The role of mechanical ventilation *per se* in perioperative neurocognitive disorder, while feasible, is uncertain, as it is difficult to isolate from the many other features of the perioperative period, such as surgery, anesthesia, or extended critical care. In the specific case of our review, there are few if any reports of mechanical ventilation in preclinical models; thus, we regret that we cannot comment further on the role at this time.

Competing Interests

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Setup of a Dedicated Coronavirus Intensive Care Unit

Logistical Aspects

To the Editor:

Northern Italy is facing a 2019 coronavirus disease (COVID-19) outbreak[1,2]; patients are mainly minimally symptomatic but may develop acute respiratory failure requiring admission to the intensive care unit (ICU).[3] Logistics are fundamental for the safety of both healthcare professionals and ICU patients, and to limit the spread of this highly infective disease.

Once alerted to the first coronavirus case requiring admission to ICU, a section of our unit was emptied and reorganized in 2h (fig. 1). Access to the unit was limited to the minimal number of healthcare providers and mandatory through a double filter. A “clean filter” for donning is equipped with disposable personal protective equipment (gowns, filter face respirators, visors, hair covers, gloves, boot covers[4]), mirror, chairs, scrubs, waste management material, and hand disinfectants. A “contaminated filter” for doffing is equipped with waste management material, mirror, bathroom to wash before exiting, and hand disinfectants.

For each patient, complete monitoring (blood pressure, oxygen saturation measured by pulse oximetry, end-tidal carbon dioxide, heart rate, respiratory rate, and temperature) is available and duplicated in the “control unit,” a clean area separated by a glass wall allowing direct visualization of the patients.

A dedicated aspiration system connects the expiratory valve to wall gas aspiration; this system is also available for a helmet, which is preferred to masks for continuous positive airway pressure/noninvasive ventilation to limit the droplets’ spread.[5]

A “laboratory section” includes a dedicated ultrasound machine (images are shared through a Picture Archiving and Communication System’s connection available in the unit); disposable fiberbronchoscopes and video-laryngoscopes (fiberbronchoscopy is limited to urgent indications, in order to limit airways opening); point-of-care arterial blood gas and coagulation analyses; transport ventilator; and emergency cart with defibrillator.

The main door of the unit is opened only for the patient’s admittance and once per day for garbage evacuation, performed by fully protected professionals and followed by cleaning with sodium hypochlorite 0.1 to 0.5%.

The communication between coronavirus and control units is fundamental both for clinical management and nursing; it is facilitated by an intercom and a dedicated smartphone. All the therapy is prepared outside the coronavirus unit in order to limit the time spent in it, which is physically demanding due to limited transpiration and rebreathing. All the consumable and products needed in the coronavirus unit are provided by nurses and physicians working in the control unit and dropped off in the contaminated filter, where nurses and physicians working inside the coronavirus unit can retrieve them.

A similar smaller and separated structure (buffer zone) admits patients with suspected COVID-19 infection while waiting for results. If positive, the patient is admitted to the coronavirus unit; if negative, to the general intensive care unit.

A dedicated gurney equipped with a StarMed Ventukit helmet (Intersurgical, Italy), two oxygen bottles, bag-mask, monitor, and emergency bag for intubation and chest drain positioning is available for emergency calls in the wards for positive/suspected patients; the intensivist mandatorily wears full protection equipment before leaving the unit.

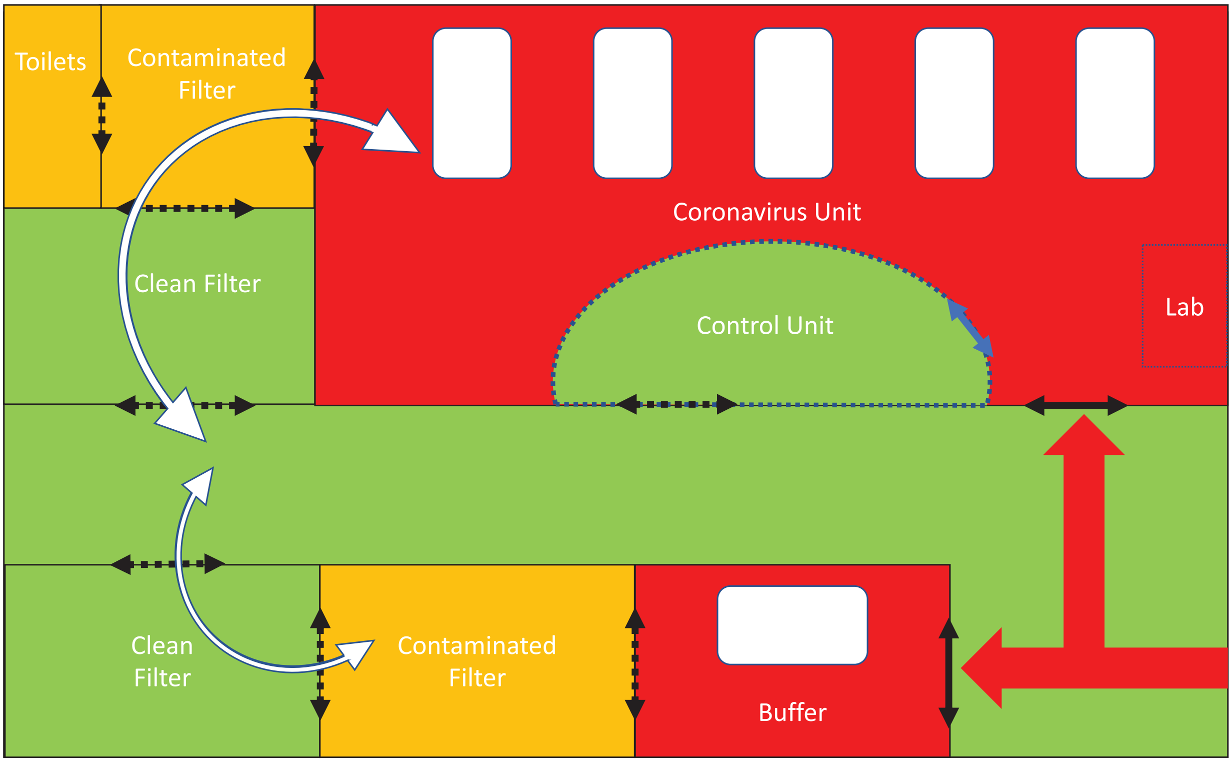

Fig. 1. Organization of the intensive coronavirus unit. In *red*: isolated areas where full personal protection equipment is mandatory; in *yellow*: contaminated filter areas; in *green*: clean areas. A similar smaller area is a buffer zone for suspected patients. *Double black arrows with dotted line*: doors, kept open; *double black arrows with continuous line*: doors, kept closed; *double blue arrows with continuous line*: glass door, permanently closed; *blue dotted line*: glass wall; *continuous black line*: walls; *dotted blue line*: glass wall; *white rectangles*: intensive care unit beds; *white arrows*: healthcare providers' path to enter the unit; *red arrow*: patients' path to enter the unit.

The same structure was then replicated to reach 41 dedicated intensive care unit beds in 2 weeks, for a total number of 55 COVID-19 patients admitted so far. We hope sharing such information may be of help to other intensive care units having to face similar issues.

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Competing Interests

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Emergency Open-source Three-dimensional Printable Ventilator Circuit Splitter and Flow Regulator during the COVID-19 Pandemic

To the Editor:

We present a novel addition to a previously described solution to address ventilator shortages from severe acute respiratory syndrome coronavirus 2 (SARS-CoV2) pandemic infection surges. Using access to open-source data for three-dimensional printing, ventilator splitters can be rapidly produced at any location to allow multiple patients to share a single ventilator in disaster situations. The original ventilator circuit splitting solution has been previously described[1] and was implemented during the 2017 Las Vegas mass shooting.[2]

A three-dimensional printable Y-piece (Y-splitter), with an optional inspiratory limb flow limiter to account for differential lung compliance, can function to divide the ventilator's inspiratory and expiratory limbs among patients, based on Neyman and Irvin's concept (figs. 1, 2, and 3). Ideally, patients with comparable lung compliance are paired together. More than two patients may be theoretically possible with nesting additional Y-splitters. However, the required flow may exceed ventilator capacity. With advances in additive manufacturing and the widespread accessibility of three-dimensional printers, local production bypasses global travel barriers or supply chain breakdown.

A single piece is readily printed in approximately 1 h without additional support material using a consumer three-dimensional printer. Production can be scaled to produce 12 Y-splitters at a time on a typical consumer 200 mm × 200 mm × 200 mm three-dimensional printer. We used polylactic acid filament, although other filaments are likely to be applicable.

There are limitations to these devices and the concept of ventilator sharing. First, there is a risk of cross-contamination between patients connected to the same ventilator; this can be mitigated with inline filtration. Second, the patients sharing the ventilator must be in close proximity to the machine, which will be restricted to the length of the ventilator tubing. This is a concern where positive cases require airborne or contact isolation. Third, the patients must be paralyzed to facilitate a controlled mode of ventilation. Additionally, to ventilate multiple patients with the same settings, several parameters need to be considered such as patient size, ideal body weight, lung compliance, mode of

Fig. 1. Three-dimensional printable Y-splitter (*) and optional flow limiter (**) attachment.