Canadian Anesthesiologists' Society (CAS) Background Paper for the CAS Position Statement on reducing harmful emissions, waste and costs

This document accompanies the document Greening the OR: CAS Position Statement on reducing harmful emissions, waste and costs and provides the rationale and evidence for CAS' recommendations. Both the Lancet Commission on Health and Climate Change and the World Health Organization have declared climate change as one the biggest health threats to global health of the 21st Century.[1,2] Climate change exacerbates existing health threats and creates new public health challenges.[3] The World Health Organization conservatively projects that an additional 250,000 deaths will occur per year by the 2030's as a result of climate change.[4] The healthcare sector is a significant contributor to climate change and is estimated to produce 4.6% of total national greenhouse gas emissions in Canada.[5] A national effort at all levels is warranted to reduce the environmental impact of all aspects of health care, including anesthesia care. This imperative is supported by the World Federation of Societies of Anaesthesiologists.[6]

Anesthesiologists use a number of medical gases to provide anesthesia, analgesia and sedation. When administered to patients, these gases (e.g. nitrous oxide, desflurane, sevoflurane) are then exhaled and vented out into the environment by healthcare facilities. When released, these gases act as greenhouse gases, trapping heat inside the atmosphere and contributing to global warming.[7] In North America, anesthetic gases are estimated to contribute to approximately 50% of the total perioperative carbon footprint.[8] Strategies attempting to capture and safely dispose of or reuse these gases are limited to the fraction of gases that are successfully captured. Also, in the absence of approval for reuse, storage and transportation of waste gases raises further concerns.[9]

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Desflurane

When comparing the environmental impact of the different medical gases, studies have shown that desflurane lingers in the atmosphere for approximately 14 years, while sevoflurane only remains for 1.4 years.[7] The Global Warming Potential over 100 years (GWP100) is the typical value used to compare anesthetic gases and reflects the gases' capacity to trap heat within the atmosphere (relative to carbon dioxide, which has a GWP100 = 1). Sevoflurane has a GWP100 of 144 while that of desflurane is 2590.[7] Thus, desflurane has far greater negative impact on the environment than sevoflurane. Sevoflurane and desflurane are clinically very comparable agents, with desflurane having insufficient advantage to justify its use, given the higher degree of detriment to the environment.[10-15] Furthermore, desflurane is a more expensive agent, resulting in higher costs to our struggling healthcare system.[16]

Not surprisingly, the use of desflurane has decreased significantly over the past several years as education about its environmental impact has spread. Numerous individual healthcare institutions in Canada and internationally have completely stopped using desflurane.[17-19] There has been no documented clinical impact to this cessation. Scotland is the first country to ban the use of desflurane at a national level, with plans for the United Kingdom to follow by the end of this year.[20] Its use will be severely restricted in the entire European Union as of Jan 1, 2026.20 In keeping with the CAS' Guidelines to the Practice of Anesthesia, CAS recommends that anesthesia providers, when using volatile anesthetic gases, should choose agents with the lowest global warming potential and use minimal gas flows to reduce environmental impact.[21] Anesthesia departments are urged to remove desflurane from their formularies and a national ban should also be considered. Automated end-tidal gas control systems are associated with a significant reduction in fresh gas flows and volatile gas consumption and should be adopted with all volatile-based anesthetics.[22]

Nitrous oxide

Nitrous oxide is used in the operating room as an anesthetic gas, on obstetrical wards to help blunt pain during labour and as a sedative agent in a variety of settings. It remains in the atmosphere for an estimated 114 years, has a GWP100 = 273 and contributes to the destruction of the ozone layer.[7] Its utility as an anesthetic gas in the operating room has greatly diminished over the decades as newer gases with favourable properties have been developed (i.e. sevoflurane). Its use in labour has likewise diminished with the availability of far more effective analgesia methods (i.e. epidural analgesia) but is still used in many centres when epidural analgesia is delayed or unavailable. This gas is made available for use via pipelines within healthcare facilities and/or smaller, portable tanks at the bedside.

Numerous institutional studies across several different countries have found that a substantial amount of nitrous oxide gas readily leaks, unused, out of these pipelines systems directly into the atmosphere.[23] Initiatives that have involved switching to portable tanks for nitrous oxide administration have resulted in an 80-98% reduction in nitrous oxide utilization and release into the environment.[24-26] This reduced waste is also associated with significantly reduced costs.

Given the significant impact of nitrous oxide on the environment and the tremendous amount of wastage found through pipeline leakage, many countries are calling for the decommissioning of nitrous oxide pipelines within their healthcare facilities.[27-29] CAS supports the elimination of nitrous oxide pipelines in Canadian healthcare facilities and the removal of these pipelines in new hospital build plans, favouring portable cylinders which are not subject to the same degree of wasteful leakage. CAS also recommends that anesthesia providers reduce nitrous oxide usage as much as possible, in favour or more environmentally sustainable options.

Single-use /disposable devices used in anesthesia care

There has been an increase in the production of single-use medical devices in recent years.[30] This has been accompanied by a reduction in the production and availability of reusable devices. Although some single-use items are understandable (e.g. intravenous needles and syringes), some medical supplies which are easily cleaned (e.g. laryngeal mask airways, laryngoscopes, surgical gowns/drapes) have been supplied in reusable form for many years and shown to be safe. Several studies involving detailed assessments of single use vs. reusable equipment reveal that disposable devices typically result in higher greenhouse gas emissions on a life-cycle basis as well as higher costs.[30, 31] Decisions made by industry to limit purchasing options to single use items have restricted environmentally sustainable procurement options and often lead to increased healthcare costs. Procurement policies that prioritize environmental sustainability will send a clear message to industry that offering reusable and fiscally responsible medical supplies will provide a competitive advantage.[30] Furthermore, the strategic decision to measure and disclose the carbon footprint of various products will better inform and facilitate environmentally responsible procurement decisions.

Disposal of pharmaceutical agents

The operating room is a source of considerable pharmaceutical waste. Medications that should be incinerated are frequently discarded into sinks and garbage cans. As a result, medications that are environmentally toxic find their way into the groundwater.

Other medications that are known to be mutagenic, carcinogenic and/or endocrine disruptors can impact all living organisms, including humans. Conversely, non-pharmaceutical waste, such as empty plastic syringes, are commonly discarded in pharmaceutical waste bins, which are then unnecessarily incinerated, increasing the amount of harmful dioxins and furans released into the atmosphere.[32,33] Action needs to occur at all levels, as outlined in our position statement, to ensure that disposal methods have the lowest possible negative impact on the environment.

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