# Back to the OR of the Future: Reply

## In Reply:

I wish to thank Kevin Tremper for his kind words[1] regarding my recent Editorial and his impeccable cinematic taste, as well as for verifying that I alone am not the only baby boomer anesthesiologist suffering from "manual blood pressure posttraumatic stress disorder" or chronic otitis externa.[2] Although the controversy related to noninvasive blood pressure accuracy has moved on from the now nearly extinct manual blood pressure measurement in the operating room, it does continue to rage with regard to invasive arterial monitoring that does systematically alter clinical management, as has been well described in the Journal.[3]

I greatly appreciate Kevin's request for more support for decision support systems, and in my somewhat wide-ranging and admittedly hyperbolic riffing on the future, I do apologize for giving short shrift to this important topic. Process outcomes are extremely important to patients and institutions. Given that they are often hard to quantify (particularly on a patient level) or may not be universally generalizable (*e.g.*, length of stay or cost may vary widely between institutions and can be highly confounded), "hard" clinical outcomes are most often accorded higher priority; however, this may not always be the most appropriate approach.

Thanks again to Dr. Tremper for sharing his thoughts and expertise on the upcoming future. I once again call on some late 1980s pop music philosophers—the now defunct band Timbuk 3—for guidance: "Things are going great, and they're only getting better…The future's so bright, I gotta wear shades…"

### Competing Interests

The author declares no competing interests.

Martin J. London, M.D., F.A.S.E. University of California, San Francisco, San Francisco, California. martin.london@ucsf.edu

DOI: 10.1097/ALN.0000000000004082

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*(Accepted for publication October 28, 2021. Published online first on November 29, 2021.)*

# Emergency Airway Management in COVID-19: Comment

## To the Editor:

As intensivists with experience managing patients with coronavirus disease COVID-19 respiratory failure, we read with interest the article by Wong *et al.*[1] describing risk factors for successful emergency airway management in COVID-19 patients. We applaud the impressive size, completeness, and multinational breadth of the dataset compiled by the authors.

We recognize that first-pass success is an important metric for airway management and that COVID patients are challenging, in part due to precautions against disease transmission.[2] However, we note that successful intubation may not fully describe the risk involved in difficult airway management, and that even when airway management is ultimately successful, physiologic derangements during the intubation process can be common.[3]

Patients with COVID-19 may be particularly at risk for physiologic deterioration during airway management. In our hospital we found that aggressive use of noninvasive ventilation allowed many patients to avoid intubation.[4] However, those who failed noninvasive ventilation were often exhausted after days of progressive respiratory insufficiency despite maximal use of high-flow nasal cannula, bilevel positive airway pressure, or helmet ventilation. Further, hypovolemia was common due to diuretic therapy to improve oxygenation. In such patients the combination of anesthetic induction, brief apnea, and transition to positive pressure ventilation often resulted in severe refractory hypoxemia and hypotension. Toward the end of our first wave (May 2020), we would not infrequently perform awake fiberoptic intubation in patients failing high-flow nasal cannula to avoid severe cardiorespiratory deterioration associated with even brief apnea and anesthetic induction.

Wong *et al.* note that their registry did not capture the incidence or severity of hypoxemia or cardiovascular collapse due to airway management. Although we agree that

hypoxemia and cardiovascular instability are not normally consequences of airway management, they may complicate physiologically difficult intubation[5] and many COVID patients who fail noninvasive ventilation due to progressive disease fall into that category. Existing evidence suggests that first-pass success may not distinguish between anatomical and physiologically difficult airways,[6] further limiting the ability of the first-pass success metric to detect cardiorespiratory consequences of COVID-19 airway management.

Wong *et al.* describe a higher likelihood of first-pass success with rapid sequence intubation. It is unclear, however, whether this finding should be generalized to all patients with COVID-19 respiratory failure. Rapid sequence intubation may be well tolerated early in the course of COVID respiratory failure but markedly less well in those who require intubation after a week of failed noninvasive support. In such late-stage patients, airway managers should integrate physiologic complications of airway management into their decision tree.

## Competing Interests

Dr. Tung receives a salary as Critical Care executive section editor for *Anesthesia & Analgesia*. Dr. Shahul is supported in part by National Institutes of Health (Bethesda, Maryland) grants R01HL148191 and R21HL14848811. Dr. Rubin is the president of DRDR Mobile Health (Chicago, Illinois), a company that creates mobile applications for healthcare, including functional capacity assessment applications. He has engaged in consulting for mobile applications as well. He has not taken any salary or money from the company.

Daniel S. Rubin, M.D., M.S., Avery Tung, M.D., Sajid S. Shahul, M.D., M.P.H. University of Chicago, Chicago, Illinois (D.S.R.).
drubin@dacc.uchicago.edu

DOI: 10.1097/ALN.0000000000004060

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*(Accepted for publication October 15, 2021. Published online first on November 10, 2021.)*

# Emergency Airway Management in COVID-19: Reply

## In Reply:

We thank Rubin *et al.*[1] for their thoughtful discourse on the intubateCOVID study reporting emergency airway management in COVID-19 patients.[2,3] We welcome the discussion our article has invited. We agree that patients with COVID-19 requiring tracheal intubation are often physiologically compromised, having failed noninvasive means for respiratory support, and that first-pass success is an imperfect outcome measure for assessing risks to patients during tracheal intubation. Their account of the physiologic derangements that can occur with induction of anesthesia and transition to positive pressure ventilation mirrors our own experiences in managing this cohort of patients.[4]

Our study has limitations with the incomplete patient-level data that may help us truly interpret the physiologic

impact of tracheal intubation in this setting. We can, however, infer from these data that physiologic and anatomical difficulty are not mutually exclusive. First-pass success is a surrogate for overall ease of performing the tracheal intubation procedure, and a high or low rate of success in this measure informs the likelihood of encountering delays in securing the airway and prolonged apnea times that would then result in physiologic deterioration. In the event of this deterioration, cessation of tracheal intubation attempts may be prompted in exchange for bag-mask ventilation or cardiovascular stabilization with vasopressor administration. Thus, first-pass success may indeed be a meaningful indicator for physiologically difficult airways. Delving into our data, this may be the underlying reason for rapid sequence induction being associated with an improved first-pass success rate, as abandoning tracheal intubation attempts in exchange for optimizing physiology is less likely. This may dovetail into the discussion of early *versus* late tracheal intubation attempts, with early intubation potentially associated with greater physiologic stability than late tracheal intubation.[4]

Ultimately, however, we acknowledge that further studies incorporating patient-level physiologic variables and other outcome measures may be required to investigate particular patient factors to inform airway managers in their approaches to mitigate risk. Although all studies have limitations, we began the pandemic with little or no information, and multicenter collaborative studies such as intubateCOVID have needed to move quickly to provide evidence to inform clinicians and improve the quality of patient care.

## Research Support

Financial support was received from the Difficult Airway Society (London, United Kingdom), the American Society of Anesthesiologists (Schaumburg, Illinois), the International Anesthesia Research Society (San Francisco, California), and the Anesthesia Patient Safety Foundation (Rochester, Minnesota).

## Competing Interests

The authors declare no competing interests.

Kariem El-Boghdadly, F.R.C.A., M.Sc., Danny J. N. Wong, F.R.C.A., Ph.D., Craig Johnstone, F.R.C.A., Imran Ahmad, F.R.C.A.; on behalf of the intubateCOVID Collaborators. Guy's and St. Thomas' NHS Foundation Trust, London, United Kingdom (K.E.-B.). elboghdadly@gmail.com

DOI: 10.1097/ALN.0000000000004061

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*(Accepted for publication October 15, 2021. Published online first on November 10, 2021.)*

# Individualized Fluid and Vasopressor Therapy: Comment

## To the Editor:

We read with great interest the randomized controlled trial published recently by Joosten *et al.* in Anesthesiology.[1] This study assessed the ability of a closed-loop system for the titration of a norepinephrine infusion combined with a fluid-management decision support system to decrease the percentage of intraoperative time at risk for tissue hypoperfusion when compared with a "traditional" manually controlled goal-directed hemodynamic optimization. The authors reported that patients in the computer-assisted group had significantly less total intraoperative time with hypotension (primary outcome), less oscillation in mean arterial pressure (MAP) during surgery, and a higher mean cardiac index at the end of the procedure—while also receiving less total norepinephrine by infusion and having a lower fluid balance.[1]