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## Letter to the editor

### COVID-19 in pediatric patients: What the prehospital teams need to know



It has already been 4 months since the world became aware of a new viral infection with pandemic and fatal potential. The new terms “2019-nCoV” (novel coronavirus; from January 7, 2020 to February 11, 2020), “2019 novel coronavirus SARS-CoV-2” (severe acute respiratory syndrome-coronavirus), and “COVID-19” (February 11, 2020) have been used by the scientific community and then by the media and the general population. In addition, most experts report cases of non-pediatric patients to describe the pathogen, the epidemiology, clinical features, diagnostic tests, treatment, and survival [1].

The first pediatric case diagnosed and reported in the literature was that of a 3-month-old infant on January 26, 2020 in Xiaogan (Hubei province), 1 month after the first adult case. We thus questioned the rarity of pediatric cases: Are they underestimated? Do children have a particular immunity to this virus? What are the most interesting age groups to identify? How vigilant should prehospital medical teams be in the context of a pandemic? To answer all these questions, we performed a brief review of the literature using the electronic bibliographic PubMed database (from 2003 to March 17, 2020).

Among the 80 articles (1,087 articles COVID-19) found in the database using the keywords “2019-nCoV,” “COVID-19,” “pneumonia,” “pediatric,” “infant,” and “children,” 15 retrospective studies and four clinical cases reported the clinical and epidemiological features of children with suspected or confirmed COVID-19. Pediatric cases exist and were mainly synthesized in a recent retrospective cohort of 2,143 cases collected (approx. 2.6% of cases in China) from January 16 to February 8, 2020 [2]. Four age groups were reported: newborns (20 cases), infants under 1 year of age (379 cases), children from 1 to 15 years of age (1429 cases), and adolescents over 15 years of age (335 cases). Infection can range from asymptomatic clinical features (4.4%) to severe or critical respiratory distress (5.8%) [2]. However, respiratory distress seems to occur in children with comorbid conditions [3].

The major viral transmission mode is human-to-human through respiratory droplets (cough, sneeze) from people with or without symptoms during close contact in a family (cluster), or through contaminated hands in contact with the mouth, nose, or eye [1,4]. Additionally, a fecal-oral transmission seems possible [3]. Transmission from a child to an adult is uncertain [1,5]. Maternal-infant vertical transmission and breastmilk transmission have not been established [3,6]; births were by cesarean section in 90% of cases [3]. Neonates born to symptomatic COVID-19 mothers are negative for the virus at birth, but secondary contamination by the mother (skin-to-skin) or a third party is possible [3]. Infected children other than neonates have asymptomatic clinical features [2]. The three hypotheses put forward for resistance to COVID-19 include the following: the few interactions of children with sick

people, the functional immaturity of the angiotensin-converting enzyme 2 (ACE2) receptor, and the specific immunological responses of the child [3]. Finally, clinical symptoms of COVID-19 range from digestive signs (vomiting, diarrhea, nausea – less than 10% of cases), to upper respiratory tract infection (nasopharyngitis, dry cough, flu-like syndrome – less than 50% of cases), isolated fever in the newborn, or other nonspecific signs [1,3,4].

In this short review, we have learned four lessons for medical prehospital teams. First, in the event of an unexpected out-of-hospital delivery, a mother suspected of having COVID-19 should wear a mask or be oxygenated during expulsion efforts in the event of desaturation. Separation of mother and child is undesirable (as it is potentially detrimental). The child can stay in contact with the mother provided that she wears a surgical mask from birth, during post-delivery monitoring, and during transfer to the maternity ward [3,7]. The mother's hands should also be washed and the prehospital team should wear an N95 respirator.

Second, we may underestimate cases of COVID-19 in infants and children with viral illness without respiratory symptoms, particularly in cases with digestive features. A nasal or pharyngeal swab should complete the diagnostic strategy. The detection of COVID-19 in stool samples could also be considered [3].

Thirdly, we may overestimate COVID-19 cases in instances of lung infections due to other pathogens and subsequently over-occupy a negative flow chamber [3].

Finally, a prehospital team in contact with asymptomatic children must remain vigilant regarding personal protective equipment so as to avoid spreading the virus during subsequent interventions (nosocomial infection) [8,9], especially since victims may have comorbid factors.

In conclusion, prehospital teams who take care of children with symptoms that may be caused by COVID-19, and do not require hospital treatment, should leave the child at home with instructions for the parents [5]. Children are less likely than adults to develop severe symptoms [1,2]. Furthermore, prehospital teams should protect themselves by wearing an N95 respirator and, if possible, a mask should be worn by the child (infants younger than 1 year cannot wear masks).

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#### Disclosure of interest

The authors declare that they have no competing interest.

#### References

- [1] Zimmermann P, Curtis N. Coronavirus infections in children including COVID-19. *Pediatr Infect Dis J* 2020;39:355–68.

- [2] Dong Y, Mo X, Hu Y, et al. Epidemiology of COVID-19 Among Children in China. *Pediatrics* 2020;145. <http://dx.doi.org/10.1542/peds.2020-0702> [pii: e20200702; Epub ahead of print].
- [3] Lu Q, Shi Y. Coronavirus disease (COVID-19) and neonate: what neonatologist need to know. *J Med Virol* 2020;92:564–7. <http://dx.doi.org/10.1002/jmv.25740> [Epub ahead of print].
- [4] Chen ZM, Fu JF, Shu Q, et al. Diagnosis and treatment recommendations for pediatric respiratory infection caused by the 2019 novel coronavirus. *World J Pediatr* 2020. <http://dx.doi.org/10.1007/s12519-020-00345-5> [Epub ahead of print].
- [5] World Health Organization. Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19); 2020. [https://www.who.int/publications-detail/report-of-the-who-china-joint-mission-on-coronavirus-disease-2019-\(covid-19\)](https://www.who.int/publications-detail/report-of-the-who-china-joint-mission-on-coronavirus-disease-2019-(covid-19)).
- [6] Chen H, Guo J, Wang C, et al. Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. *Lancet* 2020;395:809–15.
- [7] Propositions de la Société française de néonatalogie et de la Société française de pédiatrie concernant les nouveau-nés dans le contexte d'épidémie à COVID-19, avec le concours du Groupe de Pathologies Infectieuses Pédiatriques (GPIP); [Actualisée le 16 mars 2020] 2020. <http://www.co-naitre.net/actualites/covid-19-recommandations-de-la-sfn-sfp-et-du-groupe-de-pathologies-infectieuses-pediatriques/>.
- [8] Thomas-Rüddel D, Winning J, Dickmann P, et al. Coronavirus disease 2019 (COVID-19): update for anesthesiologists and intensivists March 2020. *Anaesthesist* 2020. <http://dx.doi.org/10.1007/s00101-020-00760-3> [Epub ahead of print].
- [9] Wang S, Guo L, Chen L, et al. A Case Report of Neonatal COVID-19 Infection in China. *Clin Infect Dis* 2020. <http://dx.doi.org/10.1093/cid/ciaa225> [pii: ciaa225; Epub ahead of print].

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