Efficient Use of Fresh Gas Flow with Inhaled Anesthetics Can Decrease Costs and Impact Medical Greenhouse Gas Emissions at UCSF

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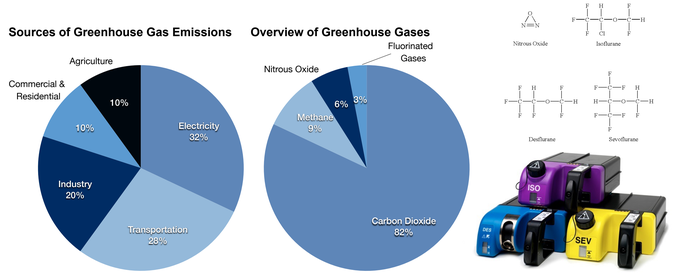
Introduction

Inhaled anesthetics, which contain environmentally deleterious greenhouse gases (GHGs) are used daily in the practice of anesthesia. The hypothesis is that a reduction in FGFs would significantly decrease volatile agent consumption and resultant purchasing costs at UCSF. The project will first incorporate the recording of FGFs and amount of reagent utilized into our electronic medical record system. Total fresh gas flows (FGFs) utilized by anesthesia providers will be analyzed and subsequent education of faculty and staff will be implemented to encourage efficient use of inhaled anesthetics. The importance of environmental sustainability will be highlighted with the emphasis that a reduction in inhaled gas usage via decreased FGF is both economically and environmentally advantageous. At an individual level, the gain may be small, but over a lifetime, small reductions in anesthetic gas emissions can have a profound impact.



Compound	Atmospheric lifetime* (yr)	Radiative efficiencies (W m^{-2} ppb^{-1})	Global warming potentials†			
			This work	Brown and colleagues[6]	Langbein and colleagues[7]	WMO[5]
Isoflurane $CF_3CHClOCHF_2$	3.2‡	0.453	**510**	328[6]	545[7]	349
Desflurane $CF_3CHFOCHF_2$	8.9[6]	0.469	**1620**	–	1525[7]	—
Sevoflurane $(CF_3)_2CHOCH_2F$	1.8[6]	0.351	**210**	54[6]	218[6]	—

Materials and Methods

In March 2015, we began data collection on FGFs utilized in the Moffitt-Long UCSF operating rooms. The initial audit period was not advertised and the data collection system in the electronic medical record was sufficiently discrete as to not alert the anesthesia provider.

Information on FGFs utilized all anesthetics was obtained, however, only cases with inhalational gases were analysed. Cases greater than 1 hour were included due to large variability in FGFs utilized for the induction of anesthesia and emergence from anesthesia. Cases performed outside of the OR (MRI, CT scanner, and other remote locations) were not evaluated (as some machines are not GE Aisys machines and cannot import data into our EMR).

An APeX chart review was conducted over a one-week period (May 1-7, 2015) to validate report functionality for the 372 anesthetics delivered and screened for patients who met our inclusion/exclusion criteria as listed above.

A multiple choice survey was sent to all anesthesia residents (CA-1 - 3) enrolled at UCSF Medical center during the 2014-2015 academic year (N= 73). Forty-eight residents (65%) responded to the survey. Data were collected on knowledge of environmental harm as it pertains to inhalational agents routinely used in anesthesia, costs of inhaled anesthetic agents, and beliefs on an individuals practice patterns as it pertains to FGFs utilized during the maintenance phase of anesthesia.

Data was exported from EPIC (Epic Systems) and analysis was performed using Prism(GraphPad Software) and Excel (Microsoft). Descriptive statistics were used to summarize the data.

Project Goals

- To incorporate FGFs and mLs inhaled anesthetic used per case into UCSF Medical Center Electronic Medical Record (EMR)
- To assess current providers knowledge of environmental effects and cost of inhalational gases used in daily anesthesia practice
- To assess current FGFs utilized by UCSF anesthesia providers in Moffitt-Long operating rooms
- Intervention to reduce FGFs used in the maintenance phase of anesthesia

Current Guidelines on FGFs

	Desflurane	Isoflurane	Sevoflurane
Lowest allowable FGF			
< 2 MAC hours	0.5 L/min	0.5 L/min	1 L/min
> 2 MAC hours	0.5 L/min	0.5 L/min	2 L/min

Results and Outcomes

Most environmentally friendly agent (% answered)				
	Total	CA-1 (n=20)	CA-2 (n=10)	CA-3 (n=14)
Desflurane	0	0	0	0
Isoflurane	19	15	30	21
N_20	54	45	70	50
Sevoflurane	27	45	0	29

Least environmentally friendly agent (% answered)				
	Total	CA-1 (n=20)	CA-2 (n=10)	CA-3 (n=14)
Desflurane	75	75	80	71
Isoflurane	10	15	10	0
N_20	6	0	0	21
Sevoflurane	8	10	10	7

Table 1. Provider knowledge based on a multiple choice survey. Twenty-seven percent of respondents identified the most environmentally friendly agent (sevoflurane), while 75% of residents correctly identified the least friendly agent (desflurane). The majority of residents (> 90%) successfully identified the most and least expensive agents (desflurane and sevoflurane, respectively).

- Only 10% of respondents described themselves as both environmentally and cost conscious when planning their anesthetic.
- 48% of respondents were aware of a “Pause Gas Flow” option on the Aisys anesthesia machine
- Greater than 90% of respondents correctly identified the most and least expensive volatile agents.

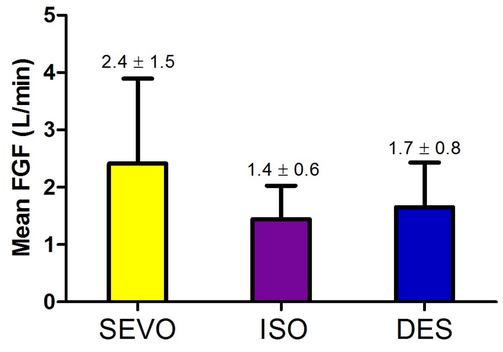


Figure 1. Mean FGFs documented during the maintenance of anesthesia.

During maintenance of anesthesia, what is your estimate of FGF (in L/min) of gas that you utilize or would utilize for the vapors listed below?

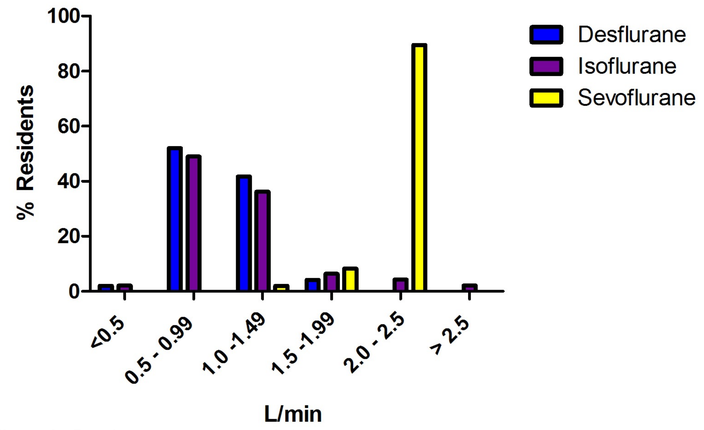


Figure 2 . Practice patterns assessed via survey.

Conclusions

- Higher than necessary FGFs are utilized currently by anesthesia providers
- Half of the residents are unaware of a built in option on the ventilator to assist with efficient use of FGFs

Future Goals

The current project incorporated FGFs into the UCSF electronic medical record and developed a report that can be utilized for future analysis. Our baseline data demonstrates that higher than necessary FGFs are utilized currently. Annually, UCSF’s Graduate Medical Education office supports departmental resident incentive projects, one of which could be a project on FGFs now that a system is in place to easily analyze the data. This project has a monetary incentive if the goals are actualized which may be useful for driving long-lasting behavioral change, and will be presented to the next resident class as such. This project has fostered discussion within the department regarding other ways to promote sustainability within the operating rooms. Future projects include waste management, energy conservation, re-stocking, and education regarding purchasing costs of standard equipment.

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