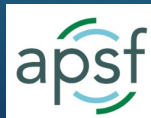


LOW-FLOW ANESTHESIA EMPOWERING THE CAREGIVER

Anesthesia Patient Safety Foundation Technology Education Initiative
In Collaboration with the American Society of Anesthesiologists

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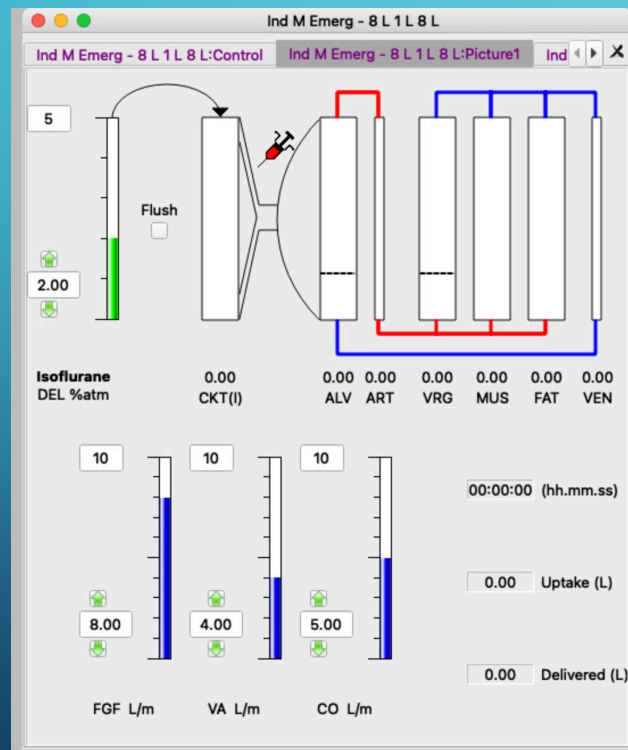
MPOG & “GREENING” PRACTICE

- Inhalation anesthesia is a good place to start
 - Desflurane and Nitrous Oxide have the greatest negative impact
 - Is the clinical benefit sufficient to warrant the environmental impact?
 - Minimize the environmental impact of the inhalation agents while achieving clinical goals
- SUS Metrics – Maintenance of Anesthesia
- Proposed SUS-06 Pedes: Induction Metric

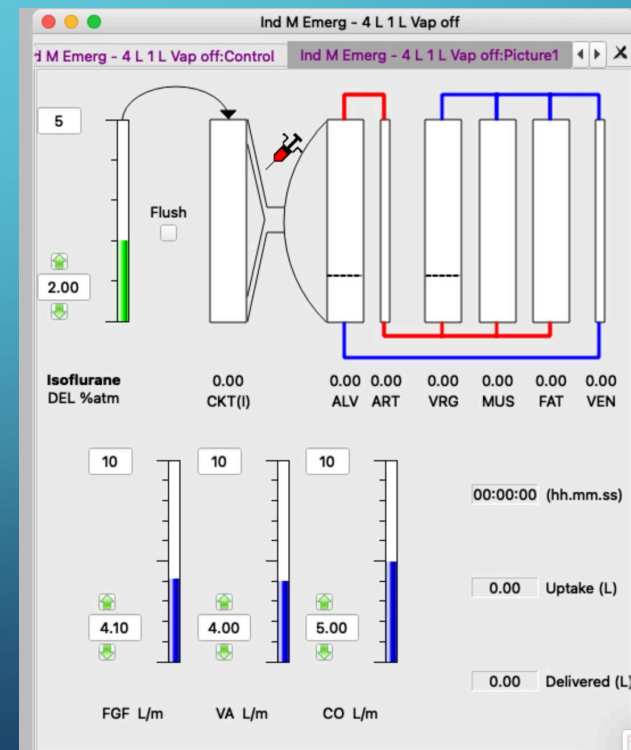
LOW-FLOW ANESTHESIA BEYOND MAINTENANCE

Efficiency of Anesthetic Delivery

Anesthetic Uptake / Anesthetic Delivered



28%



46%

BARRIERS TO PRACTICING LOW-FLOW ANESTHESIA

- Sufficient oxygen delivery
- Adequate anesthetic depth
- Rate of change of circuit concentrations
- Sevoflurane Package Insert (medically obsolete)
 - Not less than 1 L/min FGF up to 2 MAC-Hrs
 - Not less than 2 L/min FGF for longer
- **ECONOMICS ARE NOT A BARRIER TO WASTE!**

APSF/ASA COURSE ON LOW-FLOW ANESTHESIA

The screenshot shows the APSF website's 'Patient Safety Resources' section. The main heading is 'LOW-FLOW ANESTHESIA'. Below the heading is a diagram of an anesthesia machine with various gauges and flow meters. The text below the diagram reads: 'This course consists of 8 topics designed to empower the anesthesia professional with the knowledge required to safely and effectively reduce anesthetic waste and pollution through the practice of low-flow anesthesia. Using guided, simulation-based learning, basic concepts of low-flow anesthesia are explored along with strategies for reducing fresh gas flow during the induction, maintenance and emergence phases of inhalation anesthesia. Each topic is designed for about a 15 minute interaction but the motivated learner is encouraged to utilize the simulation platform to explore different strategies and reinforce the learning. The topics are designed to be followed in sequence but do not need to be done at the same time. The course is free of charge to all anesthesia professionals but a guest login is required for non-ASA members. Continuing education credits are available to physicians, nurses and anesthesia assistants. For physicians enrolled in the MOCA process, the CME credits are patient safety eligible.'

<https://www.apsf.org/apsf-technology-education-initiative/low-flow-anesthesia/>

The screenshot shows the ASA Education Center website. The main heading is 'APSF Technology Education Initiative'. Below the heading are the logos for the American Society of Anesthesiologists and the APSF Anesthesia Patient Safety Foundation. The main heading is 'Low Flow Anesthesia Course'. Below the heading is a red text box that reads: 'For the best experience, it is highly recommended to review the four topics in this section before proceeding to Course Content.' Below the red text box is a link that reads: 'Course Completion Instructions - Review before proceeding'.

<https://education.asahq.org/course/view.php?id=4353>

LOW-FLOW ANESTHESIA

DEFINITION: The practice of reducing fresh gas flow below minute ventilation to the lowest level consistent with equipment capabilities and provider comfort, while ensuring safe and effective care for the patient.

GOAL: Empower the anesthesia professional with the knowledge required to comfortably begin to reduce FGF.









LEARNING OBJECTIVES

- Understand why the gas mixture and anesthetic concentration set on the anesthesia machine are not what the patient actually inspires during low flow anesthesia
- Understand how to minimize anesthetic waste and environmental pollution during induction, maintenance and emergence.
- Understand how to manage total fresh gas flow, FGF composition and vaporizer settings during induction, maintenance and emergence to achieve desired inspired oxygen and end-expired anesthetic concentrations

COURSE TOPICS

Course Content

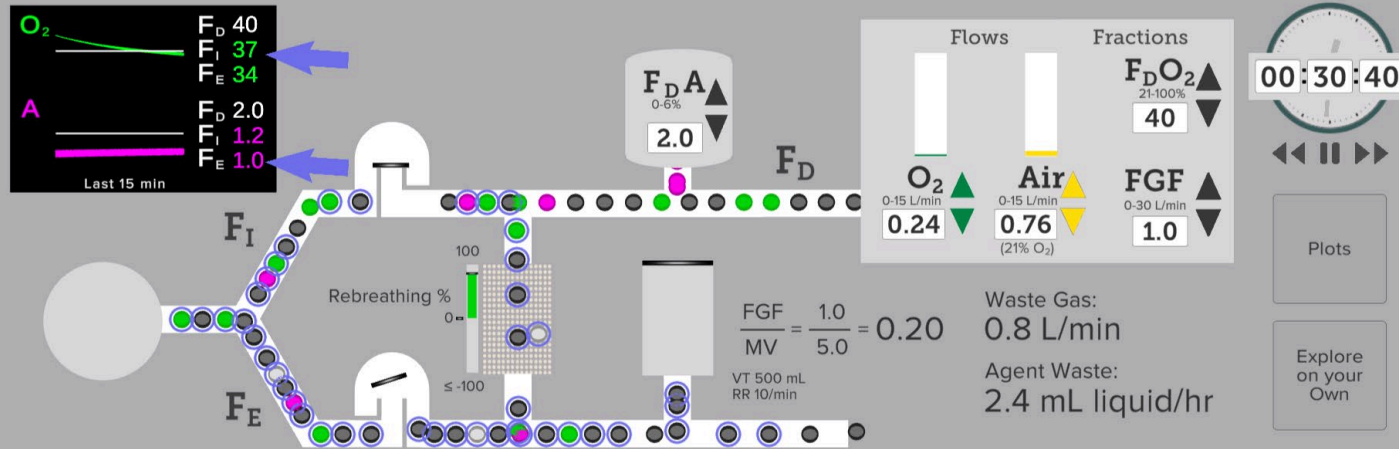
We recommend that the course is completed in the order listed.

-  **Introduction to Low-Flow Anesthesia**
-  **Using the Circle System to Control Rebreathing of Exhaled Gases**
-  **Safe Oxygen Delivery during Low-Flow Anesthesia**
-  **Effective Anesthetic Delivery during Low-Flow Anesthesia**
-  **Managing Fresh Gas Flow during the Maintenance Phase of Anesthesia**
-  **Managing Fresh Gas Flow after Intravenous Induction**
-  **Managing Fresh Gas Flow during the Emergence Phase of Anesthesia**
-  **Carbon Dioxide Absorbents and Low-Flow Anesthesia**

GUIDED SIMULATION

APSF Technology Education Initiative - Low Flow Anesthesia - Managing Fresh Gas Flow During the Maintenance Phase

About



HOW CAN FGF BE REDUCED SAFELY DURING MAINTENANCE?

7/7. We are at 30 minutes.

User Action: Change only F_DA to 1.5% and follow F_EA. Use fast forward (below the clock) to watch F_EA evolve. At one hour, desired values of F_IO₂ and F_EA are achieved.

Back

Continue

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GUIDED MACHINE SIMULATION

APSF Technology Education Initiative - Low Flow Anesthesia - Managing Fresh Gas Flow During the Maintenance Phase About

The simulation interface displays a patient circuit with various gas flow and fraction controls. On the left, a graph shows $F_{I_{O_2}}$ and $F_{E_{A}}$ over the last 15 minutes. The central panel shows a circuit diagram with a rebreathing percentage indicator and a calculation: $\frac{FGF}{MV} = \frac{1.0}{5.0} = 0.20$. The right panel contains a control panel with a clock at 00:31:05, a 'Plots' button, an 'Explore on your Own' button, a 'Quick Start' button, and a 'Help' button. The APSF logo is in the bottom right corner of the simulation area.

Parameter	Value
$F_{D_{A}}$	2.0
$F_{I_{O_2}}$	40
$F_{E_{A}}$	36
$F_{E_{O_2}}$	34
$F_{I_{O_2}}$	2.0
$F_{E_{A}}$	1.2
$F_{E_{O_2}}$	1.0
$F_{D_{O_2}}$	0.24
$F_{D_{Air}}$	0.76 (21% O_2)
$F_{D_{FGF}}$	1.0
Waste Gas	0.8 L/min
Agent Waste	2.4 mL liquid/hr

HOW CAN FGF BE REDUCED SAFELY DURING MAINTENANCE?

7/7. We are at 30 minutes.

User Action: Change only $F_{D_{A}}$ to 1.5% and follow $F_{E_{A}}$. Use fast forward (below the clock) to watch $F_{E_{A}}$ evolve. At one hour, desired values of $F_{I_{O_2}}$ and $F_{E_{A}}$ are achieved.

Back Continue

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PLOTTING FUNCTION

APSF Technology Education Initiative - Low Flow Anesthesia - Managing Fresh Gas Flow During the Maintenance Phase About

The simulation interface displays the following parameters and controls:

- Gas Flow Summary:**
 - $F_{I_{O_2}}$: 40
 - F_{I_A} : 35
 - $F_{E_{O_2}}$: 32
 - $F_{I_{O_2}}$: 2.0
 - F_{I_A} : 1.2
 - $F_{E_{O_2}}$: 1.0
- Flows:**
 - $F_{D_{O_2}}$: 0.6%
 - $F_{D_{Air}}$: 2.0
 - $F_{D_{O_2}}$: 0.24 (0-15 L/min)
 - $F_{D_{Air}}$: 0.76 (0-15 L/min, 21% O_2)
 - $F_{D_{FGF}}$: 1.0 (0-30 L/min)
- Fractions:**
 - $F_{D_{O_2}}$: 21-100%
 - $F_{D_{FGF}}$: 0-30 L/min
- Waste Gas:** 0.8 L/min
- Agent Waste:** 2.4 mL liquid/hr
- Equation:** $\frac{FGF}{MV} = \frac{1.0}{5.0} = 0.20$
- Other Parameters:** VT 500 mL, RR 10/min
- Rebreathing %:** 0-100
- Time:** 00:33:24

HOW CAN FGF BE REDUCED SAFELY DURING MAINTENANCE?

7/7. We are at 30 minutes.

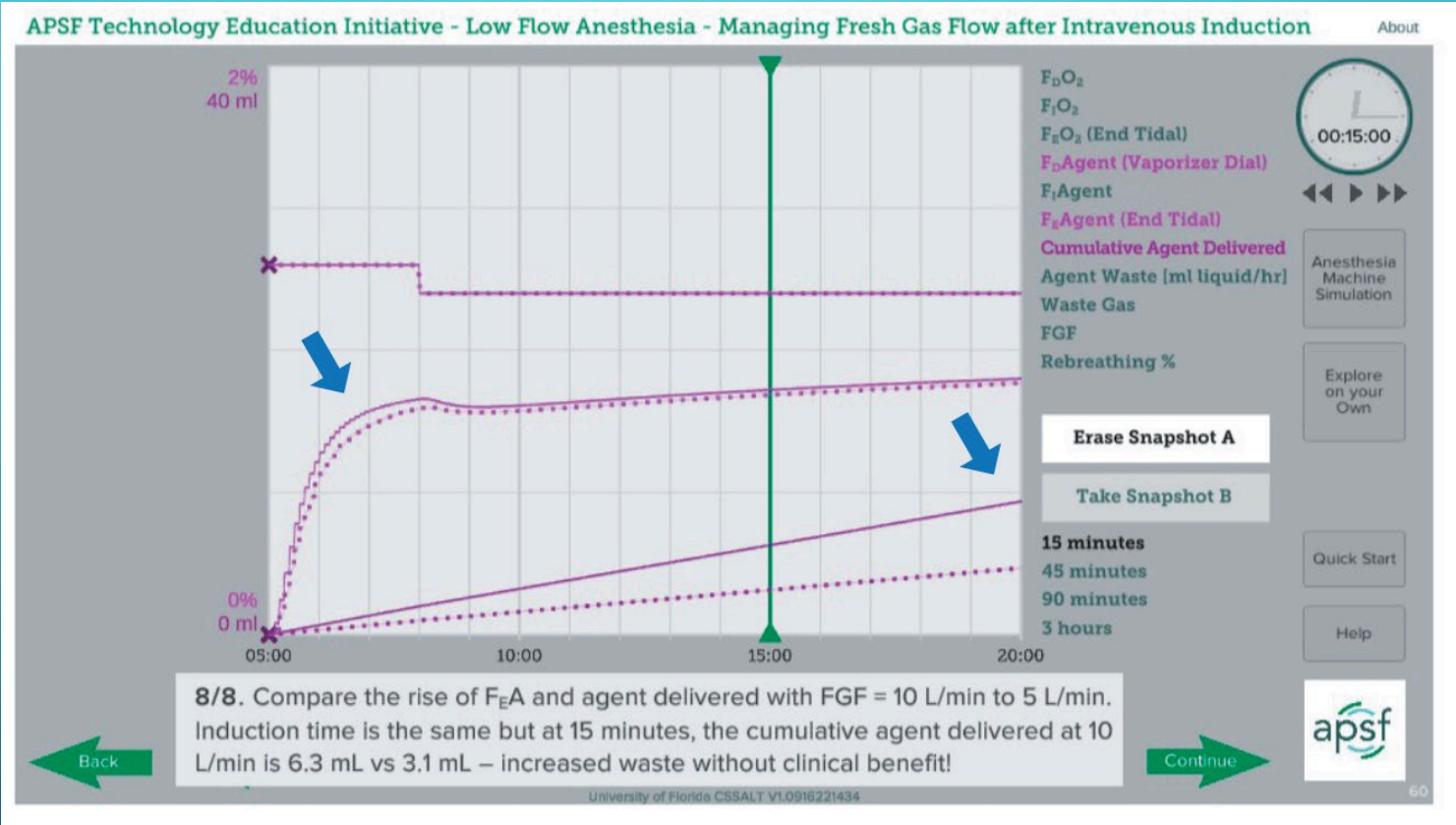
User Action: Change only F_{D_A} to 1.5% and follow F_{E_A} . Use fast forward (below the clock) to watch F_{E_A} evolve. At one hour, desired values of $F_{I_{O_2}}$ and F_{E_A} are achieved.

Navigation: Back, Continue, Plots, Explore on your Own, Quick Start, Help, apsf logo.

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PLOTTING FUNCTION



CONCLUSIONS

- Appreciation to the Low-Flow Course Development Team
- Links to the course:
 - Technology Education Initiative
 - [Apsf.org/TEI](https://www.apsf.org/TEI)
 - Low-Flow Course and Information
 - <https://www.apsf.org/apsf-technology-education-initiative/low-flow-anesthesia/>
 - ASA Education Center
 - <https://education.asahq.org/course/view.php?id=4353>
- Assessing the impact of the course – Role for MPOG?

APSF Technology Education Initiative
APSF Committee on Technology
Low-Flow Anesthesia Course Development Team

COURSE TITLE: Low-Flow Anesthesia

SPONSORSHIP: Anesthesia Patient Safety Foundation in collaboration with the American Society of Anesthesiologists and the University of Florida Center for Safety, Simulation and Advanced Learning Technologies (CSSALT)

COURSE DEVELOPMENT TEAM

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