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## Addressing human factors is crucial to preventing unrecognised oesophageal intubation

We thank Collins et al. [1] and Dr Hansel [2] for their correspondence regarding our guidelines [3]. Collins et al. emphasise the importance of an array of communication and team-level interventions in the prevention of unrecognised oesophageal intubation. We strongly agree that these aspects of clinical practice are of critical importance to both the management of oesophageal intubation and other airway crises. The consensus guidelines for preventing unrecognised oesophageal intubation restrict themselves to providing recommendations specifically addressing the risk of unrecognised oesophageal intubation [3]. A key principle of the Project for Universal Management of Airways (PUMA) is to integrate technical and human factors-based recommendations, rather than relegating the latter to a discrete, cursory human factors section [4]. This highlights their equal importance and better reflects the interplay between these elements. Many of the targeted recommendations provided contribute to flattening hierarchies, providing opportunities to challenge assumptions and facilitating other aspects of team performance. Inclusion of implementation tools [5] designed for real-time use, is also consistent with recent recommendations for the incorporation of human factors aspects into airway algorithms [6]. However, as the guidelines note, addressing the breadth and complexity of some of the more general human factors-related issues raised by Collins et al., is simply beyond their scope [3]. Some will be addressed in the forthcoming educational resources for these guidelines and in other planned PUMA guidelines that have a broader focus [4]. The Difficult Airway Society (DAS) and Association of Anaesthetists are close to publication of guidelines relating to human factors that will cover the topic in depth.

Collins et al. also raise concerns that the phrasing of some suggested declarations might contribute to bias by priming for an affirmative response. We would distinguish between use of a challenge-response checklist as described in their correspondence and the prompt for a 2-person check advocated by the guidelines. Our recommendation is that, following tracheal intubation and initial ventilation, both operator and assistant should routinely undertake unprompted independent checks for the presence of 'sustained exhaled carbon dioxide' and adequate oxygen saturation. Both are subsequently responsible for verbalising the outcome of these checks, with either proceeding first once ready. The phrase suggested in the guideline (which is only an example) confirms performance of the first check, prompts performance of the second check (if overlooked), promotes verbalisation of the outcomes of both checks and seeks to empower each practitioner to query the conclusions of the other. We do not feel the approach suggested by Collins et al. adequately addresses these goals. Any system that does not encourage the airway operator to immediately

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review the capnograph and oximetry readings themselves, then declare any identified issues without delay, may be problematic. This is particularly important given the potential variability in the availability and expertise of an airway assistant in different airway management contexts. While the airway operator verbalising 'review capnograph', as proposed by Collins et al., prompts an independent check by the airway assistant, this phrase does not actively promote two-person confirmation. Instead, the process as outlined risks the operator inadvertently delegating checking to the assistant and relying on their interpretation, culminating in a single person check by a potentially less expert practitioner. Even if the airway operator also reviews the capnograph following this declaration, the first response verbalised is no less at risk of biasing the other practitioner's interpretation than when using the process described in the guidelines. Finally, allocating responsibility for this declaration solely to the airway operator also makes it more vulnerable to being overlooked in situations where the operator is cognitively overloaded.

Dr Hansel makes the valid observation that temporal considerations have been largely neglected in airway guidelines, although this has begun to change. As well as the Vortex approach, the DAS guidelines for management of tracheal intubation in critically ill adults address this issue and future PUMA guidelines will take this further [4,5,7]. Consistent with this trend, the consensus guidelines for preventing unrecognised oesophageal intubation deliberately make no suggestion of waiting before removing the tracheal tube if the criteria for sustained exhaled carbon dioxide have not been met. Barring 'an obvious, immediately remediable cause' for its absence, the guidelines recommend that there should be no delay in removing the tracheal tube, unless doing so would be dangerous.

Dr Hansel proposes that severe bronchospasm following tracheal intubation might initially prevent detection of 'sustained exhaled carbon dioxide' despite correct tracheal tube placement, resulting in unnecessary removal of the tracheal tube if these recommendations are followed by an 'overly cautious' airway operator. We acknowledge such actions represent correct application of the guidelines but suggest that this should not be of concern and would characterise such an airway operator as 'prudent' rather than 'overly cautious'. Continued ventilation down a tracheal tube placed in the oesophagus may have catastrophic consequences. When balanced against the typically benign act of removing a correctly placed tracheal tube and attempting ventilation with a facemask or supraglottic airway, removal seems safer. We appear in agreement that removing the tracheal tube would not be dangerous in the described scenario and we would add that if tracheal intubation had precipitated bronchospasm, tube removal might even be therapeutic. Dr Hansel's rationale for delay suffers from hindsight bias, his hypothetical case describing an arguably improbably rapid and

apparently spontaneous recovery from 'no trace' to 'normal capnogram'. For an airway practitioner encountering this situation in real-time, this is not a reasonable expectation. Further, having waited 20 seconds without detecting carbon dioxide, a practitioner confident of a diagnosis of bronchospasm might be tempted to wait 10 more seconds, in the same manner that 'just one more laryngoscopy' might be successful. In this way, temporal awareness could be more easily lost than if the tracheal tube was removed immediately. Anchoring to a diagnosis of bronchospasm is seen in several coroners' reports of unrecognised oesophageal intubation. Weighing up the relative probability of oesophageal intubation vs. alternative explanations for absent sustained exhaled carbon dioxide is a potentially flawed approach to assessing the merit of removing the tracheal tube. Precautionary interventions should not be withheld until an adverse outcome becomes probable but be implemented whenever an unacceptable risk threshold has been exceeded. This imperative is even greater when the risk of harm from inaction is high and from acting is low. Thus, when potentially catastrophic outcomes are involved, it should be expected that precautionary interventions might commonly (perhaps usually) be seen in hindsight to have been implemented 'unnecessarily'. Awake tracheal intubation when an increased risk of airway management challenges has been identified is a comparable situation: while it is often noted in retrospect that it might have been unnecessary, this in no way diminishes the appropriateness of choosing to undertake it in the first place.

We would caution against language such as 'overly cautious' or 'hold our nerve' that reinforces the perception that this approach reflects anxiety or overreaction. This might be a barrier to airway practitioners adopting safe practices. In contrast, the guidelines provide a safe, clear and consistent trigger for tracheal tube removal, independent of other clinical circumstances that can be understood by the whole airway team. This helps overcome these barriers and keeps the focus on doing what is safest for the patient rather than making the correct diagnosis.

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## References

1. Collins J, Bonner P, Cafferkey A. Preventing unrecognised oesophageal intubation: addressing hierarchies and the importance of critical language. *Anaesthesia* 2022. Epub. <https://doi.org/10.1111/anae.15891>
2. Hansel J. How rapid is rapid enough? Time as an overlooked component of anaesthetic interventions. *Anaesthesia* 2022. Epub 7 October. <https://doi.org/10.1111/anae.15882>
3. Chrimes N, Higgs A, Hagberg CA, et al. Preventing unrecognised oesophageal intubation: a consensus guideline from the Project for Universal Management of Airways and international airway societies. *Anaesthesia* 2022. Epub 17 August. <https://doi.org/10.1111/anae.15817>
4. Chrimes N, Higgs A, Law JA, et al. Project for Universal Management of Airways - part 1: concept and methods. *Anaesthesia* 2020; **75**: 1671–82.
5. Chrimes N. The Vortex: a universal 'high-acuity implementation tool' for emergency airway management. *British Journal of Anaesthesia* 2016; **117** (Suppl 1): i20–i7.
6. Edelman DA, Duggan LV, Lockhart SL, Marshall SD, Turner MC, Brewster DJ. Prevalence and commonality of non-technical skills and human factors in airway management guidelines: a narrative review of the last 5 years. *Anaesthesia* 2022; **77**: 1129–36.
7. Higgs A, McGrath BA, Goddard C, et al. Guidelines for the management of tracheal intubation in critically ill adults. *British Journal of Anaesthesia* 2018; **120**: 323–52.