echocardiography (TEE) instead of regular disinfection of the echoscope? Clin Cardiol 1993; 16:737–40

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Remote Control and Monitoring of GE Aisys Anesthesia Machines Repurposed as Intensive Care Unit Ventilators

To the Editor:

The requirements of early intubation and prolonged mechanical ventilation in the management of patients with coronavirus disease 2019 (COVID-19) has created a shortage of intensive care unit (ICU) capacity and ventilators. Operating rooms and anesthesia machines[1] are being repurposed to care for these critically ill patients. Certain ICU ventilators, such as the Hamilton G5 (Hamilton Medical AG, Switzerland), permit their control monitor to be detached from the ventilator and extended outside the room on an umbilical electrical cable, which allows "frequent ventilator adjustments while simultaneously decreasing the risk of exposure to staff."[2] Although no studies have examined effects on clinical outcomes, the pragmatic benefits are evident: ICU staff need not be continuously present in the patient's room, nor frequently don and doff scarce personal protective equipment to perform alarm checks and setting changes.

In light of this public health crisis, the U.S. Food and Drug Administration has issued guidance that anesthesia machine device modifications may be made that do not create undue risk.[3] We now describe a novel, inexpensive modification to add umbilical cabling to GE Aisys and Aisys CS2 anesthesia machines (GE Healthcare, USA), allowing the same advantageous remote control and monitoring of ventilation.

The Aisys display unit control panel is anchored to a mounting plate on the boom arm by four small bolts (fig. 1, *left*). Three cables attach to the control panel, marked *A*, *B*, and *C* in figure 1 and *inset*. Loosening these bolts and cables allows the control panel to be detached. *A* is a DB15/male cable, which communicates with the electronic medical record. *B* is an HD26/male cable, which carries ventilator signals and data. *C* is a DB15/female cable, which provides

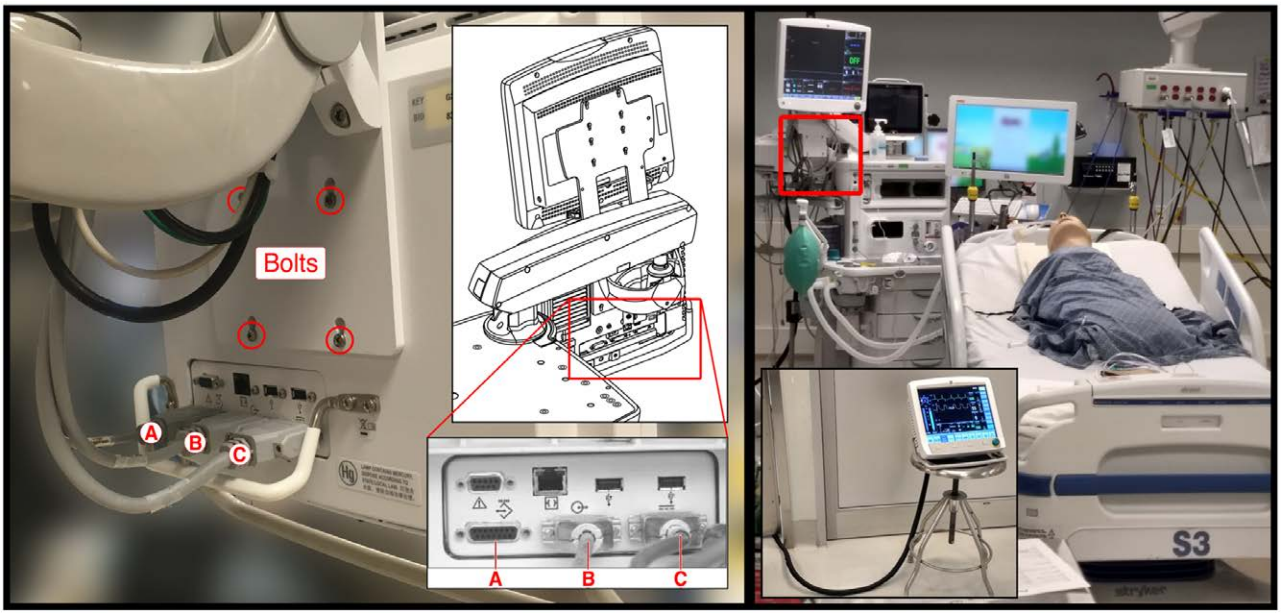

Fig. 1. Remote placement of the GE Aisys display unit control panel. The modification steps are highlighted at *left*, with *inset* engineering drawings modified from the *Aisys Anesthesia Machine Technical Reference Manual*. At *right*, an Aisys control panel is shown relocated outside of an operating room repurposed as an intensive care unit bay. The *rectangular highlight* indicates the original position of the control panel before detachment from the anesthesia machine.

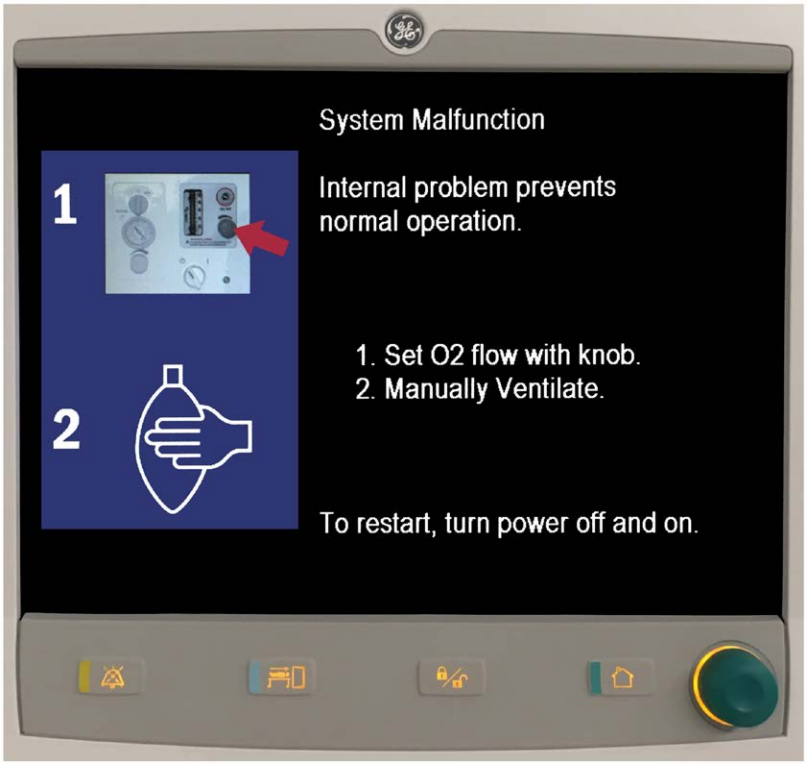

Fig. 2. In the unlikely event of a disconnection of cable B (the System Signal Interface cable), a system malfunction message appears on the Aisys control panel screen. The machine must be powered down, the cable connection re-established, and the machine powered up again in order to resume mechanical ventilation. Meanwhile, the patient must be maintained with fresh gas from the Alternate O_2 Control and manual/spontaneous ventilation as illustrated on the error screen.

system power.[4] We have added and tested 50-foot extensions to cables *A*, *B*, and *C*, permitting the detached control panel to be repositioned outside the operating room. Figure 1 (*right*) shows the remote control and monitoring of the ventilation of a mannequin within an operating room converted for ICU care. The cable extensions used were Amphenol Corporation 2 × Part #CS-DSDMDB15MF for *A* and *C*, and Part #CS-DSDHD26MF0 for *B* (Amphenol Cables On Demand, USA). When the anesthesia machine is returned to normal service, removing these extensions reverts the machine to its original configuration without a trace.

When properly coupled with supplied locking screws, accidental cable disconnection is extremely rare. If *A* becomes disconnected, data will not stream to the electronic medical record, and *A* should be reconnected. If *B* becomes disconnected, the control panel will display a system malfunction screen (fig. 2) and alarm audibly. If *C* becomes disconnected, the control panel will power down abruptly, and audible machine alarms will sound. To restart ventilator operation after disconnection of *B* or *C*, power down, reconnect the cable, and power up while manually ventilating as shown.

This modification allows anesthesiologists to interpret ventilator waveforms, adjust ventilation settings, ensure lung protective ventilation, and hear alarms at all times freely from outside the operating room. Personnel exposure and use of personal protective equipment are reduced, as anesthesiologists no longer need to enter the room for these frequent tasks. This modification can be performed without special tools or skills in 5 to 10 min.

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Competing Interests

Dr. Connor is a consultant for Teleflex, LLC (Wayne, Pennsylvania) on airway equipment design. This activity is unrelated to the material in this letter. The other authors declare no competing interests.

Christopher W. Connor, M.D., Ph.D., Louisa J. Palmer, M.B.B.S., Sujatha Pentakota, M.D. Brigham and Women's Hospital, Boston Massachusetts (C.W.C.). cconnor@bwh.harvard.edu

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References

1. American Society of Anesthesiologists: APSF/ASA Guidance on Purposing Anesthesia Machines as ICU Ventilators, April 9, 2020. Available at: https://www.asahq.org/in-the-spotlight/coronavirus-covid-19-information/purposing-anesthesia-machines-for-ventilators. Accessed April 12, 2020.
2. Anesi GL: Coronavirus disease 2019 (COVID-19): Critical care issues. UpToDate (Topic 127419 Version 18.0), April 10, 2020. Available at: https://www.uptodate.com/contents/coronavirus-disease-2019-covid-19-critical-care-issues. Accessed April 12, 2020.
3. U.S. Food and Drug Administration: Ventilator supply mitigation strategies: Letter to health care providers. March 22, 2020. Available at: https://www.fda.gov/medical-devices/letters-health-care-providers/ventilator-supply-mitigation-strategies-letter-health-care-providers. Accessed April 12, 2020.
4. Datex-Ohmeda (GE Healthcare): Aisys Anesthesia Machine Technical Reference Manual. Part Number M1046983, May 2005. Madison, Wisconsin

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Getting to a New Normal: Mandating That Patients Wear Masks as Hospitals Fully Reopen during the Coronavirus Pandemic

To the Editor:

With community spread of coronavirus disease 2019 (COVID-19) infection, a hospital-acquired infection by both patients and medical providers is a major concern. In an early report from China, among 138 confirmed cases with COVID-19 infection, 57 patients (41.3%) were considered a nosocomial infection from the hospital.[1] More than 70% of suspected nosocomial infection patients were healthcare providers. The authors reported that one of the surgical patients infected 10 healthcare providers. According to an official report on March 6, 2020, more than 3,000 medical professionals have contracted COVID-19 in Hubei province alone, and some have died.[2] At least 2,629 medical providers in Italy have been infected by this devastating virus.[3] In the United States, it was reported on April 14, 2020, that 9,000 health workers contracted COVID-19, and 27 of them have died.[4] Protection of healthcare providers, particularly those on the front line in the emergency departments, wards, and intensive care units, is an extremely important task during the pandemic due to their limited numbers and the need for them to take care of the surging number of patients. It is also critical to protect other uninfected hospital patients and nonmedical staff.

Hospitals have the highest density of patients with COVID-19; thus, hospital-acquired infection should be a top priority task in our daily clinical practice. Medical providers have priority for protective resources, such as masks, for better protection. All healthcare providers should wear regular surgical masks for all patient encounters, based on the successful experience from Singapore and Hong Kong during the pandemic.[5] However, to mandate that all patients wear masks may have much greater effectiveness in controlling nosocomial infection. Scientific findings related to the aerosol spreading and deposition pattern from breathing, coughing, sneezing, and speaking clearly indicated that placing a tight surgical mask on the patient resulted in a 288-fold greater protection than the wearing of an N95 respirator mask by a receiver (medical provider or anyone in the hospital), as indicated in table 1.[6,7] COVID-19 is a highly infectious disease that can be transmitted *via* an aerosol route even when a patient is asymptomatic. Until we can perform high-efficacy screening tests in a short period of time, it is difficult to know who has the disease. A recent clinical study clearly demonstrated that surgical masks reduce coronavirus outward transmission.[8] To prevent hospital-acquired infection, we initiated and recommend a new hospital policy to mandate that everyone entering the hospital must wear a mask, and the mask cannot be removed unless necessary for a medical intervention or drinking and eating. This policy should apply to everyone in the hospital, including all medical providers, healthcare workers, secretaries, supporting individuals, patients, and patient family members. Ensuring that patients wear a mask could potentially be more critical than masks on the care team. We can protect our staff in a better manner by managing infectious source control. In addition to the new policy, proper education and compliance reinforcement are needed. We have a dedicated entrance in our hospital with trained personnel to check the temperature, ensure mask wearing, and offer a surgical mask for any person who needs one when entering the hospital.

We have implemented this policy early on, and started a pilot virus test within 48 h before each surgical procedure, aiming toward a full reopen for "normal" full capacity