

Back to the OR of the Future: Comment

To the Editor:

I loved the recent Editorial¹ by Martin London on the operating room of the future, not only because he referred to one of my all-time favorite movies, *Back to the Future*, but also because I, as an aging baby boomer, also remember going to the operating rooms early to get the single non-invasive blood pressure device at our institution. Those of us who trained with a manual cuff and paper charting have seen tremendous improvements in care and safety enabled by technology, but not without controversy. The early non-invasive blood pressure devices were criticized for not correlating with invasive arterial blood pressure.

Surprisingly, even the pulse oximeter was not accepted early on as necessary until it became mandated. The only prospective randomized trial on the use of pulse oximetry in the operating room found no difference in overall clinical outcomes.² More recently, decision support tools have been developed that incorporate patient comorbidities, current management, and real-time vital signs with the goal of providing a decision support system analogous to the glass cockpit primary flight display in aviation,³ to which Dr. London referred.¹ Our study, which evaluated such a tool, found its use was associated with less hypotension, less fluid administration, and better compliance with tidal volume protocols in both historical and parallel controls.³ Dr. London noted these findings but stated that the study “failed to document any improvement in the requisite ‘hard’ clinical outcomes.” By this I assume he was referring to the lack of improvement in postoperative myocardial and renal injury in the parallel control group.

However, in the historical control group, not only were process-of-care measures improved, but also incidences of myocardial injury, stage 1 and 2 acute kidney injuries, 30-day mortality, and hospital length of stay.³ These findings may not be as compelling since it is possible that during the 6-yr period of this study, anesthesia care improved. In the contemporaneous matched cohort analysis, the control group also had 5% greater hospital encounter charges ($P < 0.001$). Finally, in the sensitivity analysis, when decision support system users were compared to a parallel group who never opened the application, cases performed by decision support users were associated with 1-day reduction in hospital length of stay ($P = 0.01$). Hospital encounter charges and length of stay may not be as “hard” as clinical outcomes such as

reductions in renal or cardiac injury, but they are not unreasonable surrogate markers of the overall clinical care required. Improvement in these outcomes does imply that use of this decision support tool was associated with improved care.

Currently, the tool provides live calculations of known variables that could, in theory, be done manually (e.g., real-time fluid balance calculated using absolute volume intake and outputs [and relative to the patient’s estimated blood volume]; cumulative duration of hypotension; or age-adjusted anesthetic dose incorporating inhaled and infusion agents). Given the likely advances in artificial intelligence in the future, more complex algorithms will be developed that will be impossible to implement manually. I think in the not-too-distant future, administration of general anesthesia without a live decision support tool will seem as archaic as manual blood pressure and charting. We may be approaching an inflection point in improved care and safety similar to that of the 1980s with the adoption of monitoring standards, this time employing live decision support.

It will be back to the future all over again, with Anesthesiology taking the lead in employing technology to improve patient safety.

Competing Interests

Dr. Tremper is the founder of and has an equity interest in AlertWatch (Ann Arbor, Michigan), the company that developed this decision support system.

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Back to the OR of the Future: Reply

In Reply:

I wish to thank Kevin Tremper for his kind words¹ 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.

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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