

## A contingency plan for the management of the 2019 novel coronavirus outbreak in neonatal intensive care units



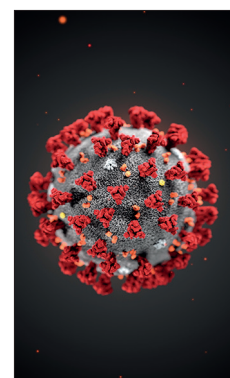
Since December, 2019, a pneumonia of unknown cause, which has clinical manifestations similar to severe acute respiratory syndrome,<sup>1,2</sup> originated in Wuhan, China, and has rapidly spread across China and to at least 23 countries. By Feb 5, 2020, the number of laboratory-confirmed cases had exceeded 20 000, with more than 400 deaths. About 100 children were affected, with the youngest being 30 h after birth. A novel virus named 2019 novel coronavirus (2019-nCoV) was considered to be the causative agent of this pneumonia. Neonates are thought to be susceptible to the virus because their immune system is not well developed, which is of great concern to neonatal medical service providers. Paediatricians and neonatologists belonging to the National Clinical Research Center for Child Health and Disorders and Pediatric Committee of Medical Association of Chinese People's Liberation Army have contributed to the control efforts in China. We aim to elicit a contingency plan for the 2019-nCoV outbreak in neonatal intensive care units (NICUs), mainly focused on diagnostic and discharge criteria, treatment, prevention, and control strategies.

Most adults or children with 2019-nCoV infection presented with mild flu-like symptoms, although patients with severe illness could rapidly develop acute respiratory distress syndrome, respiratory failure, and multiple organ failure, and deaths have been reported in some cases.<sup>3</sup> Most patients with pneumonia had abnormal chest radiography findings, such as bilateral ground-glass opacity, multiple lobular, and subsegmental areas of consolidation;<sup>4</sup> those with acute respiratory distress syndrome could show bilateral complete opacification of the lungs on CT scans.<sup>1</sup> Routine blood work was mostly unremarkable.<sup>4</sup> The nucleic acid test from respiratory tract samples or serum is effective in detecting the virus, and results are usually available within 4–6 h.<sup>5</sup>

Neonates might get 2019-nCoV infection through close contact with virus-infected patients or virus carriers. In the case of neonatal infection, the disease might have insidious onset and be non-specific.<sup>6</sup> The diagnosis of 2019-nCoV neonatal infection should meet all the following requirements: (1) showing at least

one of the clinical symptoms, including temperature instability, hypoactivity or poor feeding, or tachypnoea; (2) showing abnormal findings on chest radiograph, including unilateral or bilateral ground-glass opacity, multiple lobular, or subsegmental areas of consolidation; (3) being at high risk of 2019-nCoV infection because the patient's family members or caregivers have been diagnosed with 2019-nCoV infection, had close contact with someone with probable or confirmed 2019-nCoV, had close contact with someone with pneumonia of unknown cause, are living in or travelling to epidemic areas, or have been in animal markets or close contact with wild animals, within 14 days before the onset of illness. Those who meet the criteria of probable infection and have positive virus detection tests are confirmed to be infected with 2019-nCoV.

All probable or laboratory-confirmed neonates with 2019-nCoV should be admitted to NICUs. Standard and additional precautions should be implemented immediately (panel). General management comprises homeostasis maintenance, close follow-up of blood



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### Panel: Strategies to be implemented during screening of neonates for 2019-nCoV infection

- Standard precautions include signage at the entrance, strict hand and respiratory hygiene, daily cleaning and disinfection of the environment, and provision of gloves, mask, and goggles for all medical staff
- Additional enhanced contact precautions and respiratory droplet precautions include patients' own dedicated equipment, limited parents' visits, gown and glove change after procedures, and opening window regularly to change air
- Avoid breastfeeding from mothers with probable or laboratory-confirmed 2019-nCoV infection until the recovery of confirmed mothers or rejection of probable infection
- Medical waste generated during medical service should be collected into a double-layer infectious waste bag, which should be treated with chlorine-containing preparation for at least 10 min, then disposed of in the same way as infectious medical waste
- Terminal disinfection of the patient's room is preferentially done using hydrogen peroxide atomisation or a chlorine-containing preparation spray

work and chest radiography, and initialisation of respiratory support if necessary. The efficacy of antiviral drugs against 2019-nCoV is not certain.<sup>7</sup> Antimicrobial drugs are only prescribed to patients with probable or confirmed bacterial infection; empirical use or overuse should be avoided. For neonates with acute respiratory distress syndrome manifested by complete opacification of lungs, high-dose pulmonary surfactant replacement, nitric oxide inhalation, and high-frequency oscillatory ventilation might be effective. Intravenous glucocorticoids or immunoglobulin could be tried in some difficult cases. Neonates with intracranial infection and convulsion should be handled according to corresponding guidelines. In critically ill neonates, continuous renal replacement and extracorporeal membrane oxygenation could be implemented if necessary. Those who have no fever for at least 3 days and improved respiratory symptoms; resolution of previously abnormal chest radiography findings; and a series of two nasopharyngeal and nasal swabs negative for 2019-nCoV at least 48 h apart could be discharged home.

All neonates newly admitted to the NICU need to be screened for high risk of 2019-nCoV infection (panel). Neonates at high risk, as assessed by family history, should be isolated in a single room for at least 14 days. If a neonate develops manifestations similar to 2019-nCoV infection during the isolation period or is highly suspected of 2019-nCoV infection on admission, the patient should be immediately referred to a designated hospital or a designated unit for 2019-nCoV infection. The patient's room cannot be used by other patients before being adequately disinfected. If this patient shared a room with other neonates before being identified, all wardmates should be isolated. Isolation must last at least 14 days, unless 2019-nCoV infection is ruled out.

In NICUs, a virus outbreak will bring psychological stress to the patient's parents and other family members; therefore, social workers and psychologists should be involved. Medical service providers will also

be under tremendous psychological pressure due to overwork, shortage of medical resources, patients' poor outcomes, or other detrimental experiences. Medical staff should be provided with adequate psychological support, as their physical and mental health is crucial in the context of a virus outbreak.

Most of our recommendations are based on lessons learned from existing and previous experiences with coronavirus outbreaks in adults and children. The contingency plan will be continuously modified on the basis of accumulated clinical evidence and experience. Medical service providers should also continually update their knowledge and skills on prevention and control of the 2019-nCoV outbreak.

We declare no competing interests. JW and HQ contributed equally.

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