

# Paediatric care in the time of COVID-19 in countries with under-resourced healthcare systems

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The pandemic that is sweeping the globe is extracting its greatest toll on the elderly, the chronically unwell and the healthcare workers who bravely care for them. Children (0–19 years) have been largely spared; at the time of writing, the deaths of only 10 children and adolescents have been reported due to COVID-19, compared with over 115 000 adults, and children account for only 0.9% and 1.7% of infections in China and the USA, from where the strongest epidemiological data have been published.<sup>1,2</sup> Relatively spared too at this stage are low-income countries. But the infection is reaching every corner of the globe and will leave no population unscathed. High-income countries have prepared for COVID-19 in many ways—spending billions of dollars on fiscal stimulus, buying hundreds of thousands of mechanical ventilators, restrictive physical distancing and lock-downs, all aimed at prevention, flattening the curve and ensuring sufficient intensive care resources are available to address needs at their anticipated peak.

Populations in low-income countries including children may be hit hard by the pandemic, both indirectly and directly. Key reasons include the high burdens of HIV, tuberculosis and malnutrition; poorly managed non-communicable diseases; overcrowded housing and social congregation, inadequate sanitation and income insecurity; and health system weaknesses spanning such fundamental elements

as water, sanitation and hygiene, major workforce deficits and open hospital wards with lack of isolation. These are compounded by lack of personal protective equipment (PPE) and testing capacity. Whether protective factors, such as high rates of BCG vaccine coverage, will mitigate the extent of illness in adults or children in low-income countries is a theory which is evolving but as yet inconclusive.<sup>3</sup> Countries' actions have to be based on what we know today in order to protect the most people.

Evidence from China suggests 5% of children with COVID-19 have pneumonia and hypoxaemia, and need hospital admission, but just 0.6% of children need intensive care,<sup>4</sup> and in the USA 6%–20% of children required hospitalisation and 0.6%–2% required intensive care.<sup>2</sup> In high-income countries, one core element of the pandemic response, rapid scaling up of intensive care capacity and mechanical ventilators, has received considerable media attention and government action. There is a danger that low-income country governments and their well-intentioned partners will feel the need to follow suit. For many low-income countries, doubling or tripling the number of mechanical ventilators and intensive care capacity would still mean very few, largely urban residents, could access it. We suggest that in addition to strong containment measures, health service leaders in low-income countries prepare for a surge in COVID-19 cases by three key health system interventions: doing oxygen really well, protecting staff really well and maintaining routine services.

Based on global data prior to the emergence of COVID-19, about 200 000 children will likely have died from the many *other* causes of pneumonia in the first 3 months of 2020,<sup>5</sup> and in many low-income settings, mortality in hospitals from severe childhood pneumonia already exceeds 10%.<sup>6</sup> This common morbidity and mortality will continue during the pandemic, but general improvements to quality of care are needed for *both* routine services and COVID-19 readiness. In many countries, oxygen supplies for

children and adults are limited, especially in rural areas, and this contributes to the high mortality from pneumonia and other critical illnesses. Provision of oxygen alone without CPAP or mechanical ventilation has been shown to reduce mortality in children with pneumonia by 35%.<sup>7</sup> Doing oxygen well is not just a matter of having an oxygen cylinder, it is complex. Cylinders run out after 2–3 days of use, or a day of use in a really sick adult, are expensive, and logistically difficult at the best of times in remote or rural health facilities, more so in times when travel is restricted. Oxygen concentrators are more efficient but require a power source and maintenance. They can run more reliably off solar power.<sup>8</sup> Countries should urgently assess their capacity to provide oxygen therapy to children and adults, identify gaps and procure additional oxygen sources and required equipment to treat all people in need of oxygen therapy due to COVID-19 and other causes. Among adults, evidence suggests while only 20% of adults with COVID-19 require hospitalisation, three quarters of those will improve with standard oxygen therapy and supportive care.

Doing oxygen well also requires detecting every patient with hypoxaemia: pulse oximeters will identify 30% of children who are not detected as having hypoxaemia based on clinical signs.<sup>9</sup> But many hospitals and nearly all ambulatory care facilities lack pulse oximetry to detect hypoxaemia, which should be a key screening criterion to avoid risks of SARS Cov-2 transmission through unnecessary referral and hospitalisation. WHO has guidelines for oxygen therapy and hospital care for children; these emphasise the importance of triage, emergency treatment, history and examination, diagnosis, treatment, monitoring and supportive care, discharge planning and follow-up, all needed for any sick child, including those with COVID-19.<sup>9–11</sup>

Protecting staff is also what hospitals must do very well, and most in low-income settings are under-prepared and under-resourced. Many simple measures can be put in place, and infection control guidance is available.<sup>12</sup> The risk to staff caring for children with COVID-19 is not just from patients but probably more from other staff and caregivers. Although over 1300 healthcare workers were infected with SARS Coronavirus-1 in Hong Kong, and numerous doctors and nurses have been infected with SARS CoV-2 caring for adults, we could find no reports of transmission from a sick child to a health worker.<sup>13</sup> That is in the context of aerosol-level PPE, and is not to

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say it cannot or will not happen, but gives some reassurance for paediatric health-care workers that if proper precautions are taken they will be safe. Where testing is limited, allocating a separate ward for paediatric patients who fulfil the clinical criteria of severe pneumonia or fever and viral syndrome and their caregivers, and keeping all children with non-severe pneumonia out of hospital and advising families to self-quarantine are measures needed. Major efforts will be required to scale up supply of soap and hand sanitiser, and strengthen supply chains for PPE. Deciding to do oxygen well, rather than to scale up mechanical ventilation, is also a protective measure for staff. Emergency intubation is the highest risk of transmission to a healthcare worker.<sup>14</sup> At present, published reports suggest 66%–97% of adults mechanically ventilated with COVID-19 have died.<sup>15–17</sup> If the virus spreads in poorer countries, the death rate from ventilation if it is attempted will be higher. But doing oxygen well will save many lives.

For children in low-income countries, COVID-19 carries big indirect risks: disruption to health services, social isolation and economic stress may kill more children than the virus. Disruption of supply chains to hospitals and outreach immunisation services are already compromised in many countries in lock-down. Children with HIV, tuberculosis and other chronic conditions still need their medications and their conditions monitored, acute infections still need to be treated, high-risk newborns still need special care and immunisation programmes still need to function so as to not lose ground in the control of many diseases.<sup>18</sup> Even brief interruptions to immunisation services have had disastrous consequences in recent years leading to deadly measles outbreaks and eroding efforts to eliminate polio. Therefore, containment, and maintaining basic health and social services for children and families should be priorities. As staff numbers are already critically low for seriously ill children, maintaining services also means not reallocating them to adult care.

In conclusion, hospitals should do what they can do, really well. They should do oxygen, infection control and protection of staff really well, maintain essential child

health services and play an important role in containment and community awareness. Agencies such as the World Bank, donor and United Nations partner agencies should support these measures, rather than focusing on buying mechanical ventilators.

This crisis has painfully shown that health systems across the world have been under-resourced, particularly the low numbers of nurses and doctors, a problem which had not been addressed by responses to major health crises in the last 50 years, and which undermines all other technical advances or new interventions. In the long run, serious and sustained efforts are required to train more health-care workers, support them properly and value their commitment and contribution to their community. COVID-19 is helping the world understand this, let us hope that endures long after all this is over.

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#### REFERENCES

- W-j G, Z-y N, Hu Y, *et al.* Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med* 2020.
- COVID-19 Response Team. Coronavirus disease 2019 in children—United States, February 12–April 2, 2020. *MMWR* 2020:69.
- Shet A, Ray D, Malavive N, *et al.* Differential COVID-19-attributable mortality and BCG vaccine use in countries. *medRxiv* 2020.
- Dong Y, Mo X, Hu Y, *et al.* Epidemiological characteristics of 2143 pediatric patients with 2019 coronavirus disease in China. *Pediatrics* 2020.
- World Health Organization. Pneumonia. Available: <https://data.unicef.org/topic/child-health/pneumonia/2019>
- Agweyu A, Lilford RJ, English M, *et al.* Appropriateness of clinical severity classification of new WHO childhood pneumonia guidance: a multi-hospital, retrospective, cohort study. *Lancet Glob Health* 2018;6:e74–83.
- Duke T, Wandt F, Jonathan M, *et al.* Improved oxygen systems for childhood pneumonia: a multihospital effectiveness study in Papua New Guinea. *Lancet* 2008;372:1328–33.
- Duke T, Hwaihwanje I, Kaupa M, *et al.* Solar powered oxygen systems in remote health centers in Papua New Guinea: a large scale implementation effectiveness trial. *J Glob Health* 2017;7.
- World Health Organization. *Oxygen therapy for children*. Geneva: WHO, 2016. [http://www.who.int/maternal\\_child\\_adolescent/documents/child-oxygen-therapy/en/](http://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/)
- World Health Organization. *Hospital care for children: guidelines for the management of common illnesses with limited resources*. Geneva: WHO, ISBN, 2013. [http://www.who.int/maternal\\_child\\_adolescent/documents/child\\_hospital\\_care/en/](http://www.who.int/maternal_child_adolescent/documents/child_hospital_care/en/)
- World Health Organization. WHO–UNICEF technical specifications and guidance for oxygen therapy devices 2019.
- World Health Organization. *Infection prevention and control during health care when COVID-19 is suspected*. Geneva: World Health Organization, 2020: 1–5.
- Leung TF, Ng PC, Cheng FWT, *et al.* Infection control for SARS in a tertiary paediatric centre in Hong Kong. *J Hosp Infect* 2004;56:215–22.
- Yu IT, Xie ZH, Tsoi KK, *et al.* Why did outbreaks of severe acute respiratory syndrome occur in some hospital wards but not in others? *Clin Infect Dis* 2007;44:1017–25.
- Weiss P, Murdoch DR. Clinical course and mortality risk of severe COVID-19. *Lancet* 2020;395:1014–5.
- Ńamendys-Silva SA. Respiratory support for patients with COVID-19 infection. *Lancet Respir Med* 2020;8:e18.
- Wu C, Chen X, Cai Y, *et al.* Risk factors associated with acute respiratory distress syndrome and death in patients with coronavirus disease 2019 pneumonia in Wuhan, China. *JAMA Intern Med* 2020. doi:10.1001/jamainternmed.2020.0994. [Epub ahead of print: 13 Mar 2020].
- World Health Organization. COVID-19: operational guidance for maintaining essential health services during an outbreak, 2020. Available: WHO-2019-nCoV-essential\_health\_services-2020.1-eng.pdf [Accessed 9 Apr 2020].