University of Utah
Department of Anesthesiology
Bioengineering Research Division

Development of an Anesthetic Reflection System

Patrick Kolbay, B.S.
Dr. Joseph Orr, Ph.D.; Dr. Kai Kück, Ph.D.*

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Global Warming Potential of Anesthetic Gases

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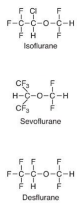
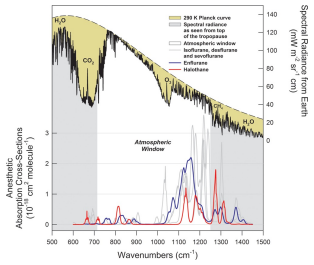
Bioengineering Research Division





Source: Anesthesia & Analgesia114(5):1081-1085, May 2012.

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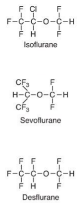

Compound	Atmospheric lifetime (y)	Radiative efficiency (Wm^{-2} ppb^{-1})	GWP 20-y time horizon	100-y time horizon	500-y time horizon
Isoflurane	3.2	0.453	1800	510	160
Sevoflurane	1.1	0.351	440	130	40
Desflurane	14	0.469	6810	2540	130

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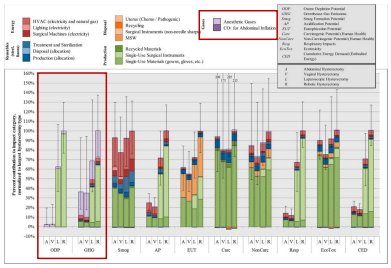

Source: Environ Sci Technol. 2015 Feb 3; 49(3): 1779–1786.

Patient Health Impact

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"…44,000-98,000 people die in U.S. hospitals each year as a result of preventable medical errors…"

Kohn LT, et al; *To Err Is Human: Building a Safer Health System.*

"DALYs from deaths due to preventable medical errors are of the same order of magnitude as the 470,000 DALY lost due to health care-related emissions."

Eckelman, M., et al; *Environmental impacts of the U.S. health care system and effects on public health.*

Investigating Porous Materials

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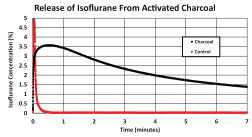

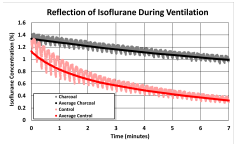

Designing the Anesthetic Reflector

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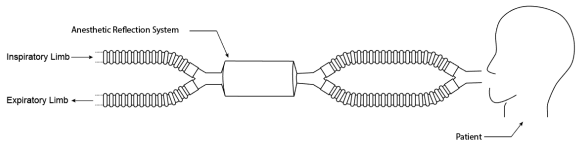

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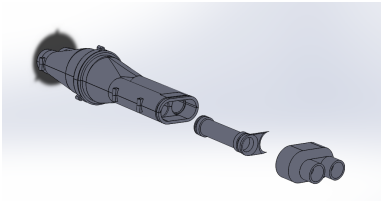

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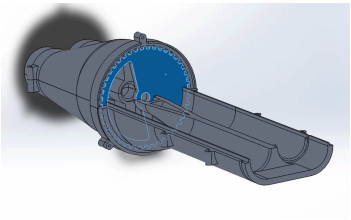

Testing the Anesthetic Reflector

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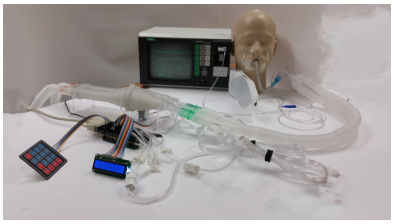

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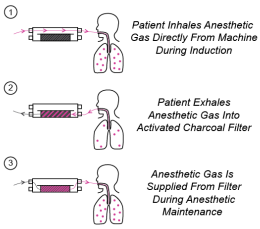

- Saturation of the activated charcoal filter took approximately 6 minutes during a mock induction.
- Following filter saturation, the hysteresis controller was able to maintain isoflurane concentrations within 0.2% by volume of a user set point (1 MAC).
- Given a cartridge with 40 grams of activated charcoal, this system would be capable of reflecting 1 MAC/hour of anesthetic gas at FGF of 1 LPM.

Future Considerations for the Anesthetic Reflector

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- Finding an alternative to activated charcoal.
  - Silica Gels
  - Zeolites
  - Metal-organic frameworks
- Improved feedback control
  - Replace hysteresis with PID control
  - Include material sorption isotherm
  - Mainstream anesthetic sensor

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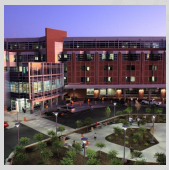

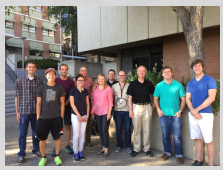

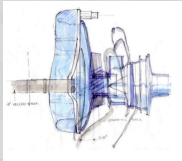

Thank You
Questions !