received betamethasone prior to birth. Antepartum GBS screen was negative; ROM occurred at delivery, no meconium-stained amniotic fluid was present; no maternal fever or any noted maternal respiratory symptoms including dyspnea, shortness of breath, malaise, cough or coryza was noted.

Delivery room: Infant noted to have poor respiratory effort, responding to bag and mask positive pressure ventilation, placed on nasal CPAP, and brought to the neonatal intensive care unit (NICU). Apgar 3 and 8 at one and five minutes.

Hospital Course:

The infant did have mild respiratory distress syndrome with a minimal reticular granular pattern or normal chest x-ray at birth, transient supplemental oxygen requirement, and requiring maximal support of bubble CPAP +6. The infant was weaned to room air by day of life (DOL) 5. Shortly after birth, the infant was normotensive with a transient initial mixed acidosis, received 10 ml/kg 0.9 normal saline. A repeat capillary blood gas was normal by 6 hours of life. Initial CBC and differential were not suggestive of infection. Ampicillin and gentamicin were started at birth and discontinued after 36 hours of treatment with negative blood culture results. The infant was initially placed exclusively on intravenous fluids and was normoglycemic. Expressed breast milk or donor breast milk feeds were initiated at DOL 1 and advanced without problems. She did have some bradycardia and desaturation events and was started on caffeine citrate on DOL 3, and did have mild physiologic jaundice managed with early phototherapy. By DOL 5, the infant was in room air, on oral maintenance dosing of caffeine citrate, tolerating full enteral feeds, and without need for parenteral fluids.

The NICU is comprised of 64 single family rooms clustered in seven 8-10 room hallways. NICU visitation during this time period was unrestricted for parents. The mother was visiting, holding her baby, and bottle feeding with expressed or donor breast milk.

DOL 6: While visiting her baby, the mother was found to have a possible syncopal episode, found poorly arousable, lethargic, and dizzy, and taken to the emergency room for evaluation. She was reportedly inconsistent with the administration of her insulin dosing and was admitted for hypoglycemia. At that time, the mother denied any shortness of breath, congestion, or cough. There was no fever noted, nor any reported respiratory symptoms, and no COVID-19 testing was done. The mother was hospitalized for one day, had readjustment in her insulin dosing, and then discharged.

DOL 8-DOL 16: She continued to visit her baby in the NICU. The baby remained in room air and in an incubator.

DOL 19, the mother was admitted to the hospital for fever, cough, and hyperglycemia. Her SARS-CoV-2 RNA test was positive. She was maintained on airborne and contact isolation but did not require positive pressure support or supplemental oxygen. She was treated with a course of doxycycline and ceftriaxone for possible pneumonia. She was also managed for diabetic ketoacidosis as well as chronic kidney disease due to diabetic nephropathy. She required hospitalization from DOL 19 to DOL 28. She maintained self-quarantine at home until her baby was discharged on DOL 31.

DOL 20: The NICU staff were notified of the mother's admission. The infant at this time was a 2.094-kilogram 35+6-week postmenstrual age infant in room air, off caffeine citrate, on full cue-based enteral feeds, taking about 60-70% of feeds by nipple. The

	DOL 5	DOL 19	DOL 20	DOL 21	DOL 22	DOL 26
WBC (x 10^3/uL)	6.8	7.0	3.6		6.4	6.4
Neutrophils (%)	30		25		19	10
Lymphocytes (%)	48		56		74	66
Monocytes (%)	17		10		2	8
Eos (%)	4		1		2	
Hemoglobin (gm/dL)	20.2	13.1	13.1		12.9	
Hematocrit (%)	57.7	38.1	36.3		37.2	
Platelet (x 10^3/uL)	256	185	249		255	
CRP (mg/dl)			<0.5		<0.5	0.6
AST (U/L)				24	27	36
ALT (U/L)				7	7	10
SARS CoV-2 RNA, Qualitative (Abbott Diagnostics Scarborough, Inc)			Positive		Positive	

infant had weaned off donor breast milk and was on the mother's expressed breast milk or 24-cal premature formula. The baby was moved to a negative pressure room, placed on airborne and contact isolation, and tested SARS CoV-2 RNA positive. CBC: WBC 3.6; ANC 900.

DOL 21: T 37.2 centigrade (99 Fahrenheit) and T 37.6 centigrade (99.6 Fahrenheit)

DOL 22: Infant's repeat SARS CoV-2 RNA was positive.

DOL 23-24: The infant was noted to have mild nasal congestion, occasional sneezing, and cough. The neonatal nurse practitioner and neonatologist rounding elected to follow the baby clinically and did not order a viral respiratory panel or chest x-ray. The infant was not noted to have any persistent symptoms by the end of the day.

DOL 24-31: There were no additional symptoms reported. The infant gradually advanced to full nipple feedings and was discharged to his mother on DOL 31. The mother received the baby at the hospital entry, and follow-up was arranged with the pediatrician on DOL 34, 14 days from diagnosis of the infant. Both the mother and the infant remain well on outpatient follow-up on DOL 47, 17 days post-discharge.

Contact Tracing:

On DOL 20 of the baby's hospitalization, the hospital infection prevention team and the NICU nursing leadership initiated contact tracing, in compliance with the hospital employee exposure algorithm (see below), reviewing potential exposures to both mother and baby during the period 14 days prior to the mother's COVID-19 positive testing to the day of COVID positive testing on the baby (DOL 3-20). This review was extended to DOL 3, due to the uncertainty of onset of mother's symptoms on DOL 19. During this time, the NICU had unrestricted parental visitation, and there were no masking requirements for visitors. The mother was documented to have visited 15 times, roomed in twice, and held the baby seven times with or without feeding (her last visit was on DOL 16). She used expressed breast milk or donor breast milk feeds. Seventy-four separate potential exposures were identified based upon schedule and location of assignment, and 30 were found to have some level of exposure.

NICU staff adopted mandatory masking on 3/30 (DOL 12), and mandatory parent masking started on 4/2 (DOL 15). Staff were not required to wear eye protection until 4/7 (DOL 20). Risk assessment was based upon direct or phone interviews; each exposure was classified as low, moderate, or high risk.

Contact tracing required dedicated time from the quality and safety director, nursing director, nursing manager, several nursing supervisors, and infection prevention specialist, as well as system-level employee health interviewers. Steps in contact tracing were: (1): Identify the period of risk; (2) Identify the primary exposures; (3) Conduct a risk assessment of exposures; (4) define who should receive testing; (4) assess for secondary exposure risk based upon testing.

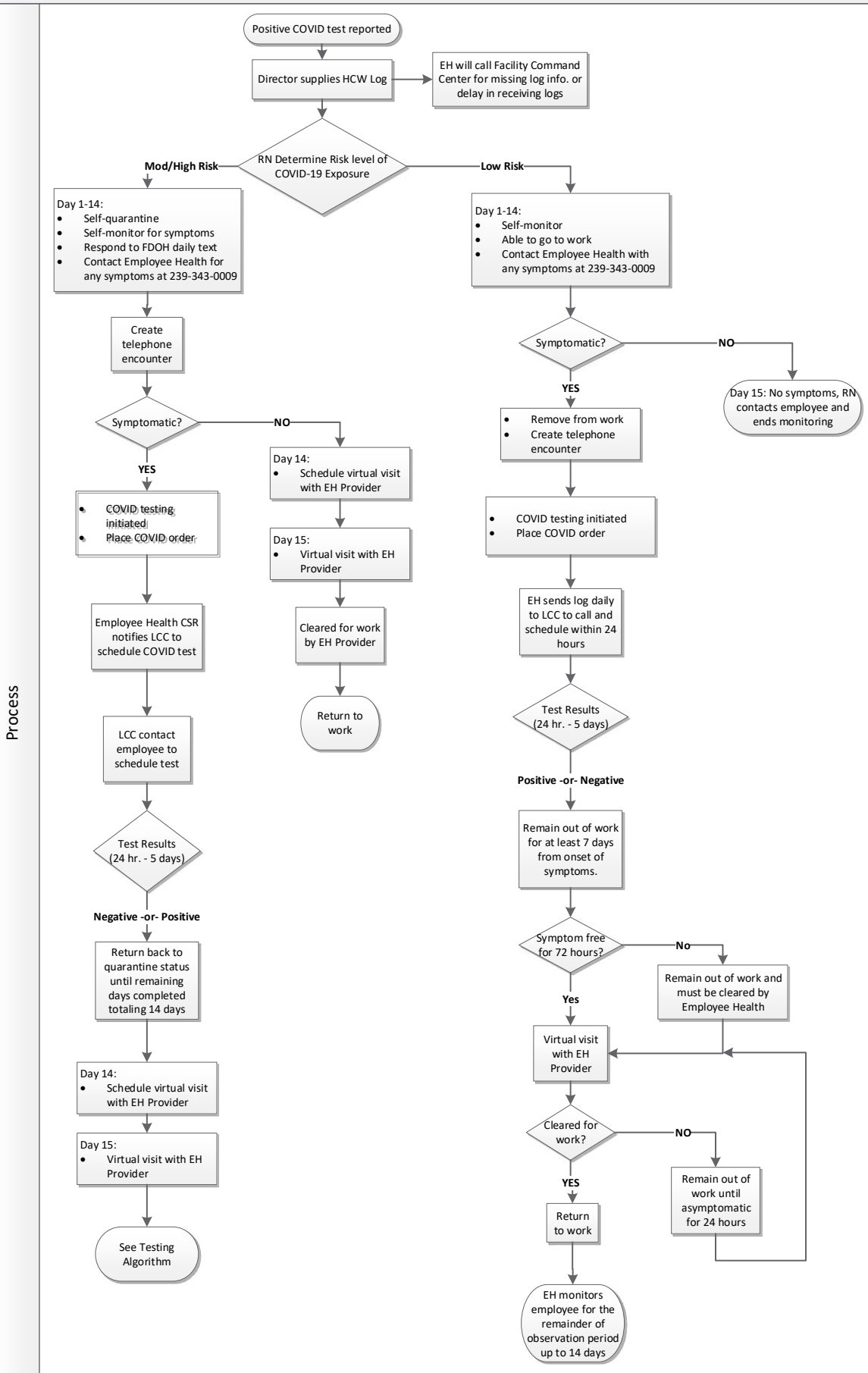
Potential candidates for review included the routine NICU staff-nurses (permanent as well as staffing resource center staff-"floater" who rotates through several departments, as well as some nursing staff who rotate from pediatric intensive care unit to NICU), respiratory therapists (permanent and "floaters"), clinical nurse assistants, patient care liaison, occupational therapy, social workers, pharmacists, dieticians, neonatologists and neonatal nurse practitioners, as well as housekeeping staff. It was also necessary to consider ancillary staff that had more variable exposure times, including milk lab personnel, ultrasonography, echocardiogram and radiology technicians, as well as medical-surgical consultants.

Risk Assessment Findings:

There were 15 high-risk, two moderate, and 12 low-risk exposures, and one medical provider was also identified to have moderate-risk exposure. There were 16 healthcare workers in the moderate or high-risk category who were placed on home quarantine for 14 days from date of potential exposure and received COVID-19 testing (one staff member with two exposures). Although our existing Employee Exposure Algorithm recommended testing of medium-high-risk exposures only if symptomatic, due to the NICU setting,

Lee Health COVID-19 EH: Employee Exposures Algorithm

Final Version 6



COVID-19_EH Employee Exposures algorithm — Version 6, Last Updated 04/23/2020

Adapted from CDC guidance documents in early April 2020, which have undergone subsequent revisions. https://cdc.gov/coronavirus/2019-ncov/guidance-risk-assesment-hcp.html

infection prevention elected to test all moderate and high-risk exposures for SARS-CoV-2 RNA testing. All testing was negative. All medium-high risk employees were required to self-quarantine for 14 days. One low-risk employee was also tested due to some respiratory symptoms and was negative. Otherwise, low-risk staff continued to work but were asked to self-monitor for 14 days, and none developed signs or symptoms of COVID-19 infection.

Secondary exposure risk was deemed to be low, with no positive testing. There were a total of eight potential newborn exposures. Six newborns remained hospitalized, with exposure to staff categorized as moderate or high-risk. The two who were discharged were doing well in a follow-up contact. The six babies remaining in the NICU showed no signs of COVID-19 infection and were negative on SARS-CoV-2 RNA testing.

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Risk Assessment: Mother never wore a mask during her exposures in the NICU

- **High Risk:** Exposure to Mother: any contact within 6 ft for >5 minutes, without mask, gown, or face shield. If no eye protection only- moderate. Contact with baby through portals for > 5 minutes if the baby is in an incubator, or any direct contact outside of incubator > 5 minutes (holding, feeding), without a gown, face shield, or surgical mask. (face shields did not start until 4/7 DOL 20)
- **Medium Risk**: Exposure to Mother: any contact within 6 ft for >5 minutes, with mask, gown, and face shield. Contact with baby through portals for > 5minutes if the baby is in an incubator, or any direct contact outside of incubator > 5 minutes (holding, feeding), with a gown, face shield, and a surgical mask.
- **Low Risk:** Exposure to Mother: any contact > 6 ft for <5 minutes. Contact with baby through portals for < 5minutes if the baby is in an incubator, or any direct contact outside of incubator < 5 minutes.

Discussion:

This is a report of a preterm newborn with nosocomial acquisition of COVID-19 from exposure to mother, as well as consequences of contact tracing following diagnosis.

Although pediatric patients and newborns have been reported in the literature, there isn't much in the way of detailed clinical descriptions of disease, especially in premature babies. Looking at nine recent published reports with a pediatric focus, as of May 3, 2020, there were 560 infants <1 year of age with confirmed SARS-CoV-2 testing.(1-8) Zhu reported ten newborns born to mothers with COVID-19 pneumonia. Still, none of these were SARS-CoV-2 positive. (7) There were five newborn cases with confirmed SARS-CoV-2 testing positive, with some clinical description of the disease, of which two were preterm. (4,5,7) This is a third case report.

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Even though this infant had only minimal symptoms, co-infections have been reported,(10) and, given the novelty of a COVID-19 positive baby, documentation of a normal chest x-ray and a viral respiratory panel would have been useful. We also did not follow serial testing to demonstrate when the PCR-based test became negative. Of interest, Zeng had reported three positive newborns where positive testing was noted on day of life 2 and 4 but became negative in all three newborns by day of life 6 or 7.5

We also describe the repercussions of this late-onset maternal exposure. Fortunately, no one was found to be positive, but many staff needed to be quarantined. The lack of any positive testing for all healthcare workers with exposure to the mother or baby also strongly implicates the mother as the primary vector for nosocomial acquisition and eliminates the likelihood of primary maternal acquisition from the identified NICU exposures.

The CDC has general guidelines for contact tracing. (10) Contact tracing in the NICU involves many potential exposures, those who are primarily based in the NICU, as well as multiple ancillary staff who will travel to other areas of the hospital. Immediate action is critical. The baby was placed under airborne and contact isolation and tested when we became aware of the exposure. Systematic and timely contact interviews and testing were implemented. If our contact tracing had yielded positive staff members, it would have necessitated a secondary level tracing that might extend outside the NICU area, and introduce many more potential exposures and increased infectivity risk throughout the hospital.

Following this event, we moved to limited visitation allowing only one parent for up to 2 hours/day, with paper screen/ attestation and physical exam assessment (temperature and targeted exam) of the parent by an APRN at the front desk, as well as enhanced video visitation for parents.

We will continue to face ongoing and evolving challenges as it relates to developing rational screening strategies- statewide and nationally, and for NICU workers, on a unit and institutional level.

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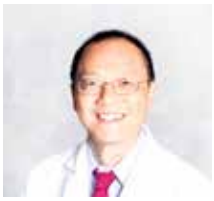

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