

Advances in the methodology of co-ventilation during a disaster

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The study by Tonetti *et al*¹ describes a potential configuration for the invasive ventilation of two adults on one ventilator ('co-venting'). This is a similar configuration to those previously published in 2006 by Neyman and Irvin (four test lungs on one ventilator),² and evaluated both in 2008 by Paladino *et al*³ (using normal lungs in sheep, ventilating four on one ventilator) and again by Branson *et al*⁴ in 2012 (with different respiratory system compliance and airways resistance in four tested lungs on one ventilator). This concept was also explored using face masks (non-invasive ventilation) in two human volunteers for 10 min by Smith and Brown in 2009.⁵ In 2017, Keven Menes used this previously evaluated 'splitting' of ventilators and implemented it during a mass shooting in Las Vegas, when a sudden influx of injured patients caused an acute ventilator shortage.⁶ This mass casualty event revealed its first successful use in humans (two patients on one ventilator), although this experience has not been published in a peer-reviewed journal.

This research and proof of concept by Neyman, Irvin² and Paladino *et al*,³ were not meant to endorse the use of co-venting on four patients exclusively. Rather the aim was to show the scalability of the procedure in a disaster. If four patients can be ventilated with one machine, the same approach can certainly be applied to two patients on a single ventilator. Indeed, the US Health and Human Services has released several documents pertaining to co-venting including the COVID-19 Task Force guidelines which described one potential method of co-venting if it were to become necessary.⁷

On 14 March 2020, a Youtube video was launched by one of the authors (CIB) showing the set-up for ventilating four test lungs on one ventilator, and also revealed the set-up for two test lungs on one ventilator.⁸ This information, along with the

previously published articles regarding this process,^{2,3} was shared with physicians at various Italian universities by one of the authors (LP) in early March as they struggled with how to address the ventilator shortage. This led to the manuscript published by Tonetti *et al*, which shows in more detail the two patient on one ventilator configuration.¹

There have been considerable recent advances and insight into this potential approach as the COVID-19 pandemic continues to challenge those managing patients needing ventilatory assistance with limited ventilator resources. While some societies have raised concern about the lack of human experience in diseased lungs (Menes use in humans had mostly normal lungs)⁶ and recommend against it,⁹ other institutions have explored it as an option in dire circumstances and published their recommended methodology.¹⁰

Everyone agrees one patient on one ventilator will always be the gold standard. Use of one ventilator for two patients is clearly outside the manufacturer's recommendations and only appropriate in dire circumstances during a disaster. Understanding the background, parts needed, set-up configuration and implementation procedure options will assist those who may need this novel approach to expand ventilator options. We commend the authors of this study for further advancing documentation of this potential expansion of ventilator availability as a life-saving intervention during a disaster and hope the additional information we have provided may be informative.

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