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Ventilator Options for COVID-19: Quality Trumps Quantity

To the Editor:

Over the past year, coronavirus disease (COVID-19) has caused “mechanical ventilator” to become a household word and discussions of predicted dire ventilator shortages spurred a multitude of proposed solutions. These ranged from invoking the Defense War Powers Act, encouraging automobile manufacturers to ramp up ventilator production, to development of ventilators by groups for the first time. “Experts” in mechanical ventilation proliferated among the medical, political, and lay communities.

Dar and colleagues cover a number of these issues in their recent paper (1). We congratulate the authors regarding their detailed discussions related to the challenges of anesthesia ventilators in the intensive care unit (ICU), a procedure far more difficult than anticipated. Anesthesia devices are meant for short-term use with an attendant nearby, as such alarms are quiet by ICU standards. The rebreathing system of the anesthesia ventilator and use of carbon dioxide absorbent complicates management and leads to excess humidity issues. Fresh gas flow, a critical setting on an anesthesia device, doesn’t exist in an ICU ventilator. Performance and operation of the anesthesia ventilator requires training and expertise. Competence with an ICU ventilator does not translate to the quite different anesthesia ventilator (2).

However, we believe that the suggestion to include “ventilation devices” such as the oxylator and GO2VENT lacks justification and could lead to inappropriate decisions by planners. To begin with, both devices are automatic resuscitators, not ventilators. By definition, they are only intended for use when attended by a caregiver, one-on-one. We must be careful and explicit in the words we use to prevent misinterpretation. Neither device has alarms and monitoring is limited to a disposable analog gauge in one and nothing in the other. These devices are small and cheap, perhaps a desirable feature to logisticians with no understanding of the intricacies of ventilatory support in the ICU.

Jonkman and colleagues have recently evaluated the oxylator, characterizing its performance and concluding that short term attended use is the only safe application (3). Previous work by Babic and

colleagues demonstrated routine, unannounced failure of the Vortran resuscitator associated with changes in device position (4). The authors appear to have ignored or been unaware of these issues when making this unwarranted recommendation.

Had the authors discussed these devices with the same scrutiny given anesthesia ventilators, they would have listed limitations to include lack of alarms, lack of monitoring, inability to guarantee a tidal volume, inability to set a respiratory rate, changes in ventilator settings with changes in respiratory mechanics, and need for an external positive end-expiratory pressure valve. Both devices also have a limited inspiratory flow (<40 L/min), leading to flow starvation in a patient, triggering the ventilator. These are major limitations even in patients without COVID-19.

They also suggest trading these devices to emergency medical services’ ambulances for devices used in the field. Again, knowledge of the field would yield the finding that ventilators are rarely used in emergency medical services (5). It would be difficult to know what you are getting in return with the trade.

As the medical community begins to feel relief from the crush of the current pandemic, we should look back and assess successes and failures. We must take care in the words we use and in our recommendations. In an attempt to cover all the bases, the authors do not appear to have given this recommendation the thought and caution it deserves. We add this to our list of COVID-19 ventilator lessons learned: 1) don’t make a ventilator for the first time, and 2) don’t encourage the use of devices that are ill-suited to the task (6). ■

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Reply: Ventilator Options for COVID-19: Quality Trumps Quantity

From the Authors:

We appreciate the thoughtful response from Drs. Branson, Rodriguez, and Austin to our original manuscript on mechanical ventilation supply and options in the pandemic (1). We actually agree with their concerns in regard to subpar ventilatory solutions, including intensive care unit (ICU) use of anesthesia machines. We further agree with their nuanced categorization of the oxylator and GO2VENT as automatic resuscitators rather than ventilators. Similar to anesthesia machines, they require the constant presence of an operator (2), lack the capabilities of a typical ICU ventilator, and lack the alarms or sophisticated monitoring that a typical ICU ventilator has, as we discussed in our manuscript and as Drs. Branson and colleagues further elaborate on in their response. These devices are not suitable replacements for an ICU ventilator under normal circumstances. We appreciate the authors' focus on avoiding misinterpretation and the opportunity to offer clarity across theirs and our response.

Unfortunately, although resourcing for ventilation around coronavirus disease (COVID-19) may be stable in the United States currently (and we recognize thankfully that much of the geographic United States never faced such resource shortages), that "relief" is not universal. Numerous supply and device shortages are presenting in areas of India, currently creating a crush of potential and actual lives lost that could otherwise be saved, and much of the world remains unvaccinated as COVID-19 continues to spread with more concerning speed as evidenced by the B.1.1.7, B.1.617, and other variants (3).

Our section on creating possible "new sources of potential ventilation" recognized that such considerations would be for challenged and scarce settings where the means of usual and acceptable care are not possible for every patient. We certainly do not "encourage use of devices which are ill-suited to the task" where the task is mechanical ventilation for an ICU patient, and

when there are any of the alternatives we outlined—including high flow nasal cannula (HFNC), noninvasive ventilation, and of course a true ICU ventilator. In that same section we also spoke of modification of bilevel positive airway pressure machines, which, although not spoken to in the response, we also offer would be wholly unsuitable when usual resources are available.

But where the situation is indeed dire and any margin gained may translate to lives saved, we discussed these possibilities to leverage other various resources that may be available. As we carefully caveated in this section, these devices are essentially last-line options for very specific cases and may serve as bridges until better supply arrives. The oxylator device is described in the same manner in the paper by Jonkman and colleagues highlighted by the authors (2). Such a scenario may be a hospital setting where all invasive and noninvasive measures are in use or awaiting transition and/or cleaning while further patients require immediate invasive ventilation. In lieu of other options, such patients undergo bag ventilation without a bridge in sight.

In a well-resourced U.S. setting, this situation virtually never happens. A patient who is intubated has a clean ventilator ready and immediately available. However, given ongoing events, it is not reasonable to assume that the same resources are available throughout the world. In these extremely few and rare scenarios, we presented these devices as possible resources to leverage as temporary bridges or stopgaps.

We profoundly agree with the authors that the potential for misinterpretation is significant. We do not think these measures provide a meaningful role in most settings. But as they are cheap, relatively easy to operate, and can serve an important role for a brief period of time in extremely stressed acute care settings, we thought they were worthy of discussion. In such dire circumstance, they may offer an opportunity to buy time, and through that, save lives. ■

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