


LESS IS MORE IN INTENSIVE CARE



Less daily oral hygiene is more in the ICU: yes

Brian H. Cuthbertson^{1,2,3,4*}  and Craig M. Dale^{5,6}

© 2020 Springer-Verlag GmbH Germany, part of Springer Nature

Ventilator associated pneumonia (VAP) and halitosis can be considered to be the two scourges of the decade in the 2000s, one medical and one social of course. While these two problems may seem unrelated, both are conditions in which pressure to adopt oral therapies may result in more harm than good.

VAP was certainly seen as the scourge of Critical Care Medicine and was identified as having $\geq 10\%$ attributable mortality in early studies [1]. VAP prevention rapidly became the focus of Critical Care Quality Improvement Programs around the world [2] with healthcare organizations whose missions is “improving health and health care worldwide” jumping on the bandwagon and pushing the agenda forward with zeal [3]. They were supported in this odyssey by governmental and non-governmental organizations internationally, which described VAP as a treatable disease [4]. Oral care and ventilator care bundles came into vogue and all such guidelines contained the recommendation to prevent VAP using oral chlorhexidine solution. In sequence, chlorhexidine oral rinse became an accepted means to attenuate VAP and a social indicator of quality care [5].

The “social scourge” of halitosis was in fact a disease invented by pharmaceutical manufacturers to scare people into using their products—and it worked! Originally considered a surgical antiseptic, floor cleaner, and treatment for gonorrhea, listerine alcohol-based solution became the first over-the-counter mouthwash to “cure” bad breath [6]. The marketing transformation of a personal imperfection into an embarrassing medical condition changed personal oral hygiene practices worldwide. In organizing a desire to purchase the mouthwash, the manufacturer advertised bad breath as a widespread,

serious, and treatable disease. In reality, alcohol-containing mouthwashes may contribute to dry mouth and make halitosis worse by reducing or eliminating saliva. Our mouths need saliva to control bacteria, minimize inflammation, and to stay fresh, meaning that the lack of saliva can cause bad breath and dental disease [7]. Nevertheless, the pursuit of the perfect smile and freshest breath is now a compulsion to millions around the world, so why should it not be so for the critically ill in critical care, right?

In these enlightened days, at the beginning of the 2020s, we know better of course (or we would do if we weren't trying to deal with a global pandemic). It turns out that the attributable mortality for VAP is probably closer to 1% and our previous studies were grossly confounded [8]. Further, and concerningly, it turns out that oral chlorhexidine may actually be causing more harm than good. Firstly, in most, but not all studies, oral chlorhexidine prevents VAP, but then again VAP is not the scourge it used to be. Secondly, meta-analysis of randomized evidence has suggested that oral chlorhexidine may be associated with increased mortality [9]. The reasons for this are unclear but they could be as simple as drug related toxicity. Further large, high-quality, randomized studies are underway to see whether this effect can be confirmed [10]. Thirdly, even if oral chlorhexidine doesn't kill you while preventing VAP, it may be harmful in other important ways related to direct toxic effects on the oral mucosa [11].

So, that said, here is the problem that we face. We have falsely conflated good oral care with the application of oral chlorhexidine; well it is an antiseptic after all just like our favorite mouthwash, so chlorhexidine application meant a job well done! But applying an antiseptic to a healthy mouth may be very different from applying it to the mouth of a patient who is critically ill. All critically ill patients suffer from severe oral dysfunction due to a variety of contributory factors such as xerostomia (dry mouth from inadequate salivary flow), abnormal

*Correspondence: brian.cuthbertson@sunnybrook.ca

¹ Department of Critical Care Medicine, Sunnybrook Health Sciences Center, 2075 Bayview Avenue, Toronto, Canada

Full author information is available at the end of the article

Table 1 Recommended research to investigate potential chlorhexidine-related adverse outcomes

Research area	Outcomes	Suggested approach
Mortality	ICU mortality	Randomized control trials
Mucosal adverse events	Oral mucosal lesions; dose response; patient predictors of oral lesions; sepsis; mortality	Prospective observational studies; controlled trials; validated oral health indexes
Pulmonary adverse events	Acute respiratory distress syndrome (ARDS); ventilator-associated events (VAEs); duration of mechanical ventilation	Retrospective and prospective observational studies
Bacterial resistance	Bacterial resistance; infection-related ventilator-associated complications (IVACs); sepsis	Antimicrobial sensitivity testing
Patient experience	Behavioral pain scores; patient self-report of pain, dry mouth, bad taste	Prospective observational studies; qualitative studies

oropharyngeal colonization, tube-related pressure injury, etc. [12, 13]. Further, if you ask patients after they are treated in a critical care unit, severe oral symptoms are their main complaint, more than cognitive, psychiatric and physical disorders that get more attention). Studies suggest that oral chlorhexidine is applied far more frequently than an evidence-based oral care bundle and this evidence also suggests that nurses believe that they have completed good oral care for their patient by quickly swabbing the mouth with this antiseptic solution [14]. We encourage research to elucidate the potential toxic effects of oral chlorhexidine prophylactic rinse, including but not limited to mucosal lesions, acute pulmonary distress syndrome and increased mortality (Table 1).

Good oral care actually involves a comprehensive set of interventions including oral hydration, lip moisturization, and careful toothbrushing to mechanically remove plaque, the sticky biofilm of bacteria that collects above and below the gum line; this does not, and should not include oral chlorhexidine [9]. Biofilm helps to protect bacteria from antiseptics rinses, increasing the likelihood of its survival. Eliminating interventions that may cause harm and focusing on those that promote oral health makes good sense. Further emphasizing the importance of comprehensive oral care is research demonstrating tooth loss among ICU survivors, placing them at risk of morbidity (e.g., malnutrition, depression) and reduced quality of life [15]. Good oral care, therefore, should attend to the prevention of debilitating oral disease—and not VAP alone. The appropriate application of a comprehensive oral care regimen is associated with better oral health outcomes in critically ill patients [12].

In conclusion, we support this motion (or at least support a modified version of the motion). Applying oral chlorhexidine is not the same as good oral care, in fact, it may be bad oral care. We need to stop conflating chlorhexidine application with good oral care. Good oral care (excluding oral chlorhexidine) is to be commended and recommended to relieve the severe symptoms suffered by

critically ill patients and prevent dental disease. The state of the evidence base at this time suggest that we should place a moratorium on the use of oral chlorhexidine until high quality randomized trials have reported [10].

Author details

¹ Department of Critical Care Medicine, Sunnybrook Health Sciences Center, 2075 Bayview Avenue, Toronto, Canada. ² Inter-Departmental Division of Critical Care Medicine, University of Toronto, Toronto, Canada. ³ Department of Anesthesiology and Pain Medicine, University of Toronto, Toronto, Canada. ⁴ Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, Canada. ⁵ Lawrence S. Bloomberg Faculty of Nursing, University of Toronto, Toronto, Canada. ⁶ Tory Trauma Program, Sunnybrook Health Sciences Center, Toronto, Canada.

Compliance with ethical standards

Conflicts of interest

The authors have no conflicts of interested related to this article.

Ethical statements

Ethical approval was not required for this work.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Received: 20 August 2020 Accepted: 25 September 2020

Published online: 10 October 2020

References

- Melsen WG, Rovers MM, Groenwold RHH, Bergmans DCJJ, Camus C, Bauer TT, Hanisch EW, Klarin B, Koeman M, Krueger WA, Lacherade J-C, Lorente L, Memish ZA, Morrow LE, Nardi G, van Nieuwenhoven CA, O'Keefe GE, Nakos G, Scannapieco FA, Seguin P, Staudinger T, Topeli A, Ferrer M, Bonten MJM (2013) Attributable mortality of ventilator-associated pneumonia: a meta-analysis of individual patient data from randomised prevention studies. *Lancet Infect Dis* 13:665–671
- Weiss CH, Amaral LAN (2010) Moving the science of quality improvement in critical care medicine forward. *Am J Respir Crit Care Med* 182:1461–1462
- Berwick DM, Calkins DR, McCannon CJ, Hackbarth AD (2006) The 100 000 lives campaign setting a goal and a deadline for improving health care quality. *JAMA* 295:324–327
- Group TSICSA (2008) VAP prevention bundle – guidance for implementation. NHS National Services Scotland, Edinburgh

5. Klompas M, Li L, Kleinman K, Szumita PM, Massaro AF (2016) Associations between ventilator bundle components and outcomes. *JAMA Intern Med* 176:1277–1283
6. Payer L (1992) How doctors, drug companies, and insurers are making you feel sick. J. Wiley, New York
7. Bollen CML, Beikler T (2012) Halitosis: the multidisciplinary approach. *Int J Oral Sci* 4:55–63
8. Bekaert M, Timsit J-F, Vansteelandt S, Depuydt P, Vésin A, Garrouste-Orgeas M, Decruyenaere J, Clec'h C, Azoulay E, Benoit D (2011) Attributable mortality of ventilator-associated pneumonia. *Am J Respir Crit Care Med* 184:1133–1139
9. Klompas M, Speck K, Howell MD, Greene LR, Berenholtz SM (2014) Reappraisal of routine oral care with chlorhexidine gluconate for patients receiving mechanical ventilation: systematic review and meta-analysis. *JAMA Intern Med* 174:751–761
10. Dale CM, Rose L, Carbone S, Smith OM, Burry L, Fan E, Amaral ACK, McCredie VA, Pinto R, Quinonez CR, Sutherland S, Scales DC, Cuthbertson BH (2019) Protocol for a multi-centered, stepped wedge, cluster randomized controlled trial of the de-adoption of oral chlorhexidine prophylaxis and implementation of an oral care bundle for mechanically ventilated critically ill patients: the CHORAL study. *Trials* 20:603
11. Plantinga NL, Wittekamp BHJ, Leleu K, Depuydt P, Van den Abeele AM, Brun-Buisson C, Bonten MJM (2016) Oral mucosal adverse events with chlorhexidine 2% mouthwash in ICU. *Intensive Care Med* 42:620–621
12. Sands KM, Wilson MJ, Lewis MAO, Wise MP, Palmer N, Hayes AJ, Barnes RA, Williams DW (2017) Respiratory pathogen colonization of dental plaque, the lower airways, and endotracheal tube biofilms during mechanical ventilation. *J Crit Care* 37:30–37
13. Choi BK, Kim MS, Kim SH (2020) Risk prediction models for the development of oral-mucosal pressure injuries in intubated patients in intensive care units: a prospective observational study. *J Tissue Viability*. <https://doi.org/10.1016/j.jtv.2020.06.002>
14. Rello J, Kourenti D, Blot S, Sierra R, Diaz E, De Waele JJ, Macor A, Agbaht K, Rodriguez A (2007) Oral care practices in intensive care units: a survey of 59 European ICUs. *Intensive Care Med* 33:1066–1070
15. Herridge MS, Moss M, Hough CL, Hopkins RO, Rice TW, Bienvenu OJ, Azoulay E (2016) Recovery and outcomes after the acute respiratory distress syndrome (ARDS) in patients and their family caregivers. *Intensive Care Med* 42:725–738