Can J Anesth/J Can Anesth (2018) 65:221–222
DOI 10.1007/s12630-017-1006-x

CORRESPONDENCE

Greenhouse gases: the choice of volatile anesthetic *does* matter

Richard Alexander, MD, BSc · Andrew Poznikoff, BSc · Stephan Malherbe, MBChB, MMed, FRCPC

Received: 13 September 2017 / Accepted: 26 October 2017 / Published online: 8 November 2017

To the Editor,

Global warming, considered one of the greatest health threats of the 21st century, is linked to greenhouse gas emissions. The major greenhouse gases – carbon dioxide (CO_2), methane, nitrous oxide, and chlorofluorocarbons – have been well studied and regulated. The contributions from the healthcare industry, however, have been largely ignored or excused under the guise of medical necessity.[1] Nevertheless, a considerable portion of hospital waste is generated in the operating room, and anesthesiologists are in an ideal position to take a leadership role to minimize the hospital-related negative environmental impact.

Volatile anesthetic drugs are halogenated fluorocarbons and potent greenhouse gases, as measured by their global warming potential (GWP), which is a relative measure of how much heat a given gas traps in the atmosphere compared with a similar mass of CO_2. Because most volatile agents remain in the atmosphere for one to 15 years,[2] the GWP is often expressed over a 20-year time horizon (GWP_{20}). This value represents the amount of heat trapped by the gas over a 20-year period, compared with a similar mass of CO_2. For example, the GWP_{20} values for desflurane, isoflurane, and sevoflurane are 6810, 1800, and 440, respectively.[2] The carbon dioxide equivalent (CDE_{20}) is the product of the GWP_{20} and the quantity of the gas. Colloquially referred to as the "carbon footprint," it represents the amount of CO_2 that would have the same global warming potential over a 20-year period.

Concerted efforts by the University of British Columbia's (UBC) Department of Anesthesiology have increased awareness about the deleterious environmental effects of volatile anesthetics. This effort resulted in the purchase of modern, low-flow anesthetic machines that closely regulate expired end-tidal anesthetic gas concentrations. It also contributed to a change in the Department's preference to use volatile anesthetics with the lowest GWP_{20} values.

To quantify these changes, we undertook a quality assurance project (Research Ethics Board approval not required as per Article 2.5, TCPS2)[A] to assess the volume of volatile anesthetics used during the years 2012-2016 according to data from seven UBC-affiliated hospital pharmacies.[B] In 2012, these sites combined used 1,318 L of desflurane and 385 L of sevoflurane. Using published values,[2] this resulted in a calculated CDE_{20} for desflurane and sevoflurane of 13,190,098 kg and 257,655 kg, respectively, for a total of *13.4 million kg* of CO_2 equivalence (Figure). Subsequently, the use of desflurane has steadily decreased whereas sevoflurane use increased, such that in 2016, desflurane use was 401 L and sevoflurane use was 772 L. Thus, the calculated CDE_{20} of 4,009,886 kg for desflurane and 515,979 kg for sevoflurane combined for a total carbon footprint of *4.5 million kg* of CO_2 equivalence. Of note, the total volume of volatile anesthetics used decreased from 1,703 L to 1,173 L

R. Alexander, MD, BSc (✉) · A. Poznikoff, BSc · S. Malherbe, MBChB, MMed, FRCPC
Department of Anesthesiology, Pharmacology & Therapeutics, University of British Columbia, Vancouver, BC, Canada
e-mail: richard.f.alexander@gmail.com

A. Poznikoff, BSc · S. Malherbe, MBChB, MMed, FRCPC
BC Children's Hospital, Vancouver, BC, Canada

[A] Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2).

[B] Vancouver General Hospital, University of British Columbia Hospital, BC Women's Hospital, BC Children's Hospital, Royal Columbian Hospital, Eagle Ridge Hospital, and Saint Paul's Hospital.

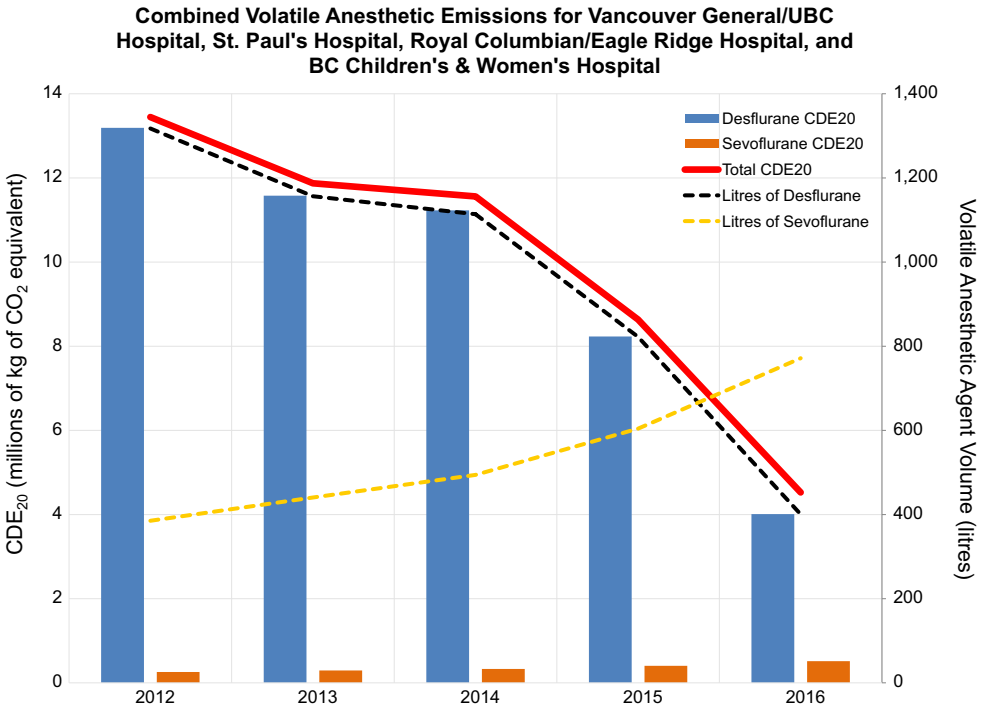

Figure Changes in the use of desflurane and sevoflurane, with the resulting environmental impact, during 2012-2016

during this interval. The difference in total CDE_{20} between 2012 and 2016 was 8.9 million kg, representing a 66% reduction in greenhouse gas emissions (Figure). To put this difference into perspective, 8.9 million kg of carbon emissions is roughly comparable to the annual emissions produced by 1,700 personal vehicles driving an average of 22,000 km per year.[3]

We encourage anesthesiologists to examine and quantify the environmental impact of their practice. The American Society of Anesthesiologists recently released a comprehensive document on actions that anesthesiologists can adopt to "green" the operating room.[4] Suggestions to reduce our carbon footprint included low-flow anesthesia, the use of regional anesthesia and total intravenous anesthesia where possible, and less use of nitrous oxide and desflurane.[5] Such changes in practice could substantially reduce an institution's carbon footprint, as we have demonstrated.

Acknowledgements The authors thank Dr. Mitch Giffin for his help in acquiring the appropriate data.

Conflict of interest Dr. Malherbe has previously been compensated by Abbvie as a professional consultant and speaker. The UBC visiting professor program is partly supported by an unrestricted educational grant from Abbvie.

Editorial responsibility This submission was handled by Dr. Steven Backman, Associate Editor, *Canadian Journal of Anesthesia.*

Funding None.

References

1. *Ryan SM*, *Nielsen CJ*. Global warming potential of inhaled anesthetics: application to clinical use. Anesth Analg 2010; 111: 92-8.
2. *Andersen MP*, *Nielsen OJ*, *Wallington TJ*, *Karpichev B*, *Sander SP*. Assessing the impact on global climate from general anesthetic gases. Anesth Analg 2012; 114: 1081-5.
3. *McGain F*. Why anaesthetists should no longer use nitrous oxide. Anaesth Intensive Care 2007; 35: 808-9.
4. *American Society of Anesthesiologists; Task Force on Environmental Sustainability Committee on Equipment and Facilities.* Greening the Operating Room and Perioperative Arena: Environmental Sustainability for Anesthesia Practice. October 2014. Available from URL: https://www.asahq.org/resources/resources-from-asa-committees/environmental-sustainability/greening-the-operating-room (accessed October 2017).
5. *McGain F*, *Story D*, *Kayak E*, *Kashima Y*, *McAlister S*. Workplace sustainability: the "cradle to grave" view of what we do. Anesth Analg 2012; 114: 1134-9.