containment of both droplets and aerosols, the ability to clear the bag of aerosolised particles with negative air flow, and the protection of the operator and environment. Airway devices are supported on hooks, which increases the working space available. During a simulated airway management training session of our COVID-19 intubation team, direct vision, communication, and manoeuverability were accomplished for 12 operators.

Even though our results are preliminary and qualitative in nature, we demonstrate proof of concept for an additional physical barrier during aerosol-generating procedures. We believe that this easily constructed barrier, and others, have the potential to protect healthcare providers in caring for confirmed or suspected COVID-19 patients. These include patients undergoing monitored anaesthesia care or regional anaesthesia, treated with noninvasive ventilation, in overcrowded emergency department or wards, in endoscopy/bronchoscopy suites, in radiology suites, and during patient transportation.

We acknowledge that further research and testing are necessary to quantify the contamination level within the multipurpose portable negative air flow protection isolation chamber and whether it is possible to inactivate any virus before removal and doffing of the plastic drape and frame. We remain concerned that healthcare providers may develop a false sense of security if these barriers are used, so we strongly emphasise that local guidelines for PPE be maintained, and that new devices being developed during this healthcare crisis are used mainly as an additional complementary resource, not a replacement, to face the undeniable scarcity of PPE.

Declarations of interest

The authors declare that they have no conflicts of interest.

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Implementing shared ventilation must be scientific and ethical, or it risks harm

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Keywords: co-ventilation; COVID-19; critical care; medical ethics; resource allocation; SARS-CoV-2; shared ventilation; ventilator

Editor—In the USA and around the world, the surge of patients with respiratory failure as a result of the pandemic of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has overwhelmed healthcare systems. The need for ventilators in many hospitals in the USA may soon exceed the supply.[1] In the scenario of an inadequate supply of ventilators, healthcare systems may choose to implement ethical ventilator allocation schemes[1] or devise alternative treatment methods to support patients in respiratory failure as a result of coronavirus disease 2019 (COVID-19). One such alternative is to use a single ventilator to provide mechanical ventilation to two or more patients. Although this method was tested with artificial lungs[2] and in sheep,[3] and briefly utilised successfully in a mass casualty event,[4] there are no outcome data for ventilator sharing amongst patients with acute respiratory distress syndrome (ARDS). Recently, the Assistant Secretary for Health and the US Surgeon General released a letter[5] tacitly approving the decision to use shared ventilation at 'the individual institution, care provider, and patient level' despite a joint statement of several major medical societies, including the American Society of Anesthesiologists (ASA), explicitly advising against its use.[6]

The decision to implement shared ventilation is ethically fraught because it necessarily deprives one patient of standard-of-care treatment to potentially save another patient's life. To justify this risk, shared ventilation must confer a survival benefit to a population of patients compared with utilising an ethical ventilator allocation scheme and pursuing alternative respiratory support measures for patients not receiving ventilator treatment. However, without scientific investigation of shared ventilation in a representative population of patients with COVID-19, it is impossible to know how patients will fare. If the mortality rate of sharing ventilators increases compared with standard-of-care ventilation, more patients could die despite expanded treatment capacity.

The following conceptual framework helps to assess the impact on survival of shared ventilation. Consider a hospital that needs to treat 200 patients in respiratory failure, but has only 100 ventilators. If we assume that all patients who do not receive a ventilator die and the mortality rate for patients receiving standard ventilation is 50%, then 50 of the 200 patients will survive. With ventilator sharing for all 200 patients, 100 patients will survive if the mortality rate is the same. However, in a shared ventilation strategy, it would be impossible to individualise the adjustment of certain key parameters, such as tidal volume and PEEP, to limit ventilator-induced lung injury.[2,6] Thus, the mortality rate of patients receiving shared ventilation is likely to exceed the mortality rate of standard ventilation. If the mortality rate of shared ventilation is 75%, then only 50 of the 200 patients will survive, and there will be no benefit. In this example, the degree to which the mortality rate of shared ventilation is below or above 75% will determine the extent to which patients are saved or harmed by this strategy compared with the standard of care with ventilator allocation.

Although limited, this simplified algebraic framework raises several key points. First, it is critical to compare the morality rates of shared and standard ventilation to determine the overall effectiveness or harm (Fig 1). If practitioners knew the mortality rate of mechanically ventilated patients with COVID-19, then this analysis would provide an estimate for the tolerable increase in mortality with shared ventilation that would still achieve net benefit. Furthermore, it highlights that the overall benefit of shared ventilation is diminished with higher mortality rates of COVID-19 in standard-of-care treatment. In subpopulations with higher mortality, such as severe ARDS with multiorgan failure, shared ventilation is unlikely to yield a substantial survival benefit. This conceptual framework, moreover, does not take into account important considerations with shared ventilation, such as the logistical burden of its implementation or risk to healthcare workers from multiple circuit disconnects as two patients are connected to a single ventilator or placed back to their own ventilators.

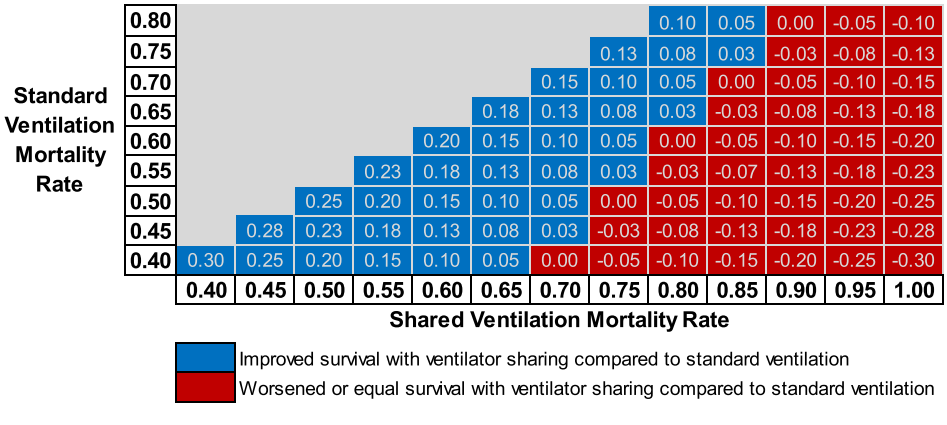

Fig 1. Comparing survival differences with shared or standard ventilation by their hypothetical mortality rates. The numbers within each cell represent the proportional change in survival with shared ventilation for a population of patients comparing the shown mortality rates. Four key assumptions are made in this analysis: (i) the shared ventilation strategy doubles treatment capacity (a condition that is unlikely to be met in practice), (ii) all patients receive either shared ventilation or standard ventilation, (iii) all patients not receiving ventilator treatment will die, and (iv) the mortality rate of shared ventilation will not be less than standard ventilation.

Increasing the survival rate is the singular priority of practitioners providing care to critically ill patients during the SARS-CoV-2 pandemic in the face of ventilator scarcity. However, as Fig 1 demonstrates, the overall mortality with shared ventilation may exceed ventilator allocation with standard-of-care treatment. It is important for practitioners to acknowledge that shared ventilation is an unproved medical treatment that may cause more harm than good, and its benefit should be demonstrated in a scientific and ethical manner. Physicians of any hospital proceeding with shared ventilation should, at a minimum, (i) obtain informed consent that acknowledges its unproved benefit, (ii) offer non-invasive respiratory therapies or palliative treatments as an alternative, (iii) diligently record and analyse outcomes before and after implementation of shared ventilation, (iv) expeditiously disseminate the conclusions of their analysis publicly, and (v) develop an ethical protocol to discontinue shared ventilation if pre-specified evaluations show harm. It is incumbent upon the first practitioners offering shared ventilation to demonstrate its benefit. Without undertaking such measures, implementation of shared ventilation diminishes the ethical and scientific basis of our care and risks an increased rate of death in the patients we are desperately trying to save.

Declaration of interest

The author declares that they have no conflict of interest.

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Considerations for resuscitation and transfer of paediatric patients with COVID-19

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Keywords: COVID-19; infection control; negative pressure room; paediatric; resuscitation; transport

Editor—We read with great interest the article by Odor and colleagues[1] entitled Anaesthesia and COVID-19: infection control. We would like to describe the current measures implemented at a tertiary university hospital in Singapore for the safe resuscitation and transfer of paediatric patients with coronavirus disease 2019 (COVID-19).

The novel COVID-19 caused by the severe acute respiratory syndrome coronavirus 2 first emerged in Wuhan, China in December 2019.[2] Viral transmission primarily occurs through respiratory droplet spread and touching of contaminated surfaces.[3,4] Children appear to be less affected than adults.[5] Most children are asymptomatic or have mild-to-moderate symptoms, with severe and critical disease being more prevalent in younger children.[6] New information is emerging on a daily basis that may change our initial understanding of paediatric COVID-19. As the pandemic spreads, we will encounter more paediatric patients with COVID-19 disease who require resuscitation and transfer.

All suspected patients at our hospital are admitted to a designated COVID-19 ward. Where possible, all high-risk patients are admitted to a negative-pressure isolation room. Early identification of deteriorating patients is essential to allow for intervention and resuscitation in a controlled setting. Aerosol-generating procedures, such as