

From the laboratories of Azad Mashari, Jay Han and Joseph Fisher

One suggested approach to the severe global shortage of ventilators during the current pandemic has been the splitting of ventilators in order to ventilate multiple patients with one device. The simplest version of this involves simply splitting the inspiratory and expiratory limbs of the circuit into a branch for each patient. Indeed a 3D-printable splitter device, the Prisma VEsper, was granted emergency approval by the FDA last week. This approach however poses significant risks and has a high likelihood of harming one or both patients. This motivated a joint statement by all the major critical care societies and the Anesthesia Patient Safety Foundation (<https://www.apsf.org/news-updates/joint-statement-on-multiple-patients-per-ventilator/>) warning about the hazards of such an approach.

Our team is investigating an alternative technique for ventilator splitting which addresses the hazards, at the cost of a significant increase in complexity. This approach includes separate fresh gas flows and pressure-isolated secondary circuits for each patient with the primary ventilator acting to drive a bellows assembly for each patient circuit. This technique is still limited to pressure control mode and the respiratory rates of the two patients must be matched, but FiO₂, PEEP, and driving pressure/tidal volume can be individually adjusted and, most critically in terms of safety, compliance changes in one patient or obstruction in one of the patient circuits does not impact the ventilation to other patients. Bench validation of the model will be completed over the next week with further testing to follow.

Cerebrus Ventilation Splitting Strategy

Based on Sommer DD, Fisher JA, Ramcharan V, Marshall S, Vidic DM. Improvised automatic lung ventilation for unanticipated emergencies. Crit Care Med. 1994;22: 705–709.

This approach uses the primary ventilator circuit as a driving system for a parallel set of secondary circuits for each patient.

The theoretical limit of patients on one vent is determined primarily by the maximal tidal volume the primary vent can provide.

Compliance changes in one patient have no effect on the other

Ventilation modes: PCV only

Controls:

- RR: Primary Vent Setting (shared)
- PEEP: Individual PEEP valves for each patient
- Driving pressure: Primary Vent Setting plus fine adjustment through individual FGF
- FiO₂: individual FGF control

