



UNIVERSITY OF MICHIGAN HEALTH-WEST
MICHIGAN MEDICINE

Environmental Sustainability

SUS-01

A Quality Improvement discussion

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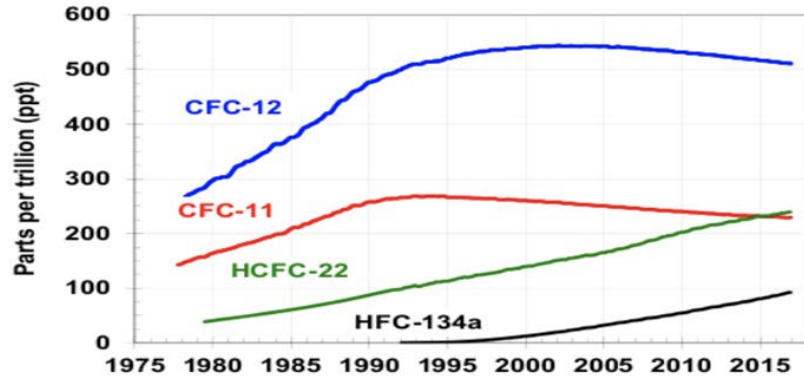
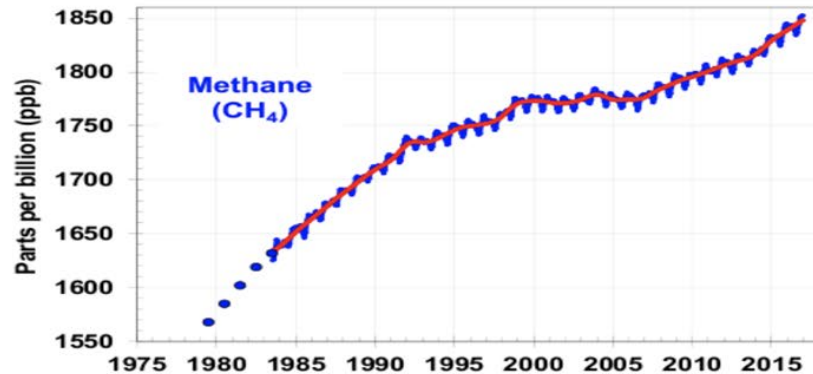
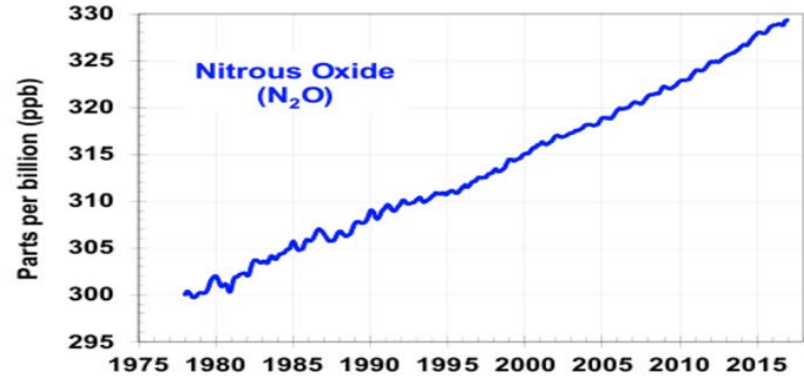
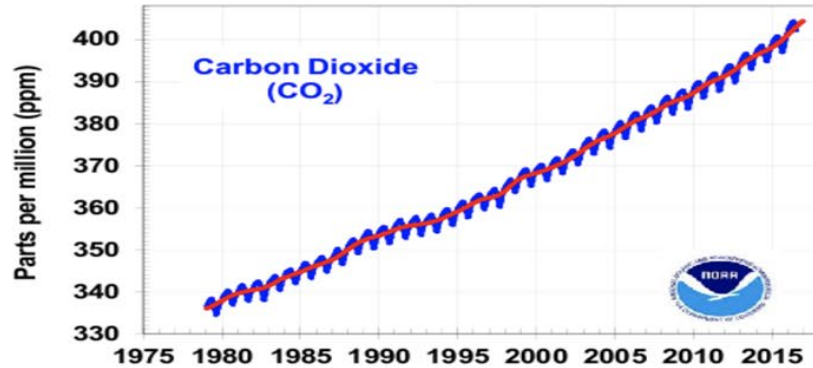
No financial disclosures

What impact does anesthesia have on the environment?

- Modern healthcare is a leading producer of environmental pollutants.
 - Responsible for 10% of national greenhouse gases.
- Scavenged volatile agents are vented out the back or top of facilities.
 - Remain in the atmosphere for years.
 - Sev (1.1y), Iso (3.2y), Des (14y), N₂O (114y)
- 1 hr of sevo = driving a modern car 30 miles.¹
- 1 hr of des = driving a modern car 230 miles.¹

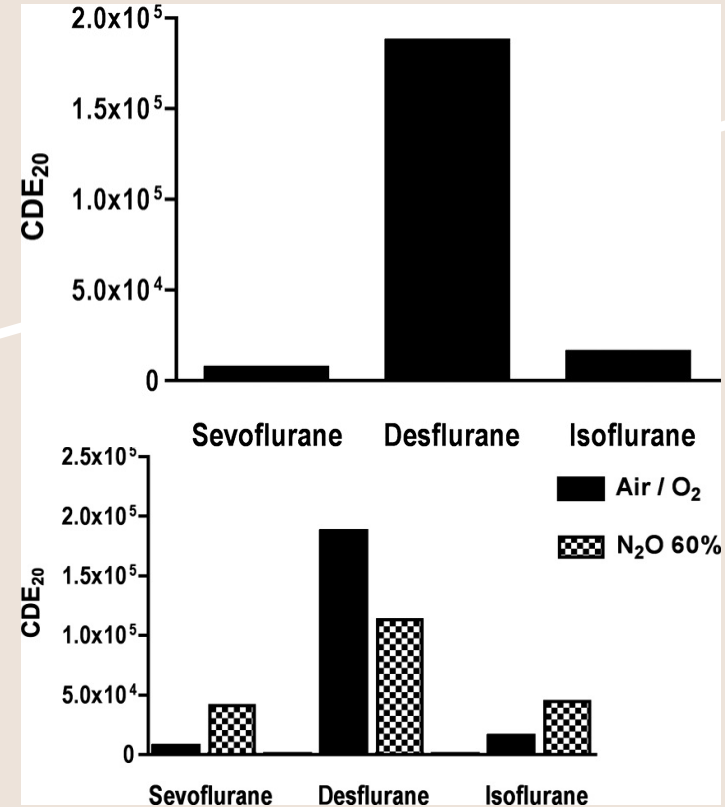


Atmospheric concentrations of major GHGs



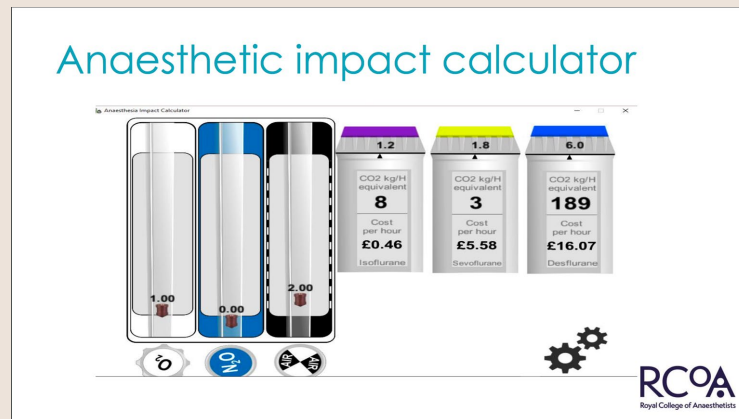
What impact does anesthesia have on the environment?

- GWP (Global Warming Potential) represents the (1) ability of a gas to trap heat combined with its (2) atmospheric lifetime and its (3) infrared absorption.
- Used to calculate CO₂ equivalencies over 20 years (CDE₂₀)
- Anesthetic gases²:
 - Sevo 349 GWP₂₀ 6,980 g CDE₂₀
 - Des 3,715 GWP₂₀ 187,186 g CDE₂₀
 - Iso 1,401 GWP₂₀ 15,551g CDE₂₀
 - Nitrous as a carrier worsens Sevo and Iso profiles



SUS-01 and beyond

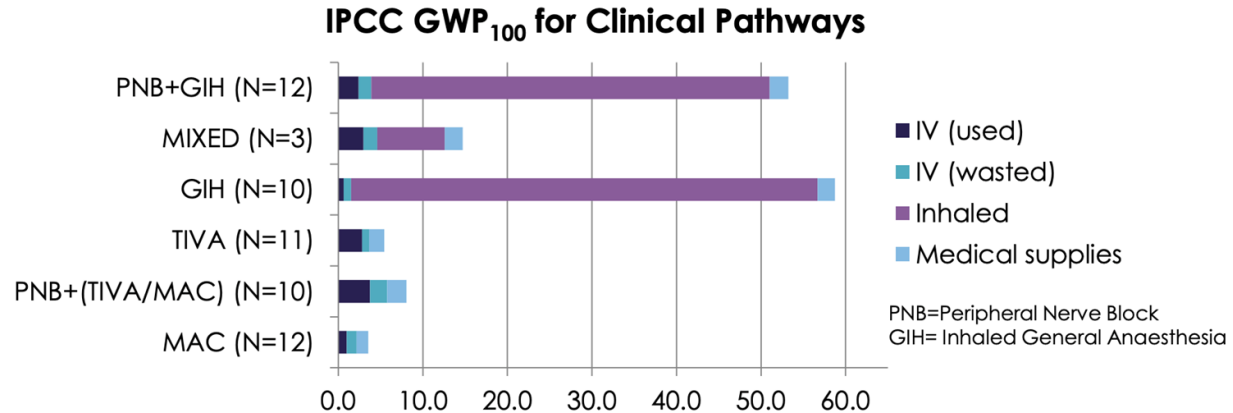
- **SUS-01:** Mean Fresh Gas Flows ≤ 3 LPM between intubation and extubation.
 - Does not take into consideration the type or concentration of gas used
 - Cannot account for benefit of ultra low-flow anesthesia (<1 LPM FGF)
- **SUS-04:** Mean Fresh Gas Flows ≤ 2 LPM between intubation and extubation.
 - Significantly harder to achieve than SUS-01
- **SUS-02:** Mean “efficiency” of anesthetic gas usage during maintenance.
 - Each gas measured in total CO₂E per hour.
 - Goal: beat 2.58 kg CO₂/hr .
 - Equivalent to 2% sevo @ 2LPM FGF



What can we do about this?

- Avoidance of general inhaled anesthesia.
 - TIVA
 - Regional + MAC
 - Neuraxial
 - WALANT (wide awake, local anesthesia, no tourniquet)

CO₂e of different forms of anaesthesia



What can we do about this?

- Provider Education & Systems processes
 - Create a culture of stewardship
- Sustainability metrics with cost pairing
 - SUS-01, SUS-02, SUS-04
 - MPOG/ASPIRE tracking
- Specific provider feedback
 - MPOG/ASPIRE reporting



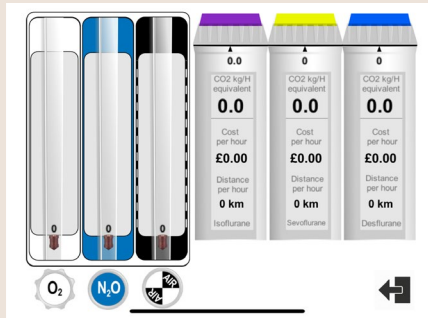
What can we do about this?

- “Pause FGF” button during intubation
- Ultra low-flow anesthesia during maintenance
 - Low-flow **sevoflurane**
 - Compound A
 - Package insert: 1LPM for 2h, then 2LPM
 - “Increase your FiO₂, overgas your agent”
- Avoid using **nitrous oxide** enriched anesthetics
 - This is the single most impactful contribution
- Avoid using **desflurane** unless expected to reduce morbidity/mortality



What can we do about this?

- Anesthesia Impact Calculator
 - On iOS and Android (Kevin Scott)



- Real-time CO₂E calculator on-screen
 - conversion to modern car miles driven
- Scavenging devices
- New tech to destroy waste anesthetic gases

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Topics Facilities Management and Design Technology and Innovation

Capturing hospital anesthetic gases



The test unit that captures anesthetic gases at Grand River Hospital, nicknamed Igor.

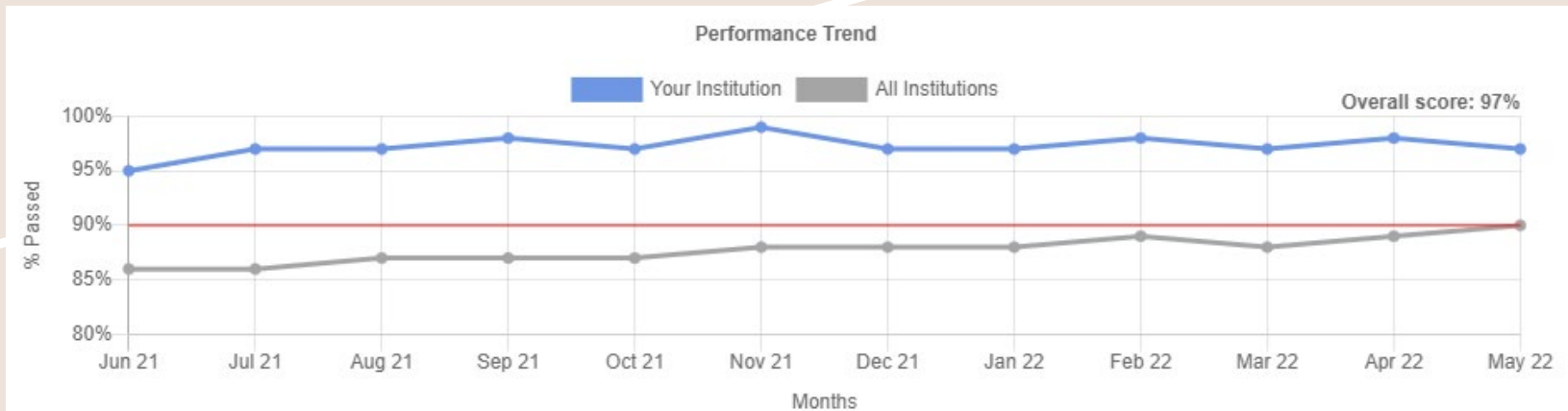
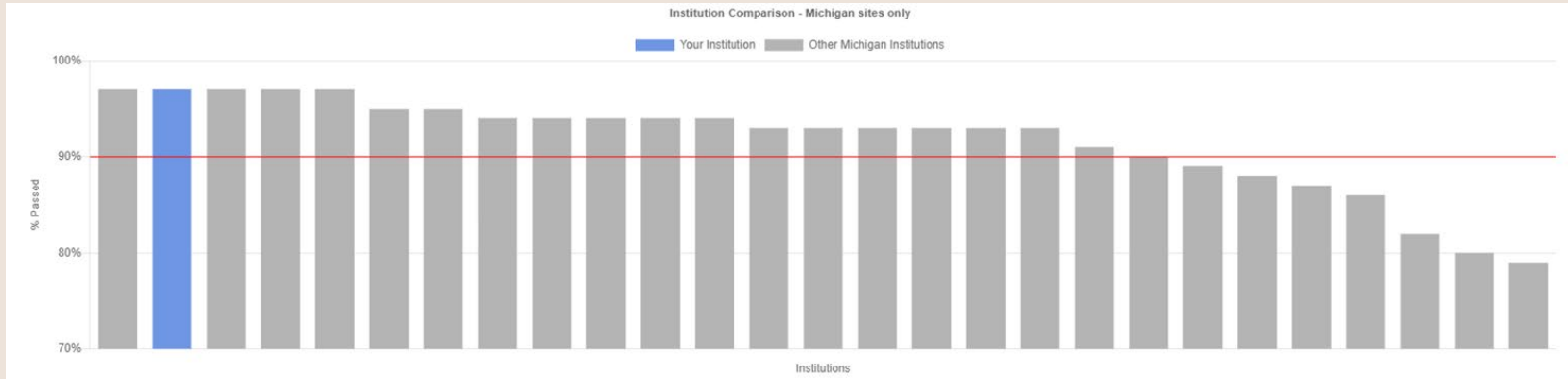


New patented technology developed in Waterloo Region will help battle climate change by capturing anesthetic gases that cause global warming.

Grand River Hospital (GRH) has activated its halogenated drug recovery (HDR) system, developed by Class 1 Inc. of Cambridge. The technology captures waste anesthetic gases exhaled by patients undergoing surgery. The gases are liquefied and stored for future re-processing.

GRH's KW Campus has been the pilot site for the system. Exhaled air from surgical patients is now diverted into specialized equipment in a mechanical room. The anesthetic gases are captured and stored in canisters

University of Michigan Health West



University of Michigan Health West

- Culture of stewardship
- Always seeking to improve practice
- High proportion of CAAs in the care team model.
 - Anecdotally ran FGF very low in training
- Historically close relationship with pharmacy
 - Emphasis on keeping costs to a minimum



References

1. Charlesworth M, Swinton F. Anesthetic gases, climate change and sustainable practice. *Lancet Planet Health* 2017;1(6):e216-17.
2. Ryan, Susan M. MD, PhD*; Nielsen, Claus J. CSc† Global Warming Potential of Inhaled Anesthetics, *Anesthesia & Analgesia*: July 2010 - Volume 111 - Issue 1 - p 92-98; doi: 10.1213/ANE.0b013e3181e058d7
3. Sherman, Tunceroglu, Parvatker, Sukumar, Dai , Eckelman, Yale University
4. <https://spec.mpog.org/Measures/Public>

Thanks!

