

Eighteen Years of Exploring Patterns of Anaesthetic Gas Flows with More Recent Data on CO2 GWP Footprint

Presenting Author: R Ross Kennedy MB., ChB., PhD

Co-author: Paul Currant MB., ChB.

Background: Over the past 18 years we have intermittently collected comprehensive data on fresh gas flows (FGF) used during administration of volatile anaesthesia. This work, including the observation of the importance of the early (“induction”) phase of anaesthesia has been presented to STA previously. Recently, with increasing interest in the global warming potential (GWP) of choices we make as physicians, we explored the effect of changing patterns of practice on GWP. Recent publications allow benchmarking.

Methods: Christchurch Hospital is a 600 bed, 24OR tertiary hospital in the South Island of New Zealand performing 30,000 operations annually. Our FGF data was collected using various techniques and described recently (1) and includes all time points where vapor is being delivered. Choice of primary agent is derived from data logged directly from 10 anaesthetic machines using Insights (GE) which we have found consistent with short term comprehensive audits. Volatile agent consumption is based on deliveries from pharmacy to the OR, based on June years. Calculation of GWP CO2 equivalents was performed using the calculator¹ described by Martindale (2). A practice survey by McGain et al (3) allows comparison with a “typical” anesthesiologist in Australia or New Zealand by scaling our agent usage and flow rates, while Zuegge et al (4) give details of the volatile GWP of an equivalent sized hospital in the USA. As use of N2O is minimal in our OR we have ignored it in our calculations and comparisons.

Results: Our mean FGF with volatile agents remains around 800ml/min. Desflurane usage has decreased from 22% of cases in 2009 to <0.5% of cases in the first 10 months of 2019. There is a slow but steady increase in use of TIVA, currently 40% of cases. From pharmacy deliveries, the GWP of vapor used has fallen from 373 tonnes of CO2 equiv in 2012/13 to 102 tonnes for 2018/19. Most of this reduction is decreasing use of desflurane. The “typical” practice from McGain’s 2017 survey is: 70% sevo, with FGF 1-2l/min; 15% desflurane, FGF 0.5-1 l/min, and 15% TIVA. Adjusting our case data to these values gives a GWP of 703 tonnes of CO2 equivalent, 7 times our results and increases cost fivefold. These effects are both primarily driven by the changes in desflurane use. Zuegge et al report a 64% reduction in CO2 equivalents over a three year period (2012-15) following various educational initiatives. Their 2015 usage pattern on our case mix gives 1400 tonnes of CO2, mostly due to desflurane.

Discussion: We have seen a large decrease in desflurane use over recent years resulting in a dramatic decrease in the GWP of our volatile agent use. This change and the move away from N2O have occurred without specific intervention. When compared to a survey of practice in (predominantly) Australia and New Zealand and data from a single, comparable, US hospital, the GWP impact of our agent use is dramatically less. Although FGF with sevoflurane in the survey and in many US hospitals are much higher than in our data, as McGain et al observe, the predominant driver for changing volatile GWP is desflurane usage, which has almost disappeared from our practice. Zuegge et al reinforce our observation that moving away from desflurane also results in significant cost savings. While our data is current (2019), McGain’s survey was conducted in 2017 and Zuegge’s data is from 2015. Our results suggest that the combination of low FGF and minimal desflurane use can dramatically reduce the GWP footprint of volatile anaesthesia.

¹ http://www.sduhealth.org.uk/documents/publications/_carbon_hotspot_anaesthetic_gases_Feb_2014.xlsx

References:

1. Kennedy RR, et al *Anaesthesia*. 2019;74:875–82.
2. Martindale TG. *Br J Anaesth* 2016; 117: Supp e1_13932
3. McGain F, et al *Anaesth Intens Care* 2019; 47:235-41
4. Zuegge KL et al *Anesth Analg* 2019;128:e97-9

Figure:

CO2 equivalent GWP footprint of volatile anaesthetic agent choices at Christchurch Hospital, New Zealand. Included for comparison are data derived from a 2017 survey of practice in Australia and New Zealand (McGain) and from a single, comparable US hospital in 2015 (Zuegge)

