Collaborating to Prevent Massive Nitrous Oxide Waste in Medical Gas Systems

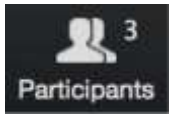
A Pacific Northwest Regional Webinar

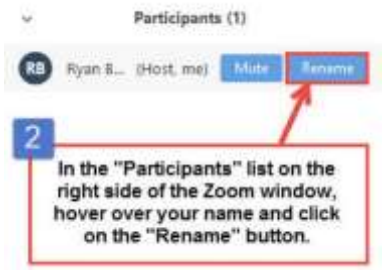
May 2, 2023

Cascadia Nitrous Oxide (N2O) Collaborative

Housekeeping Items

- Remain on mute unless intentionally speaking to the whole group
- Use the **Q & A function** for addressing questions to our presenters
- Use Chat for informal comments or messaging individuals
- These slides and the webinar recording access will be sent to you
- Please add your organization to your name
  - Click on Participants, hover over your name, click the 3 dots logo, select Rename, type in your organization following your name





What brings us here: A story of dual collaborations

- CleanMed conference presentation in 2022
- Collaborative research, assessment, solutions developed by Dr. Brian Chesebro and Andy Mason initially at Providence St. Vincent Medical Center in Portland
- Inspiration to follow Brian and Andy's lead, duplicate their work
- Legacy of roundtable meetings among PNW healthcare sustainability folks
- High interest in expanding collaboration on this issue in depth and breadth
- Ultimate vision: *Across the region, transform the delivery method of nitrous oxide within hospitals and ambulatory surgery centers to radically reduce leaks and resulting greenhouse gas emissions*

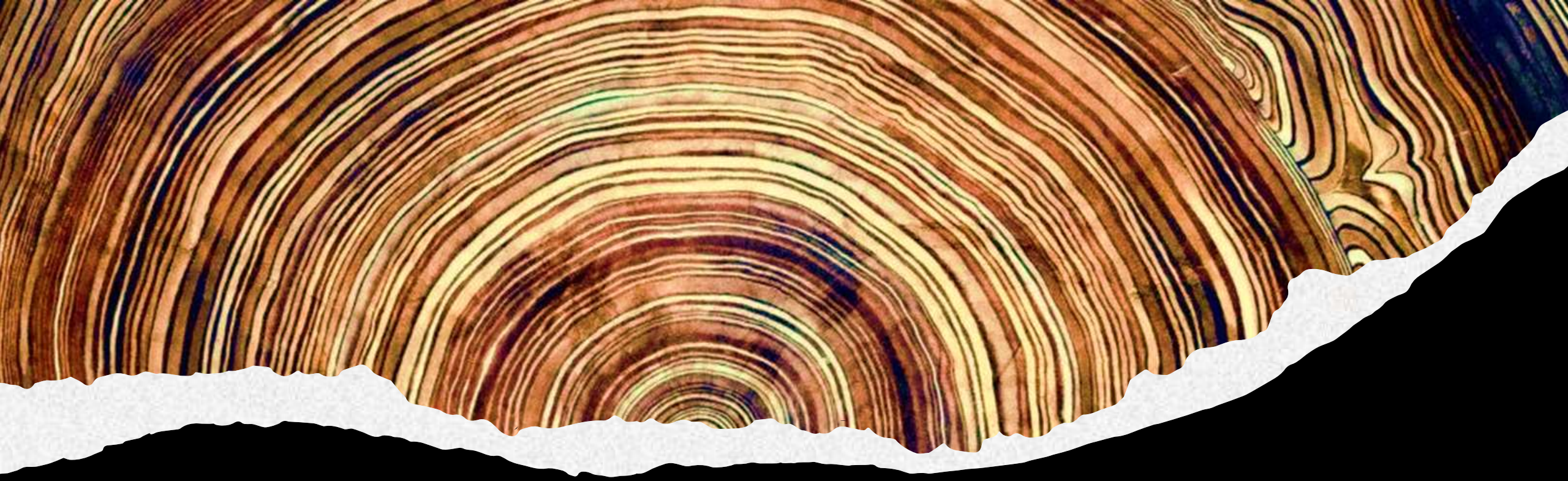
Cascadia Nitrous Oxide (N2O) Collaborative

- Dr. Stewart Brown, Vancouver General Hospital
- Dr. Brian Chesebro, Providence Health
- Geoff Glass, Providence Health
- Hillary Greenwood, Practice Greenhealth
- Dr. Liz Hansen, Seattle Children's Hospital and University of Washington (UW)
- John Leigh, CommonSpirit Health (Virginia Mason Franciscan Health in WA)
- Adam Lough, Allegheny Health Network and UW Executive MHA program
- Andy Mason, Providence Health
- Brian Nelson, PeaceHealth Southwest Medical Center
- Srini Pendikatla, Seattle Children's Hospital
- Kaeleigh Sheehan, Legacy Health
- Dr. Wyn Strodtbeck, Virginia Mason Medical Center




AGENDA

1. Introduction – John Leigh, PNW Sustainability Director, CommonSpirit Health
2. Providence Health's research, assessment and solutions
   - Dr. Brian Chesebro, Anesthesiologist
   - Andy Mason, Regional Facility Director
3. Q&A with Dr. Chesebro and Mr. Mason
4. Hospital case studies
   - Vancouver (B.C.) General Hospital – Dr. Stewart Brown, Anesthesia Fellow
   - Virginia Mason Medical Center – Dr. Wyn Strodtbeck, Anesthesiologist
   - PeaceHealth Southwest Medical Center – Brian Nelson, Sustainability Manager
   - Seattle Children's Hospital – Dr. Liz Hansen, Anesthesiologist
5. Opportunity for post-webinar implementation assistance – Adam Lough
6. Discussion and continued Q&A



Baseline Polling Question

Do you know the principal type of Nitrous Oxide medical gas system your organization uses today?

Nitrous Oxide Mitigation

Andy Mason

Facility Director
Providence St Vincent Med Center

Brian Chesebro MD

Medical Director- Environmental Stewardship
Providence Health

Nitrous Oxide (N_2O)

Clinical Uses

- adjunct to general anesthesia
- sedation / analgesia
- cryoablation (cardiac, GI)
- abdominal insufflation (?!?!?)

Side-effects

- nausea/vomiting
- inhibition of methionine synthase
  - neuropathies
  - bone marrow suppression
  - myocardial/vascular injury

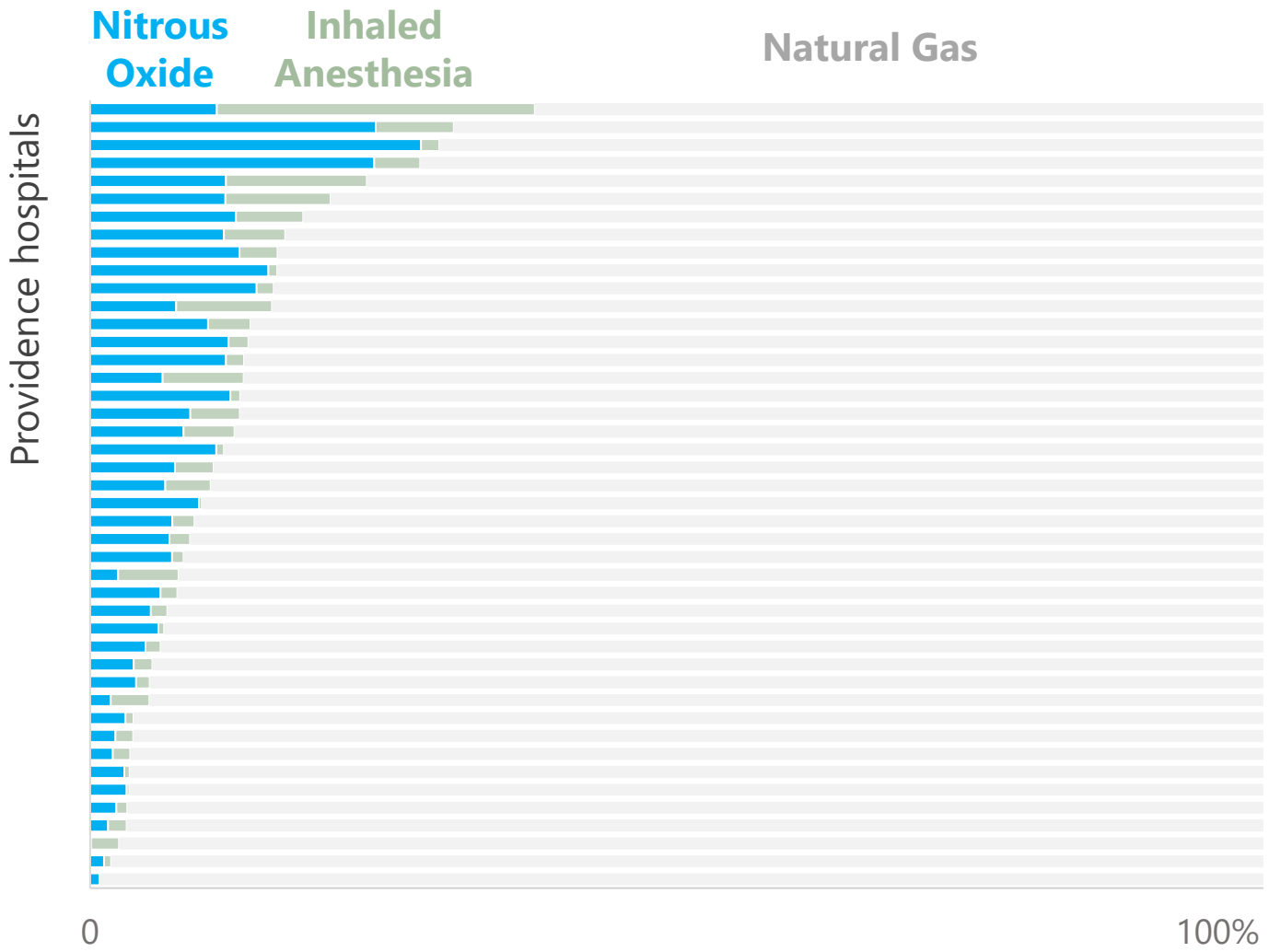
Occupational Exposure

- OSHA (25 ppm)
- spontaneous abortion
- acute intoxication

Inhaled Anesthetics

	desflurane	sevoflurane	isoflurane	**nitrous oxide**	
MAC_{40}	6.6 %	1.8 %	1.2 %	**104 %**	(clinical potency)
GWP_{100}	2540	130	510	**265**	(emissions intensity)
Atm lifetime	14	1.1	3.2	**114**	(atm lifetime- yrs)
					
	bottles	bottles	bottles	**tanks**	

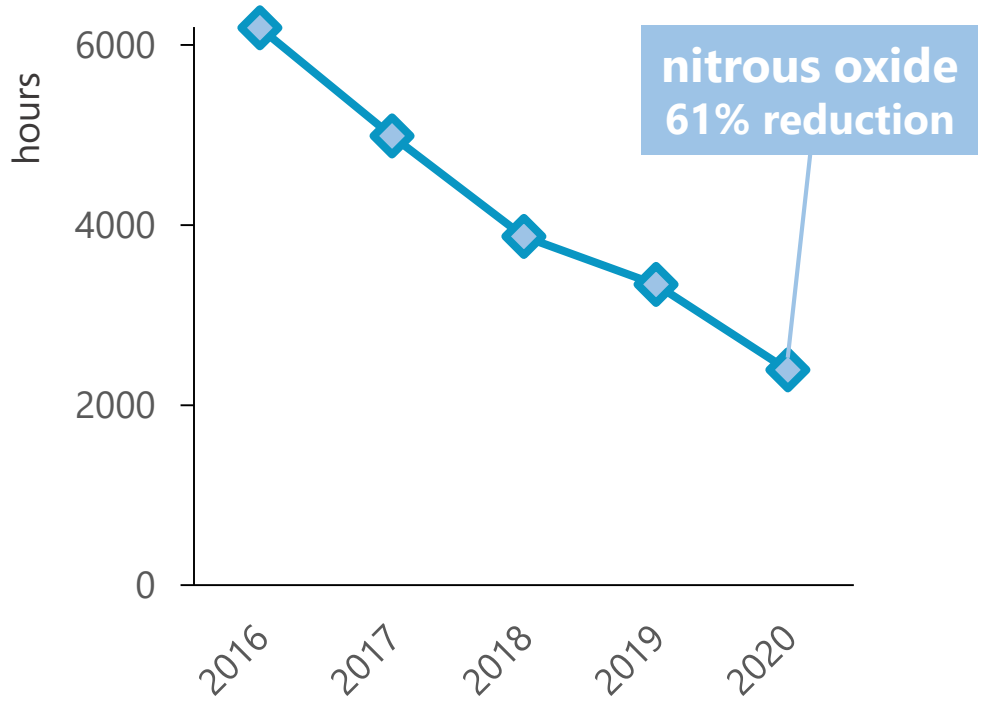
Medical gases contribute up to 40% of hospitals' direct emissions.



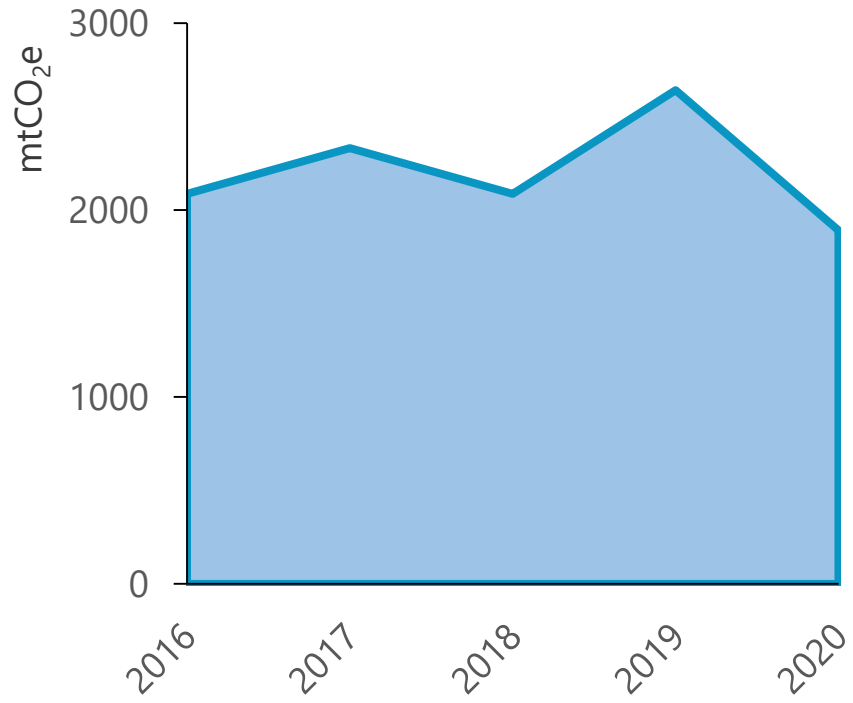
Clinical nitrous oxide use is not a primary driver of emissions.

Providence Oregon

Clinical use



GHG emissions

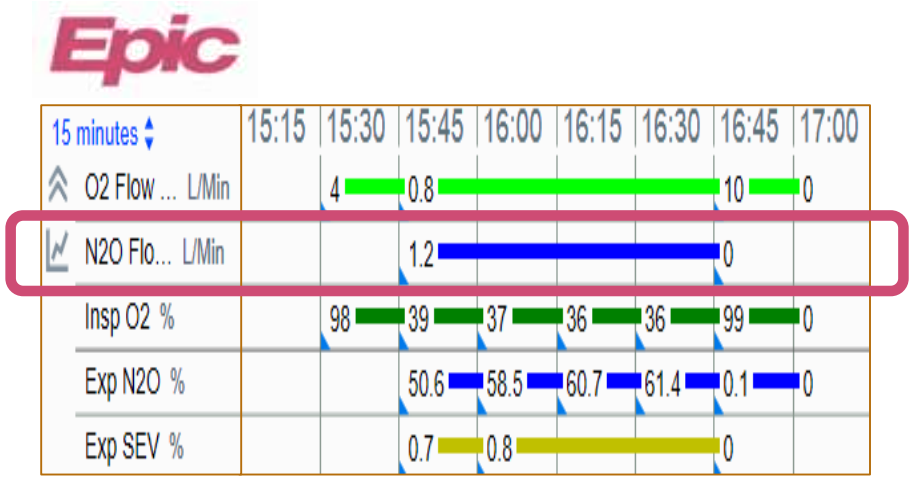


Assess system efficiency with data.

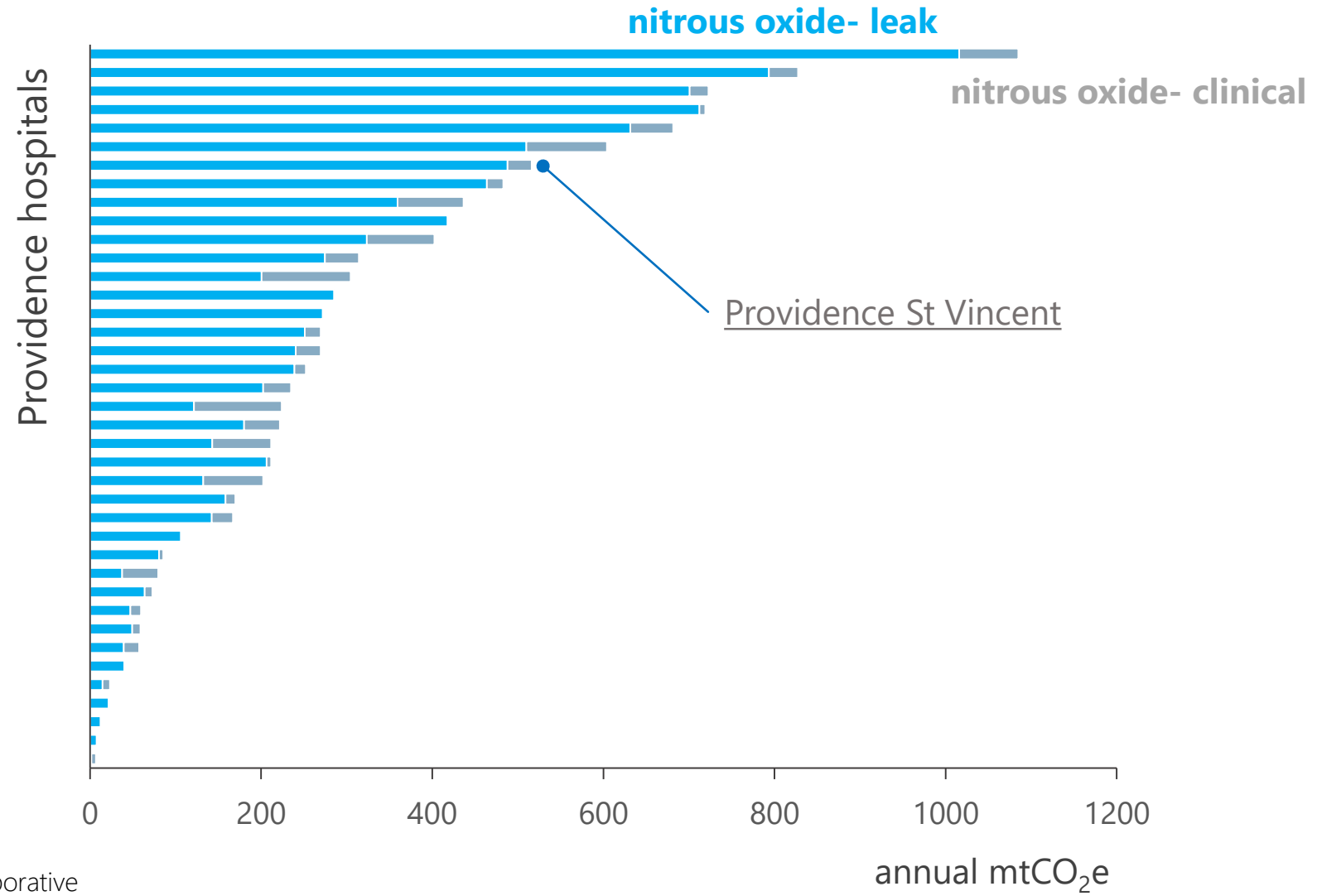
supply

	Item Desc	Qty Tanks	Nitrous Oxide (lbs)	Nitrous Oxide (Liters)
central	NITROUS OXIDE LIQ USP LC180 - 350 PSI	11	**4180**	**1,032,460**
	NITROUS OXIDE USP 50LB	6	**300**	**74,100**
cryosurgery	NITROUS OXIDE 99.5% CR 10#	21	210	51,870
	NITROUS OXIDE USP 20LB -	5	100	24,700
portable	NITROUS OXIDE USP E -	13	91	22,477
	NITROUS OXIDE USP - E 20	2	14	3458

clinical use



Facility nitrous oxide leaks are common.

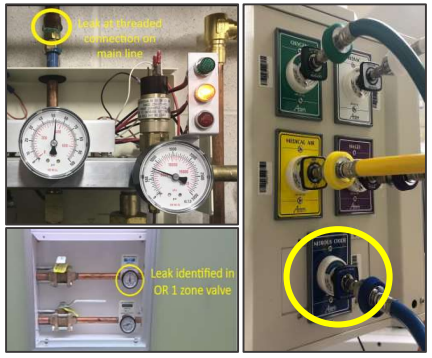


Nitrous oxide losses can occur throughout the pathway…

Supply
Tank design

liquid gas

Delivery
Manifold
Pipeline
Zone valves, gauges
Wall outlets
Anesthesia machine



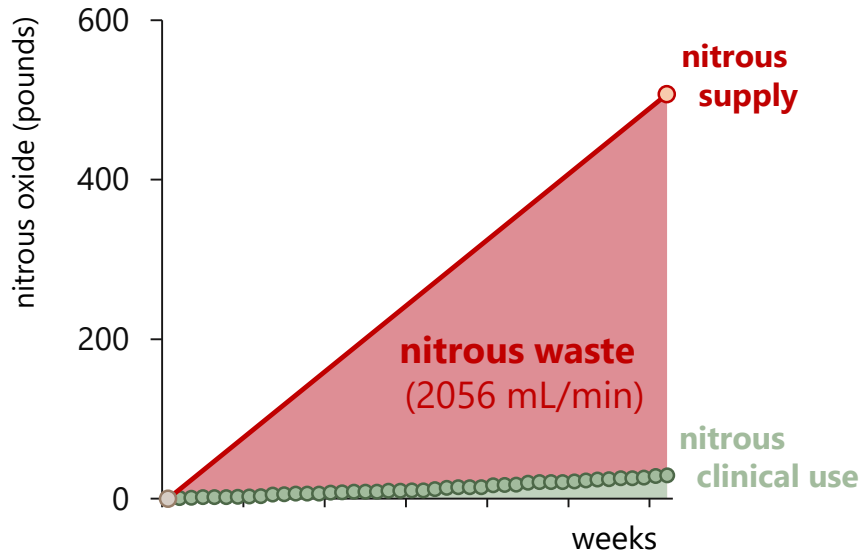
Clinical Use
Over-use (practice habits)
Inefficient use (high fresh gas flows)
Beyond anesthesiology
Anesthesia machine turnover/shutdown

Disposal
Residual volume

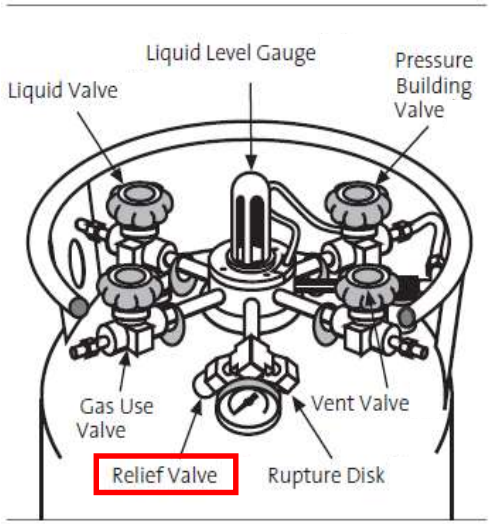
Cryogenic containers release pressure (leak) by design.

Providence St Vincent Medical Center

Central cryogenic liquid



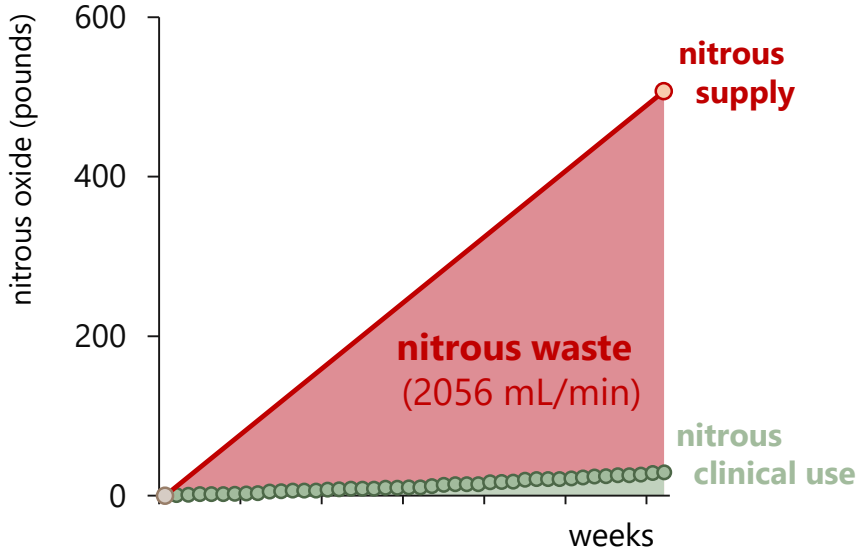
cryogenic containers



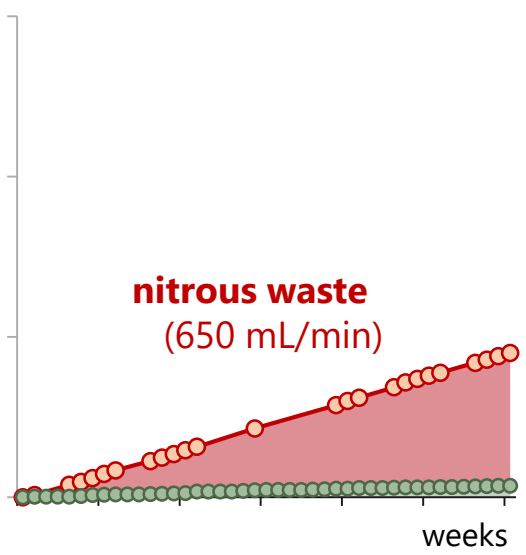
Compressed gas cylinders do not leak, but downstream components do.

Providence St Vincent Medical Center

Central cryogenic liquid



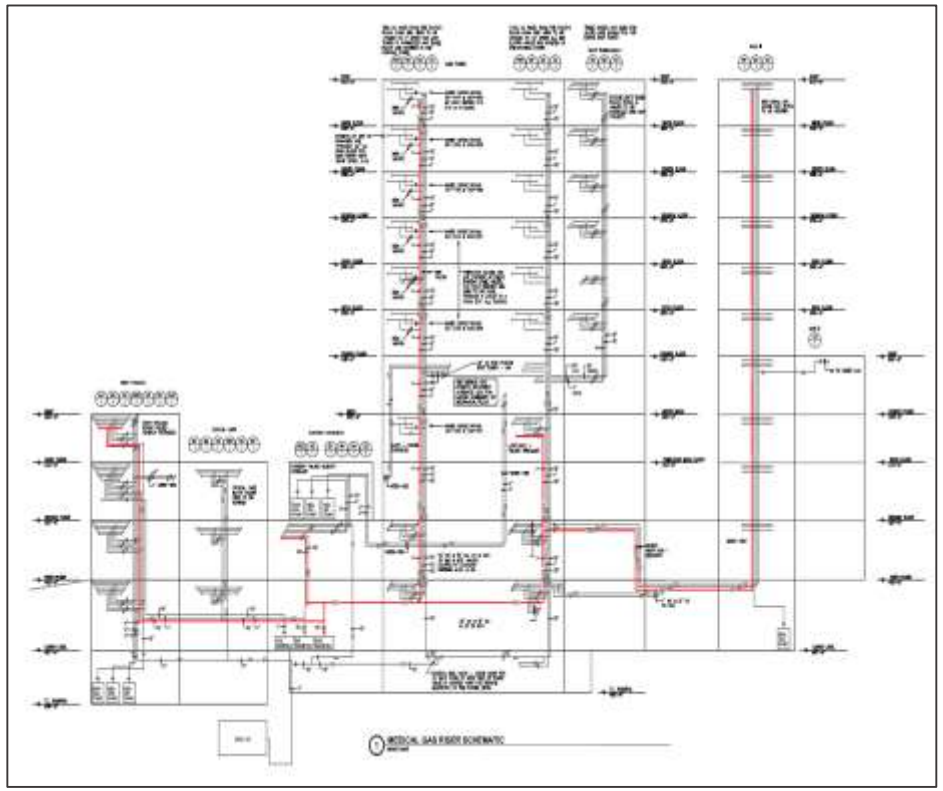
Central compressed gas



Leaks can occur throughout the delivery system.

Delivery system leak assessments are not worth the trouble.

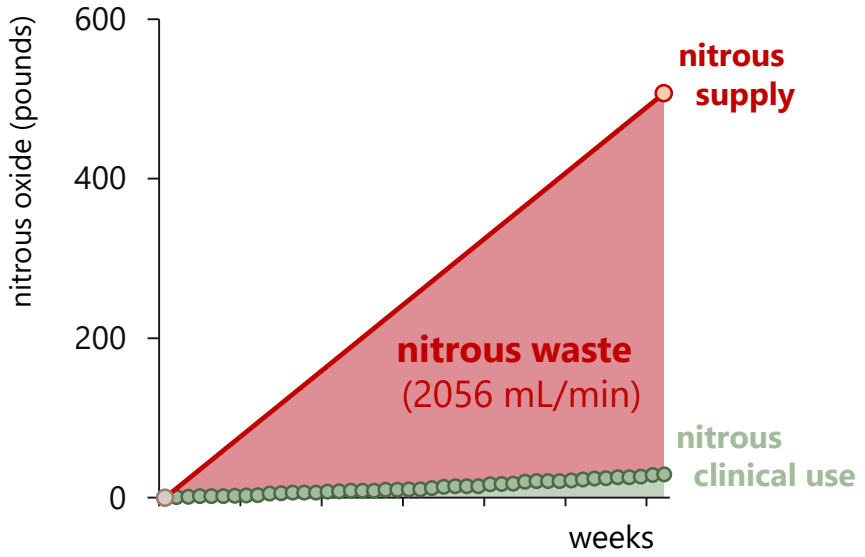
- difficult, expensive, time-consuming, *qualitative*.



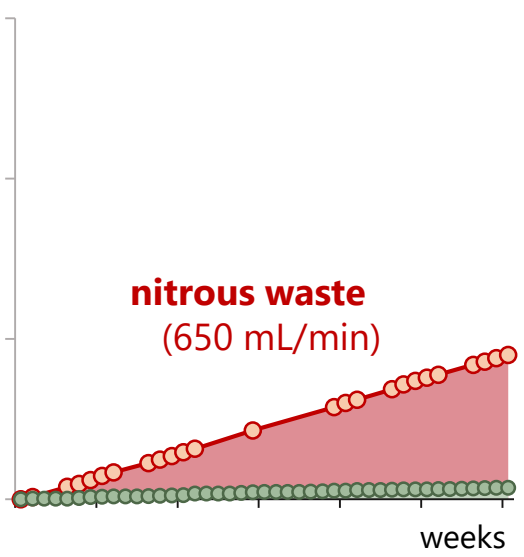
Portable nitrous oxide cylinders can bypass the central supply system.

Providence St Vincent Medical Center

Central cryogenic liquid



Central compressed gas

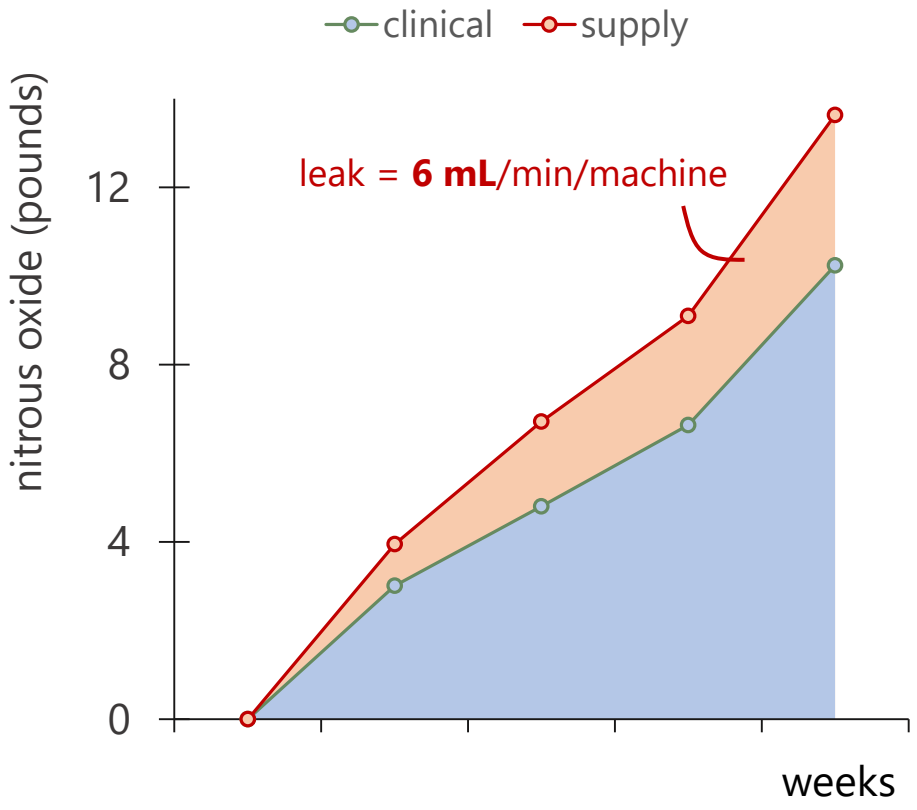


Portable Tanks…?

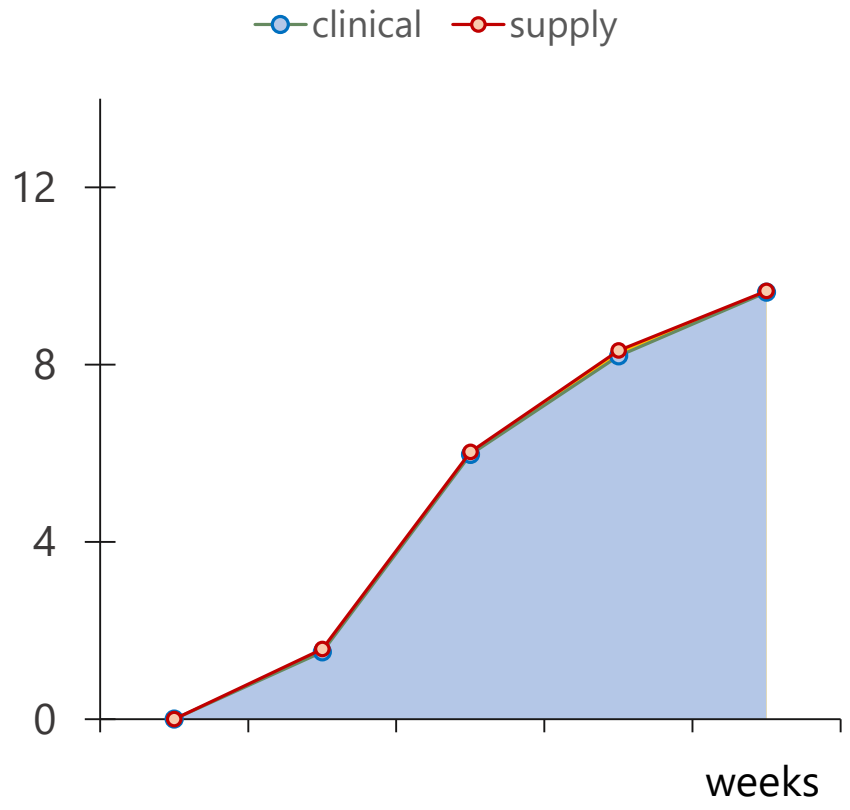
Closing the E-cylinder post-valve between clinical uses improves efficiency.

* GE Aisys C2 anesthesia machines

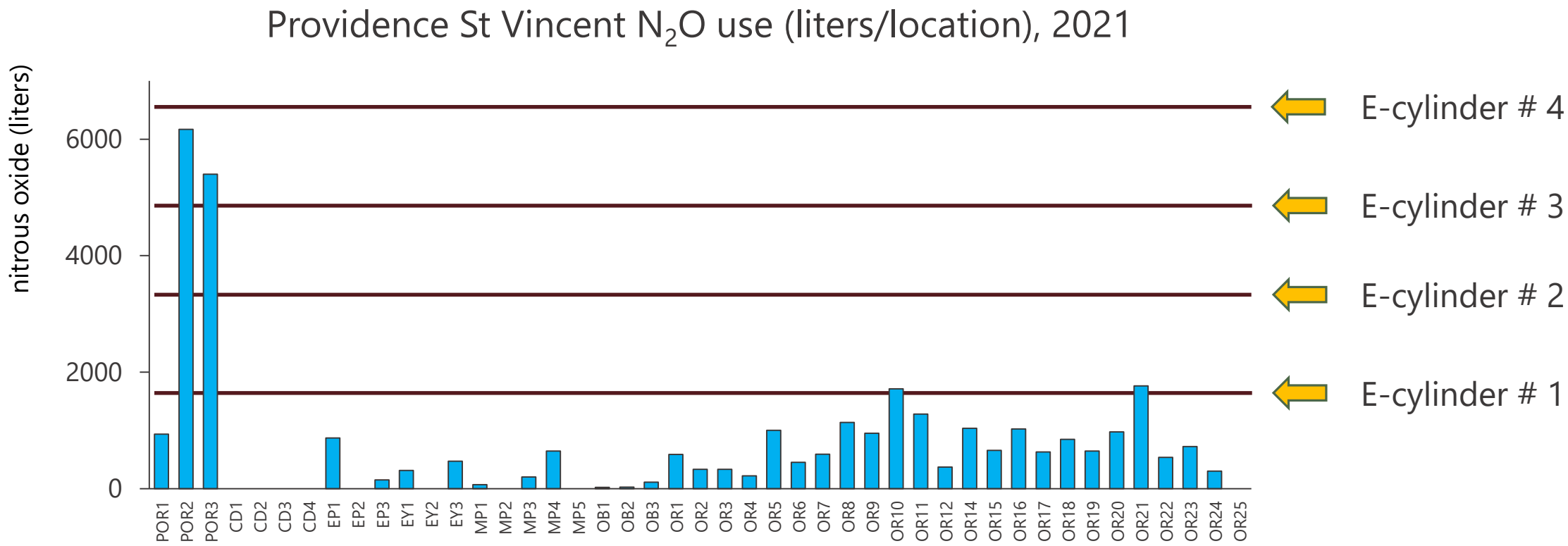
E-cylinder (OPEN)



E-cylinder (CLOSED)



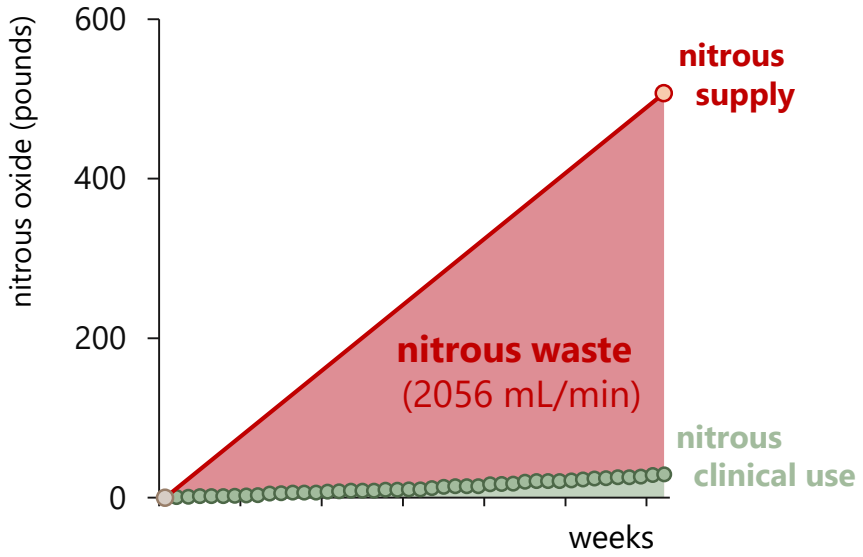
Estimate cylinder exchange frequencies by location.



Portable cylinders are efficient in hospital-wide practice.

Providence St Vincent Medical Center

Central cryogenic liquid



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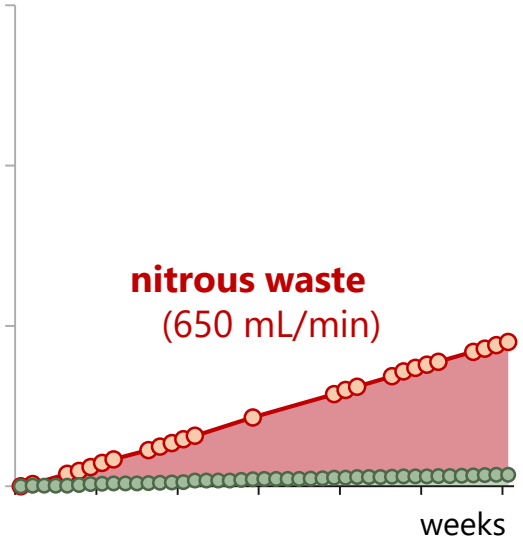
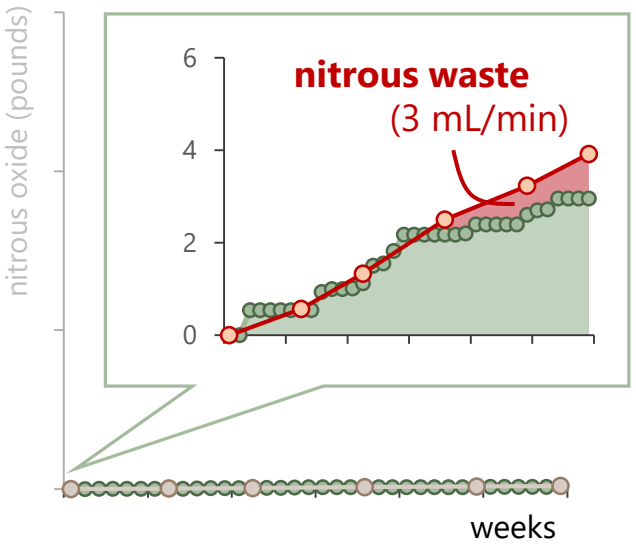


Portable compressed gas



There are multiple benefits to using portable N_2O cylinders.

COST

- financial
- **environmental
- social

First Steps Forward-

Assemble your Team-

- Anesthesiology Champion
- OR Director Champion
- Facilities Champion
- Hospital Leadership

Three Phases-

1. Assessment- impact, opportunity, risk
2. Establish portable supply
3. Decommission central system

Assessment-

Anesthesiology Champion

1. gather **clinical** use (L) data
   - by location
   - by clinician
2. determine out-of-OR uses
   - departments
   - indications
   - delivery system(s)

OR Director Champion

1. N_2O E-cylinder inventory
   - by location
2. Anesthesia machine inventory
   - make/model

Facilities Champion

1. gather procurement data
   - medical gas vendor
   - by supply tank type
2. wall outlet inventory
   - identify hospital depts
   - central system access points

Calculate **clinical** N_2O GHG emissions and % preclinical loss/leak.

Normalize nitrous oxide utilization ($mtCO_2e$ / OR / year) to benchmark & gauge opportunity.

Calculate anticipated E-cylinder exchange frequency for each location (supply logistics).

Assessment-

Data Reporting-

Nitrous Oxide- (electronic medical record)							
Date	Procedure	Surgical service	Anesthesia clinician	Anesthesia type	Operating room	total N_2O volume (liters)	total N_2O time (minutes)

Nitrous Oxide- (medical gas vendor)							
Delivery date	Item description (cylinder type)	Amount N_2O (lbs) / cylinder	# cylinders / order	$ / order	Facility name	Ship-to address	Name- person placing order, &/or Acct #

Normalization-

	Low performance									High performance
	0-10%	**11-20%**	**21-30%**	**31-40%**	**41-50%**	**51-60%**	**61-70%**	**71-80%**	**81-90%**	**91-100%**
Nitrous Oxide Use Efficiency ($mtCO_2e$/OR/yr)	> 50	25 - 50	20 - 25	15 - 20	10 - 15	7.5 - 10	5 - 7.5	2 - 5	1 - 2	< 1

Establish Portable Supply- if needed, procure N_2O E-cylinders & retrofit anesthesia machines

Anesthesiology Champion

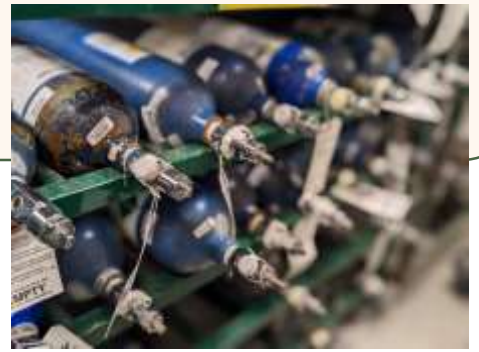
1. **Clinical operating conditions**
   - post valve CLOSED between uses
   - cylinder exchange trigger
   - anesthesia machine alarms (display, threshold, volume)

OR Director Champion

1. **Ordering** / Storage
   - personnel, PAR levels
2. **Exchange**
   (Anesthesia Technicians)

Facilities Champion

1. **Storage**
   - location(s), PAR levels
   - NFPA smoke compartments



Define N_2O E-cylinder management process, protocols, education.

Decommission Central Supply-

**** consult Medical Gas Supply Contractor ****

Anesthesiology Champion

1. Be available
2. Be supportive
3. Communicate

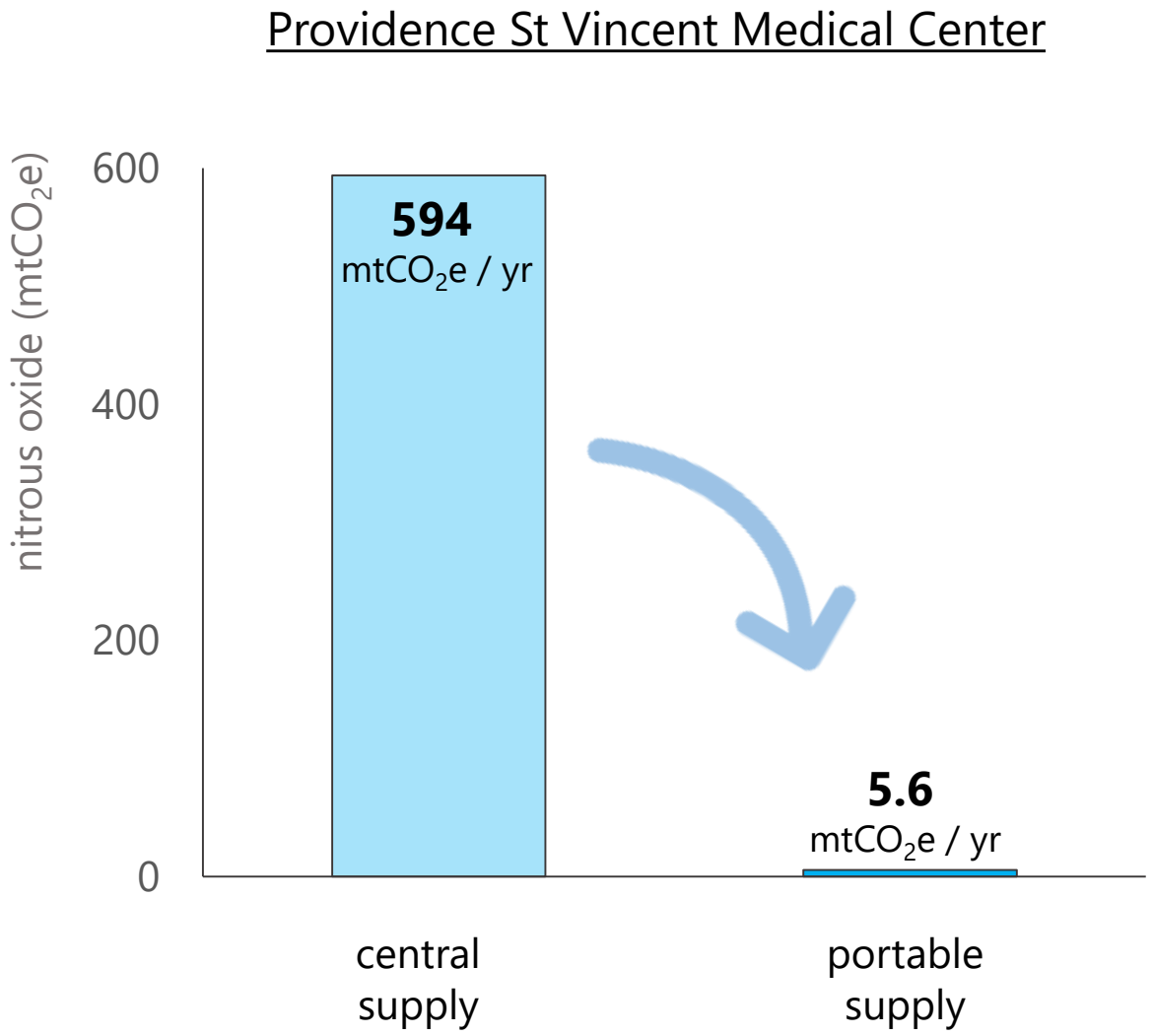
OR Director Champion

1. Be available
2. Be supportive
3. Communicate

Facilities Champion

1. Identify low pressure alarms
   - type(s)
   - locations
   - disable procedures
2. Depressurize central system
   - disable low pressure alarms
   - close proximal source valve
3. Decommission central system
   - remove drop hoses
   - blank off N_2O wall outlets
   - disable & label system zone valves
   - remove central manifold and tanks

Transition to portable supply reduced N_2O emissions by over 99%.



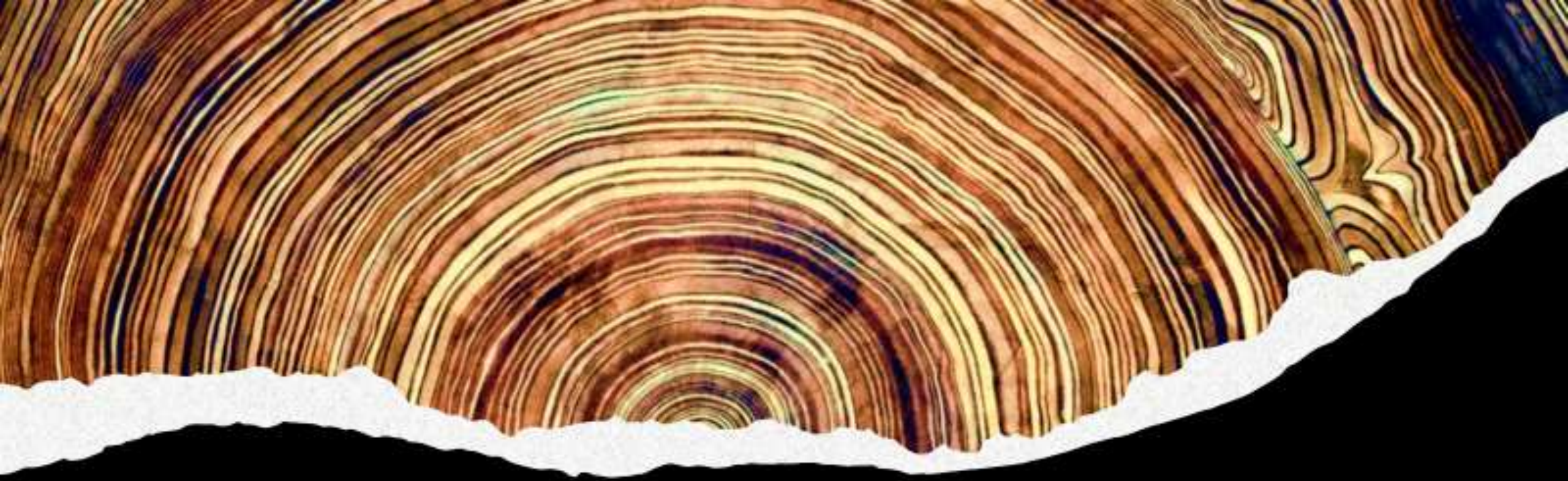
Take Home Points

- Nitrous oxide is a significant source of direct, healthcare-specific GHG emissions.
- *Most* nitrous oxide emissions are the result of inefficient facility infrastructure.
- Portable supply strategies increase overall value & can reduce emissions by 99% !

Andrew.Mason@providence.org

Brian.Chesebro@providence.org

Providence



Polling Question

To what extent has your organization considered decommissioning nitrous oxide medical gas systems?

1. Introductory remarks
2. Providence's research, assessment and solutions
   - Dr. Brian Chesebro, Anesthesiologist
   - Andy Mason, Regional Facility Director
3. Q&A with Dr. Chesebro and Mr. Mason
4. Hospital case studies
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Vancouver General Hospital's experience

Dr. Stewart Brown

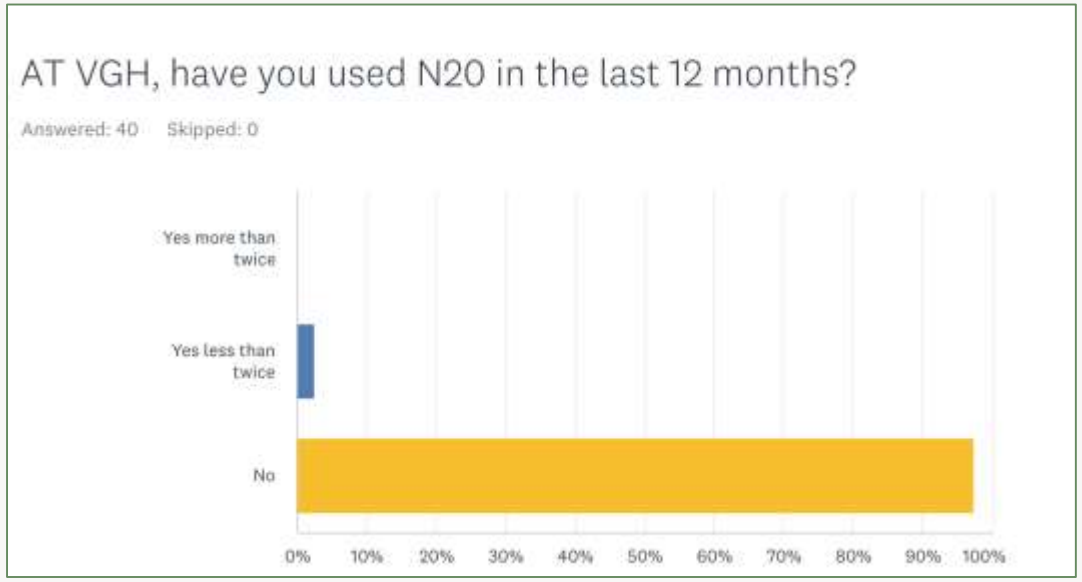
Building a case for waste reduction

- FMO → Suppliers
- 40-44 cylinders annually
- 1000kg N_2O
- Half a million liters (20c)

Measuring the deficit

Use

Survey



Data extraction

L4 fx 8

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Time	Msec Since E	Gas Control	Trend Event	EGC State	FB Reasons	IOD Reasons	EGC Chks Sta	Breath Rejec	Exit Reason	MGas Amb F	User Set Flo	Min Fl
2	14:01:58	20534263	FGC	BREATH	NON_EGC	NONE	NONE	NONE	NONE	NONE	752.76	8	
3	14:02:01	20536931	FGC	BREATH	NON_EGC	NONE	NONE	NONE	NONE	NONE	752.38	8	
4	14:02:04	20539944	FGC	BREATH	NON_EGC	NONE	NONE	NONE	NONE	NONE	752.38	8	
5	14:02:09	20545185	FGC	BREATH	NON_EGC	NONE	NONE	NONE	NONE	NONE	752.68	8	
6	14:02:12	20548248	FGC	BREATH	NON_EGC	NONE	NONE	NONE	NONE	NONE	752.76	8	
7	14:02:15	20550799	FGC	BREATH	NON_EGC	NONE	NONE	NONE	NONE	NONE	752.76	8	
8	14:02:18	20554322	FGC	BREATH	NON_EGC	NONE	NONE	NONE	NONE	NONE	752.83	8	
9	14:02:21	20556669	FGC	BREATH	NON_EGC	NONE	NONE	NONE	NONE	NONE	752.83	8	
10	14:02:26	20562127	FGC	BREATH	NON_EGC	NONE	NONE	NONE	NONE	NONE	752.68	8	
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13	14:02:35	20571415	FGC	BREATH	NON_EGC	NONE	NONE	NONE	NONE	NONE	752.61	8	
14	14:02:38	20574171	FGC	BREATH	NON_EGC	NONE	NONE	NONE	NONE	NONE	752.61	8	
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21	14:02:56	20592460	FGC	BREATH	NON_EGC	NONE	NONE	NONE	NONE	NONE	752.76	8	
22	14:02:59	20595232	FGC	BREATH	NON_EGC	NONE	NONE	NONE	NONE	NONE	752.76	8	
23	14:03:01	20597579	FGC	BREATH	NON_EGC	NONE	NONE	NONE	NONE	NONE	752.76	8	
24	14:03:07	20602666	FGC	BREATH	NON_EGC	NONE	NONE	NONE	NONE	NONE	752.61	8	

Timeline

DATA GATHERING

FMO

EXECUTIVE

PREPARATION + ALARMS

DECOMMISSION

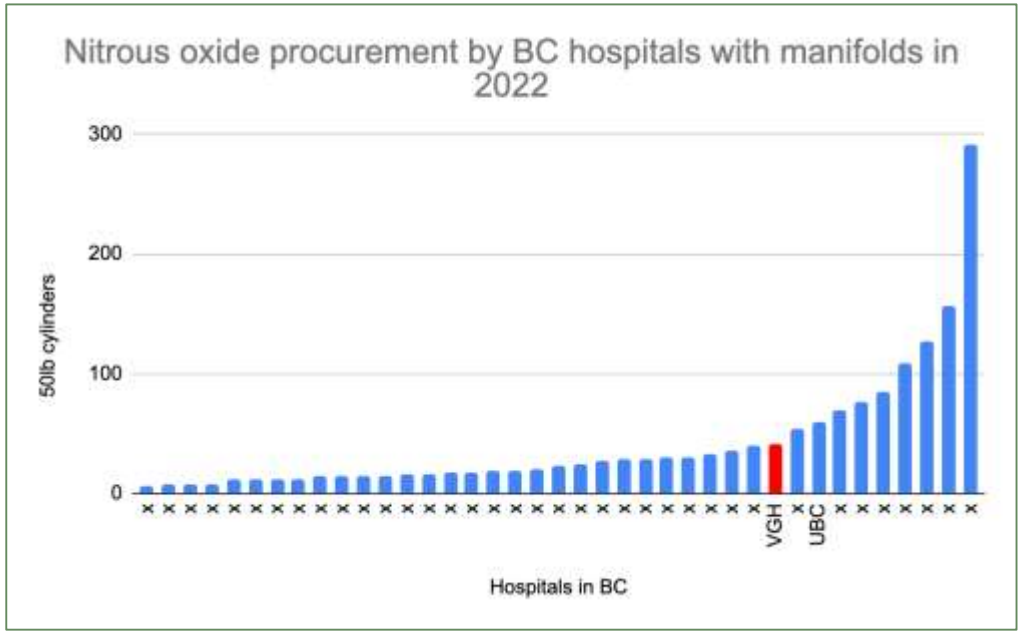
IMPACT

- $6,000 annually
- 8% of our theatre footprint

The impact of surgery on global climate: a carbon footprinting study of operating theatres in three health systems

Andrea J MacNeill, Robert Lillywhite, Carl J Brown

- More to do:



Virginia Mason Medical Center
Department of Anesthesia and Pain Medicine

Wyndam Strodtbeck, MD FASA
Chief of Anesthesiology

No disclosures or conflicts of interest

Virginia Mason Franciscan Health™

Virginia Mason Medical Center, Seattle

Independent Academic Medical Center

- 40 Anesthesiologists
- 32 Residents and Fellows
- 40 CRNAs
- 15 Anesthesia Techs

Facilities

- 29 Operating Rooms, 11 Procedure Suites
- 2 OB ORs, 4 L&D suites with nitrous oxide available
- 2 Outpatient Surgery Centers with 6 additional ORs
- Case Volume included 26,000 GA cases in 2022

Starting the journey in 2015 by reducing desflurane

2015 - Initial efforts focused on changing practice through peer persuasion including discussion at department meetings and 1:1 conversations

2016-2019

- Department protocols for desflurane use
- Remove desflurane from standard setup

2019 – Stopped purchasing desflurane and removed vaporizers

Randy Johnson, Cer.ATT and Ryan Pong, MD

	Purchases in Milliliters (ML's)							
Inhalation Gasses	2015	2016	2017	2018	2019	2020	2021	2022
Desflurane	50,400	21,600	17,280	10,080	11,520	-	-	-

January 2021 - Virginia Mason joins CSH
Earth Day 2022 – CEO Lloyd Dean announces CAP

CommonSpirit Health 2022 Climate Action Plan

CommonSpirit has committed to net-zero emissions by 2040.

What is Net-zero?

Net-zero by 2050 aligns with the Paris Climate Accord goal of limiting global temperature rise <1.5°C, helping humanity avoid many of the worst potential impacts of climate change.

In 2019, CommonSpirit's GHG footprint was **3.8 million tons of CO2 equivalent.** CommonSpirit's goal of net-zero carbon by 2040 puts us on an accelerated path to **meet the requirements of the Paris Climate Accord 10 years ahead of schedule.**

2019

CommonSpirit's starting point is a baseline greenhouse gas (GHG) footprint of 3.8 MMTCO2e, equivalent to the CO2 emissions from electricity needed to power 740,000 homes for one year[1]

2025

Supply Chain: Influenced top 30 health care vendors[2] to commit to establish science-aligned targets for reducing their Scope 1 & 2 emissions

2026

Climate Resilient Communities: Developed health equity strategies in the clinical, and community and public policy settings

2030

Buildings and Operations: Reduced operational emissions by 50%[3], equivalent to 442,000 MT CO2e

Supply Chain: Engaged top 67% [illegible] vendors2 to establish science-aligned targets for their Scope 1 & 2 emissions

Climate Resilient Communities: Advanced clinical best practices associated with climate effects on health and creating climate resilient communities across CommonSpirit's 21 states

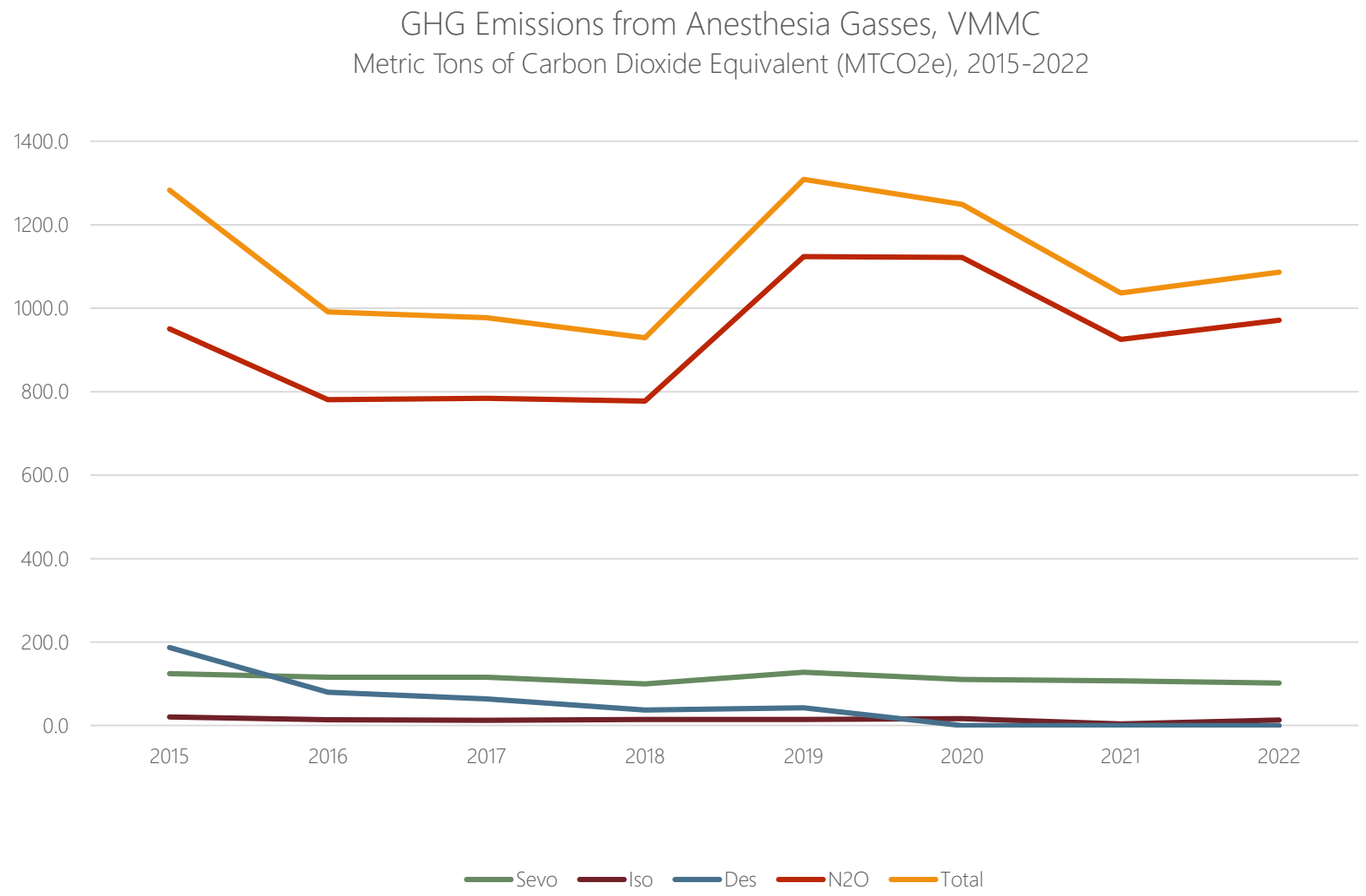
2040

Buildings and Operations: Achieved net-zero GHG emissions across the entire buildings portfolio

Supply Chain: Achieved 90% absolute reduction3 in Scope 3 emissions

Climate Resilient Communities: Excelled in delivering consistent clinical practices and in partnering with others to improve community health and support the goals of the Paris Accord

Quality 2022 – Understanding VMMC's Nitrous Oxide Use



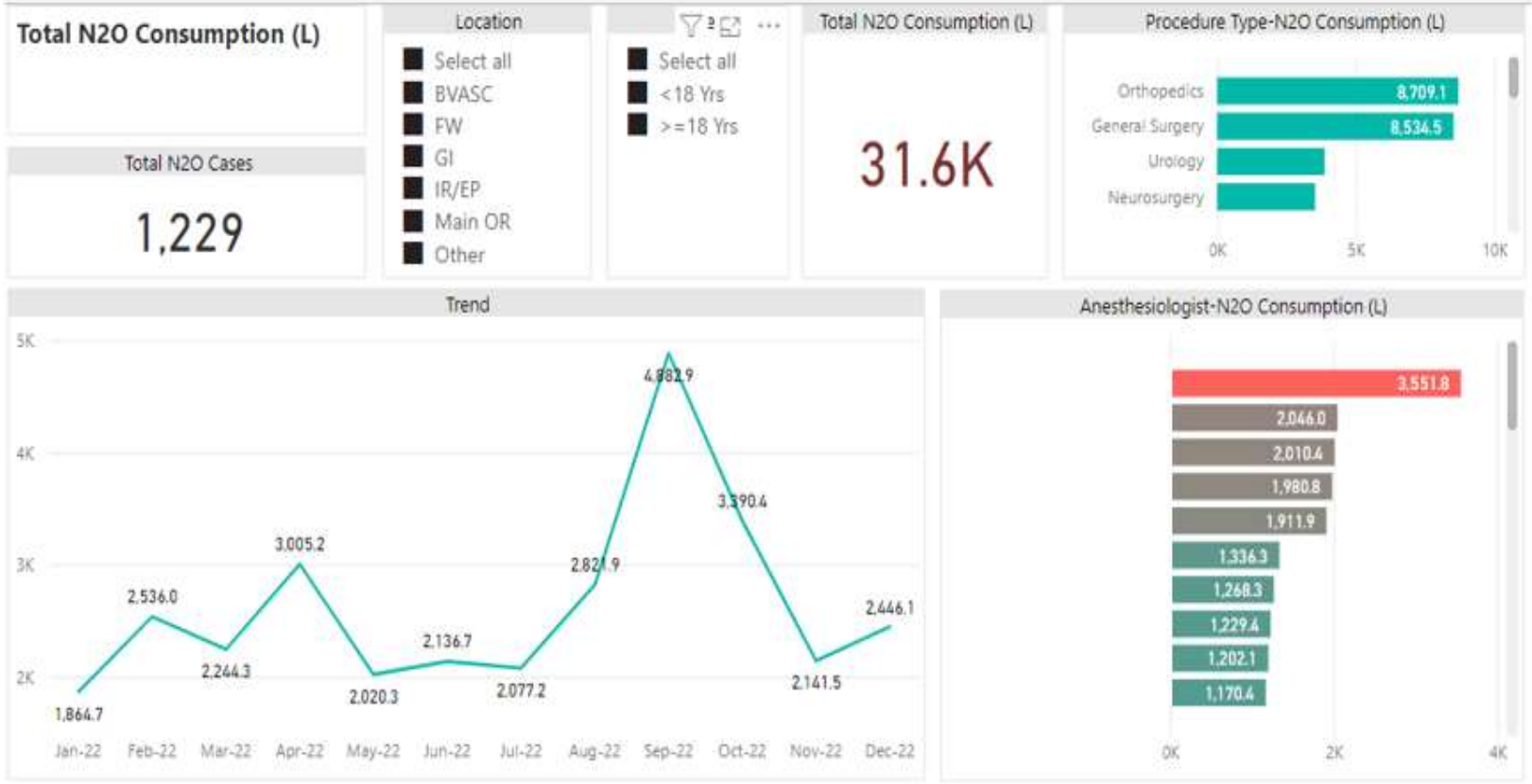
VMMC Clinical Nitrous Oxide use vs. Purchased Quantity

Hospital Name	2022 Total Sales	2022 Volume	Cryogenic volume	Large pressurized tank volume	E-cylinder volume	Total pounds
Virginia Mason Medical Center	$20,264.50	7182 LBS	6544 LBS		638 LBS	7182

31,600 L N20 used for patients

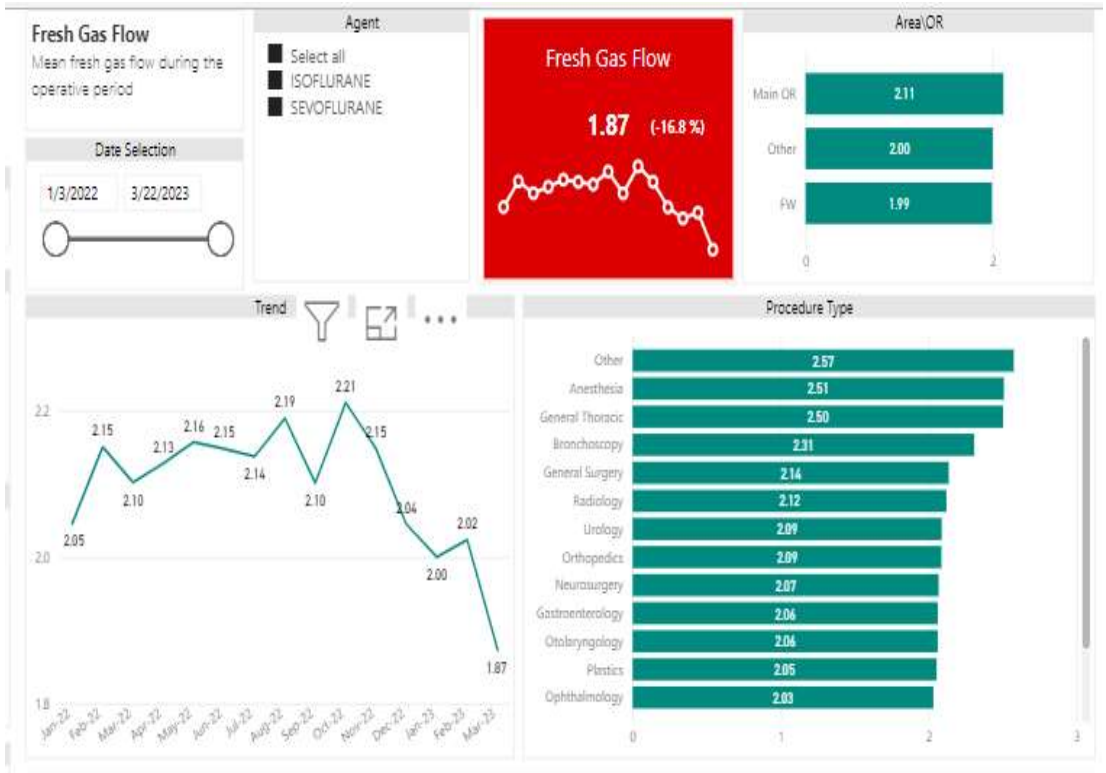
1.9% - clinical use

98.1% - environmental waste

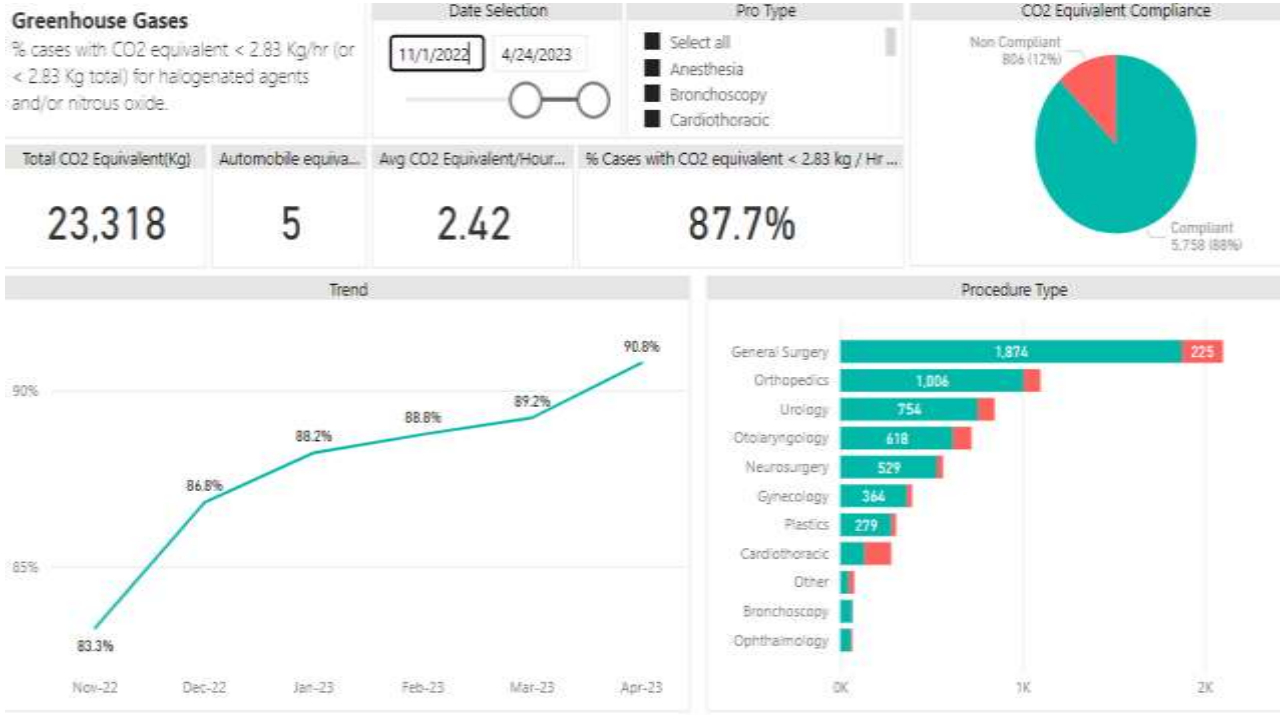


Clinical Decision Support and Personal Metrics

Smart alerts pop up after first 20 minutes of case to remind anesthesia providers to reduce fresh gas flows on anesthesia machine and again after any period of increased FGF



Anesthesiologists, CRNAs and residents can now view their personal performance on meeting the MPOG SUS-02 standard for GHG emissions during General Anesthesia



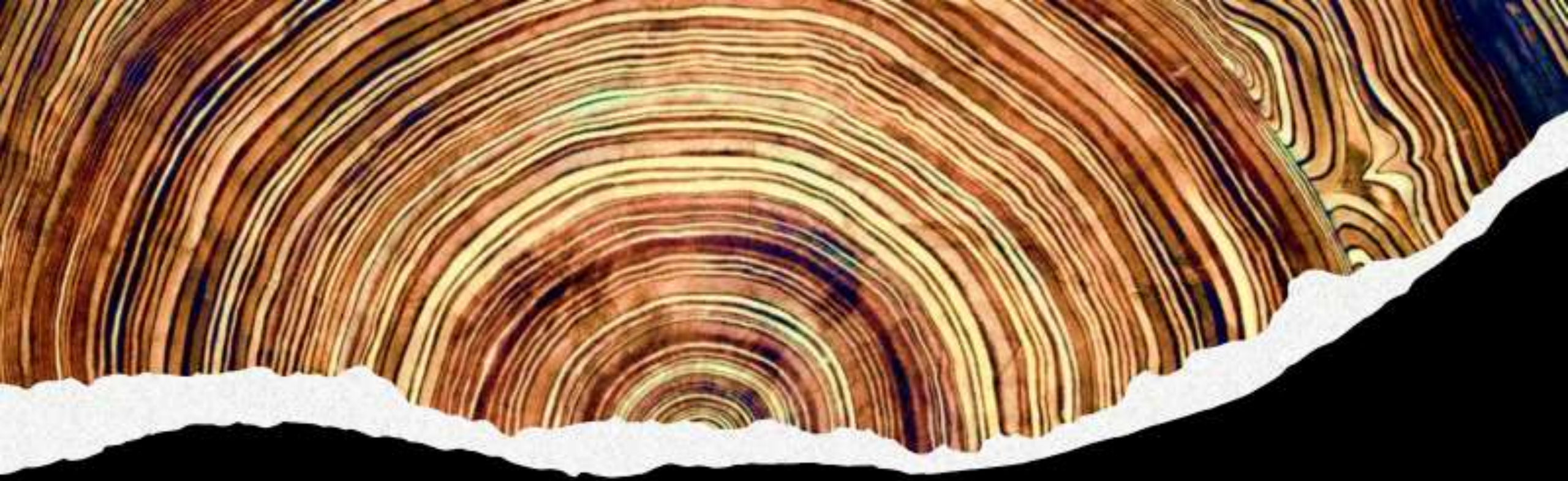
CO2 absorbent selection

WA Dept of Ecology required hazardous waste disposal of our legacy CO2 absorbent due to high pH (corrosive waste)

- >2 tons shipped out of state at $9600/year cost

Changed to new absorbent at end of 2022

- Permitted in regular trash due to lower pH
- No significant risk of Compound A formation at low fresh gas flows
- Does not generate carbon monoxide under any clinical setting
- Similar acquisition cost to the health care system
- Results for 2023 TBD



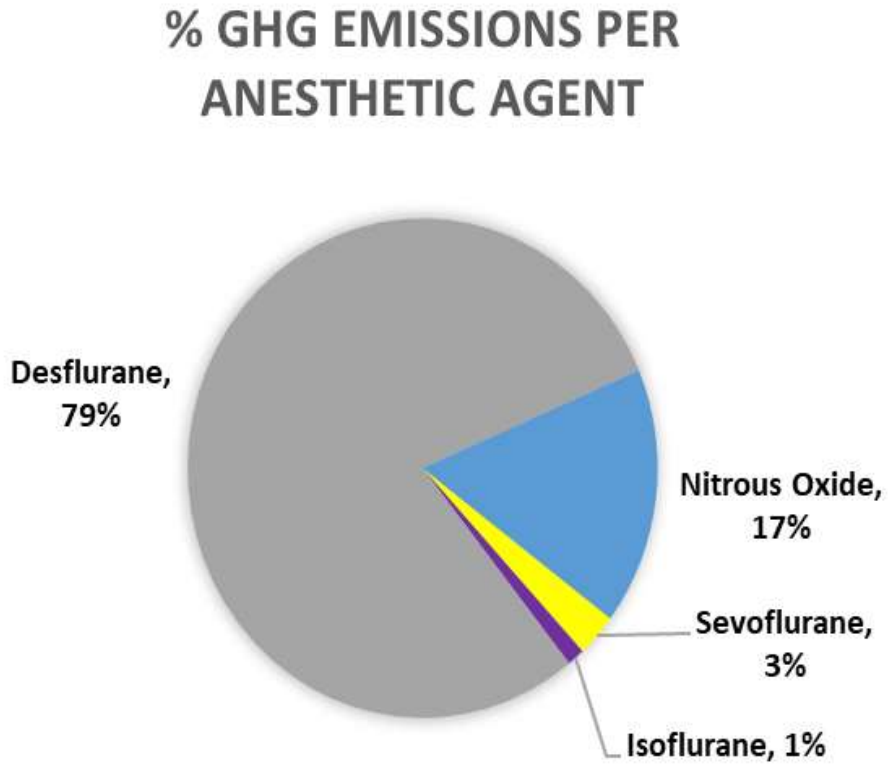
Polling Question

What concerns or barriers do you see when starting to decommission nitrous oxide medical gas systems in your organization?

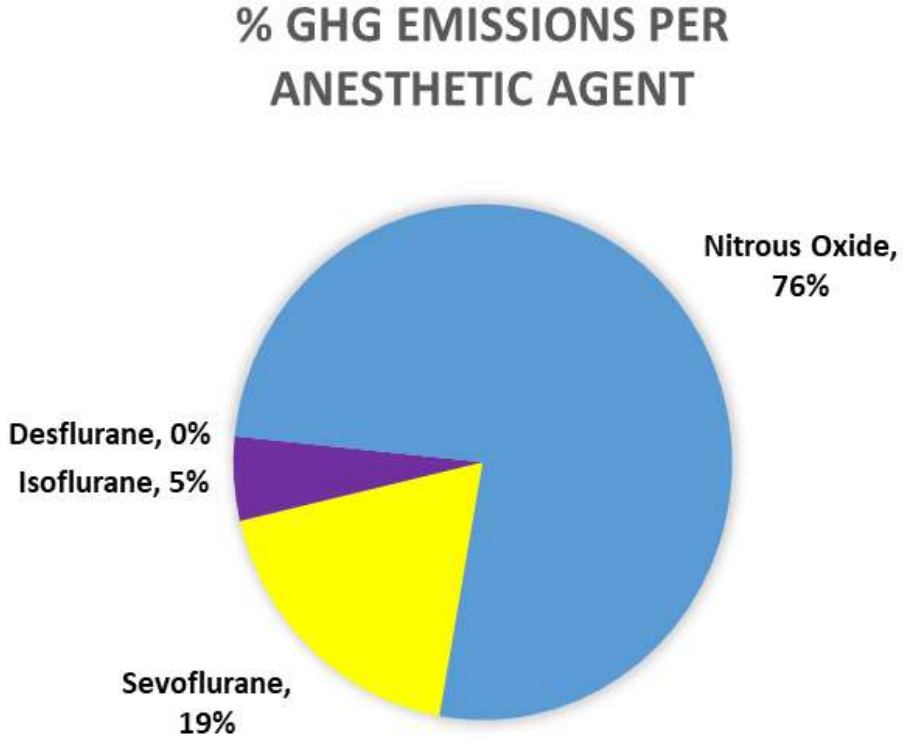
Brian Nelson
PeaceHealth Southwest Medical Center
Sustainability Programs Manager
bnelson5@peacehealth.org

Inhaled Anesthetics Footprint @ PeaceHealth

2017



2022



Nitrous Supply @ PeaceHealth

What are we currently using?
How much do we purchase?
How much do we use clinically?

Two towers with their own gas rooms:

- one containing 24 56-lb H-cylinders
- and the second with 11 56-lb H-cylinders

Supplied Annual Purchase N2O

What are we currently using?
How much do we purchase?
How much do we use clinically?

Material		Total Billed Revenue	Quantity (Base UoM)	Volume (Base UoM)	Product Revenue
NS CC10ACT50C	NITROUS OXIDE CRYOCATH 10LB ALUM C/O	$ 1,778.60	14 CL	140 LBS	$ 1,441.68
NS USP20	NITROUS OXIDE USP 20 LBS	$ 86.22	1 CL	20 LBS	$ 52.33
NS USP56	NITROUS OXIDE USP SIZE 56LBS	$ 3,943.64	37 CL	2,072 LBS	$ 3,705.95
NS USPE	NITROUS OXIDE USP E CGA 910	$ 191.99	6 CL	42 LBS	$ 158.10
NS USPEAC	NITROUS OXIDE USP EA CGA 910 C/O	$ 133.62	1 CL	7 LBS	$ 99.73

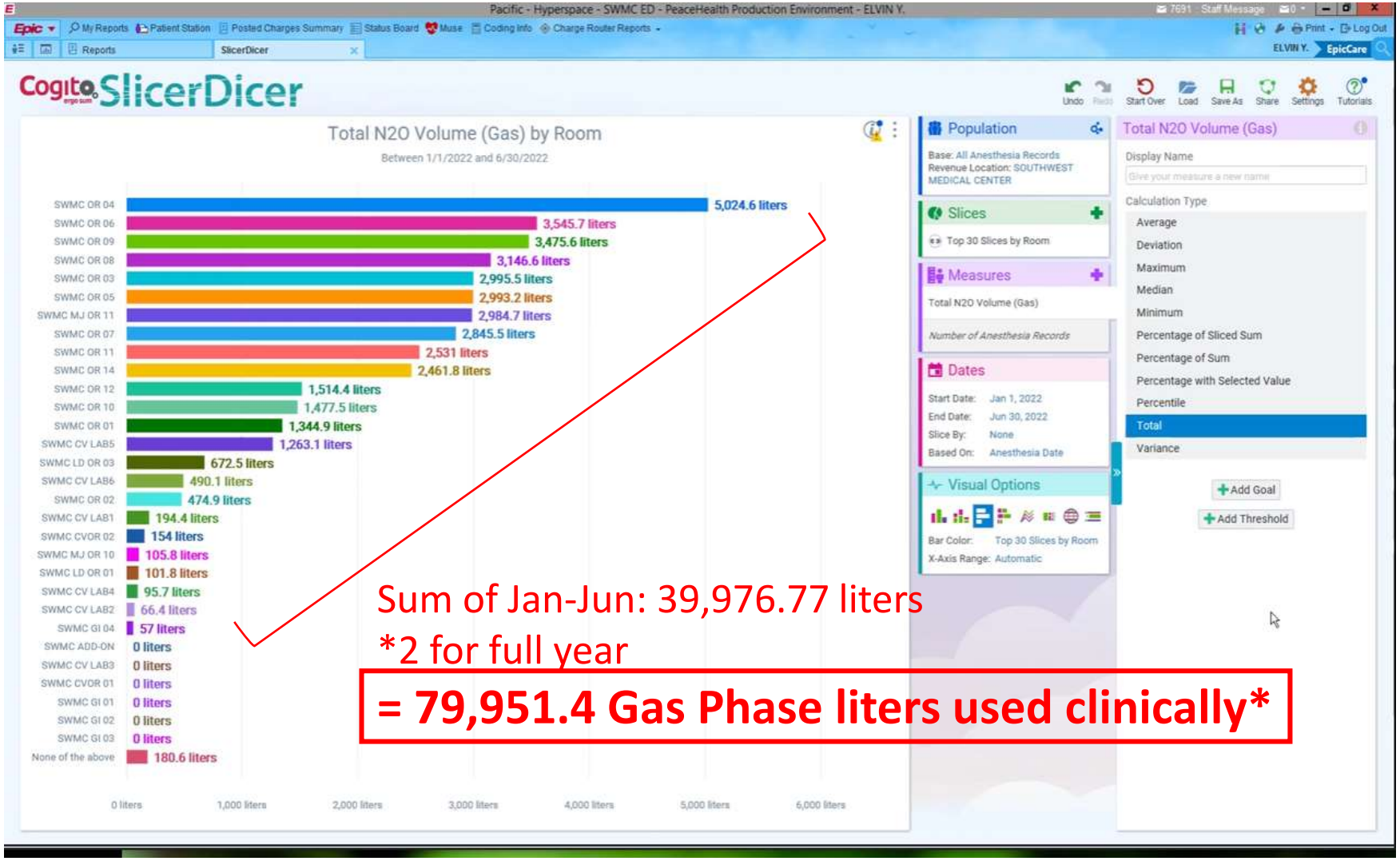
Conversion: 230.6 gas phase liters / pound

Tank	Lbs	Gas Phase Liters
USP56	2,072	477,803

Gas Phase Liters

Clinical N2O Usage

What are we currently using?
How much do we purchase?
How much do we use clinically?



Sum of Jan-Jun: 39,976.77 liters
*2 for full year

= 79,951.4 Gas Phase liters used clinically*

*Note: this usage was errant as Epic was previously over-counting the minutes of N2O usage

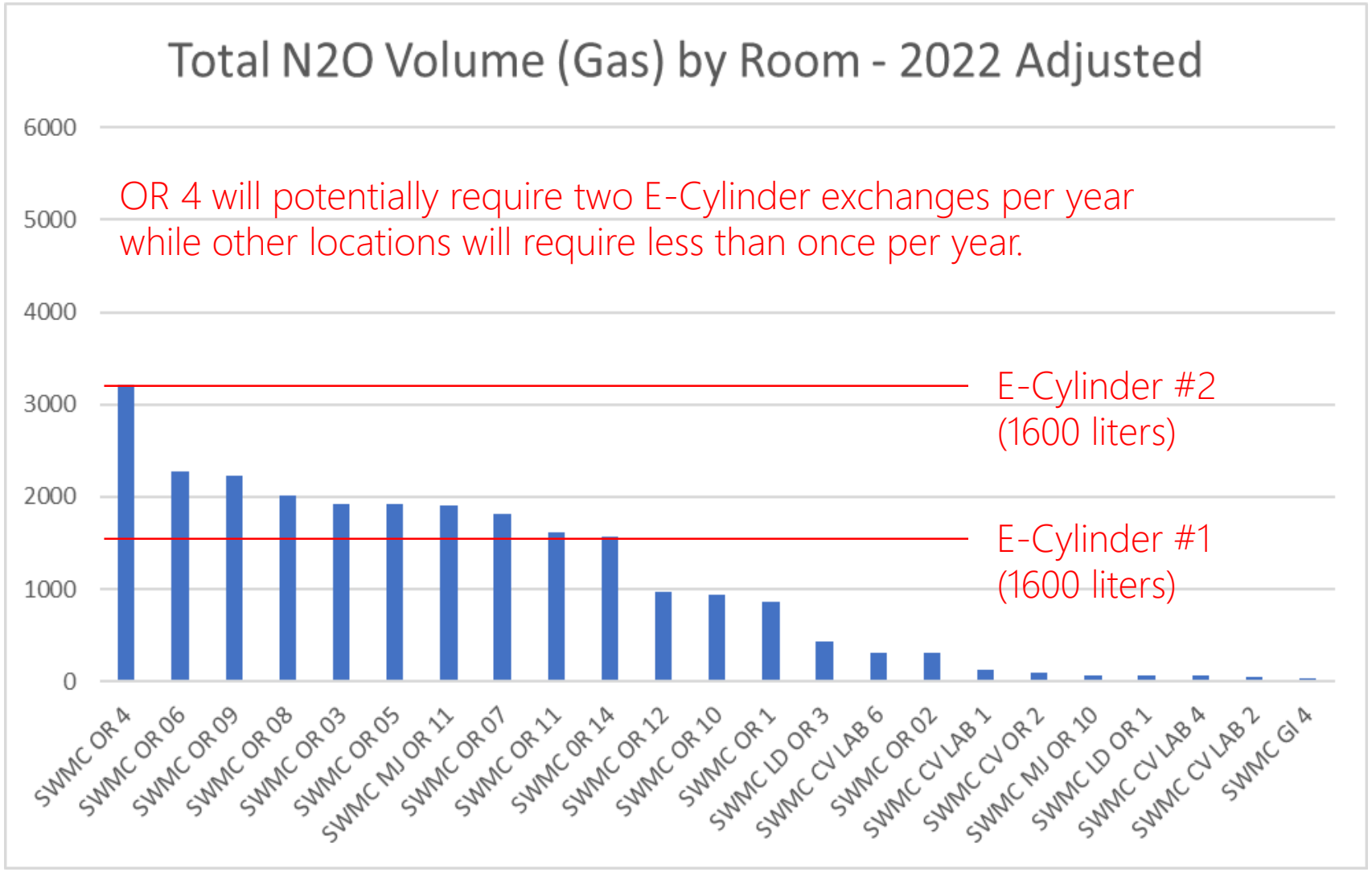
Results

For the full year that we reviewed, our results were consistent with Providence's experience.

...we used **~11%** of our supplied gas while other the remaining **~89% was wasted** and/or leaked into the hospital.

Current Recommendation

- Prove the process workflow by starting with Neuro and ENT (as the heaviest users) and moving to e-cylinders only.
- “Turn the e-cylinders on/off” education to providers and techs.
- Unplug the N2O hoses in Neuro & ENT in OR’s 4-9 (but leave the hose as it’s part of a bundle). Place “Please use the cylinder” stickers over the machine ports.
- Once workflow proven after a three-month trial, expand to all ORs for an additional three-month trial.
- Begin the effort to decommission the delivery system entirely.



- Only change to handling and ordering workflow is increasing our PAR level by 1
- Facilities on board with recommendation
- The ONLY new step is for providers to turn their cylinders on/off for each case.

Seattle Children's Named a Climate Champion

Seattle Children's is proud to have been named a 2021 Climate Champion by Health Care Without Harm! We received Silver certification in both Climate Resilience and Climate Leadership.

2022 Climate Champion

- Silver in Climate Resilience
- Gold in Climate Leadership

Seattle Children's

Seattle Children's hospital campus aims to be carbon neutral by 2025 with climate work across several areas including health care delivery, supply chain and infrastructure, and education

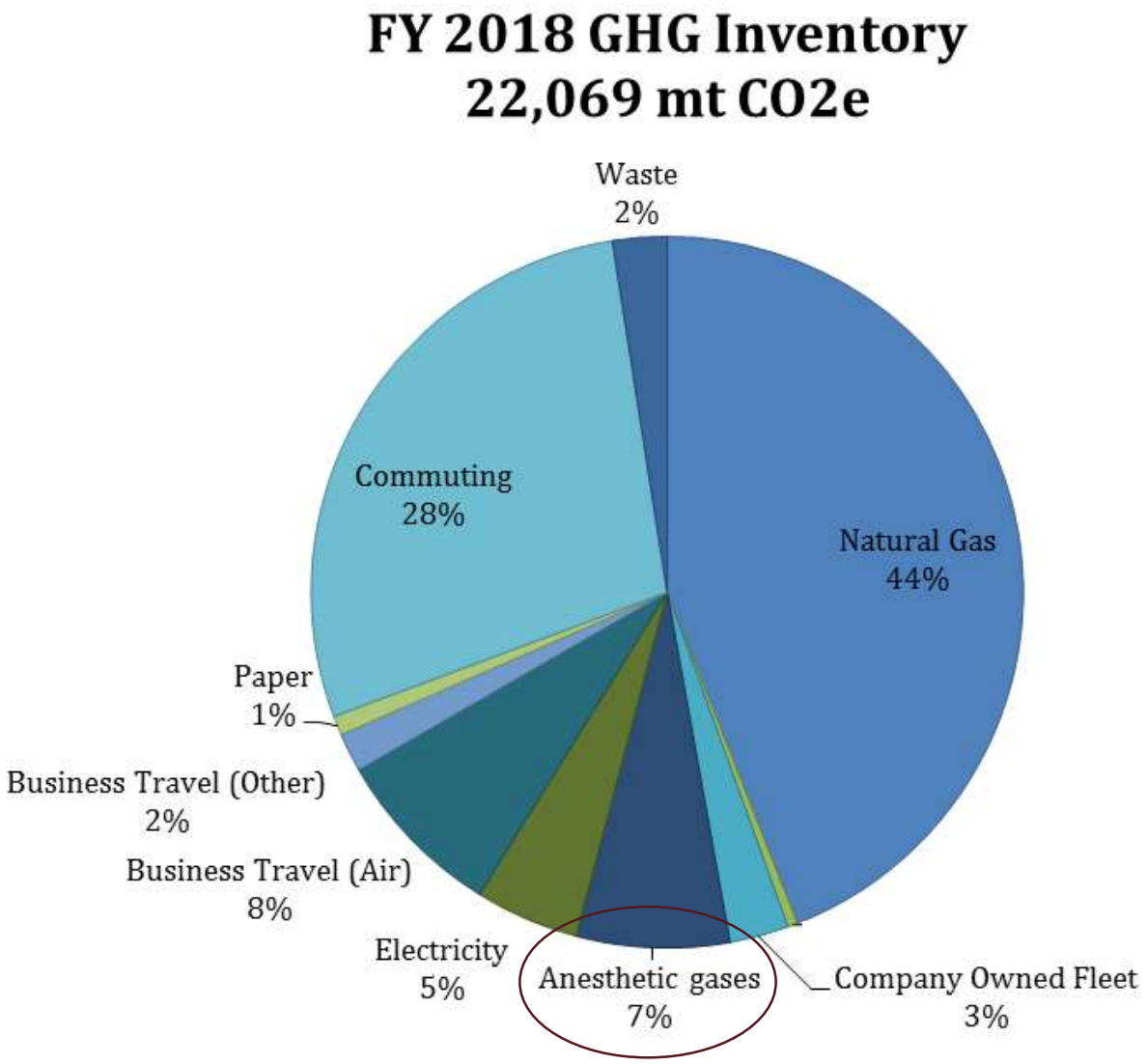
About Seattle Children's

Sustainability Program

Our Sustainability Mission

- **People:** We are committed to improving the health and well-being of our patients, families, workforce and our local and global community.
- **Planet:** We will work to promote a healthy environment to further our mission to provide hope, care and cures to help every child live the healthiest and most fulfilling life possible.
- **Promise:** We will support our promise to care for every child who needs us – regardless of their family's ability to pay – by implementing sustainable practices that enhance patient care, reduce costs and minimize our environmental footprint.

Seattle Children's Main Hospital 2018 emissions – baseline data



Socialization and Education

- Work room discussions
- Lectures to residents
- Formal presentations to department
- Hospital-wide climate pledges & initiatives
- Clinical decision support

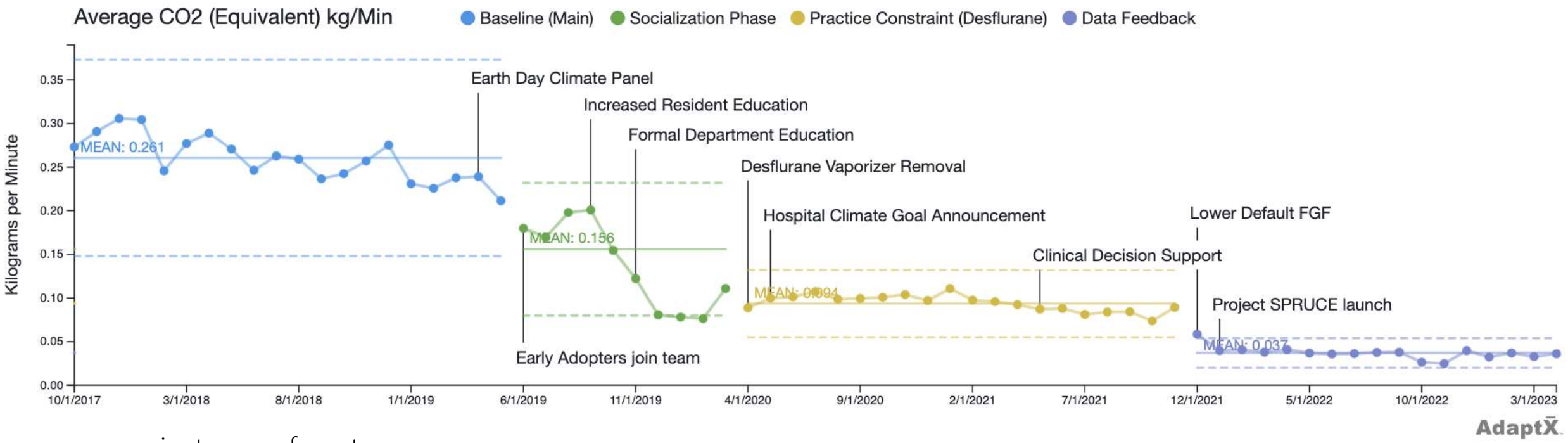
Practice Constraints and Changes

- Desflurane vaporizer removal
- Lower Fresh Gas Flow defaults
  - Low flow induction
- No nitrous oxide
- TIVA maintenance

Data Feedback

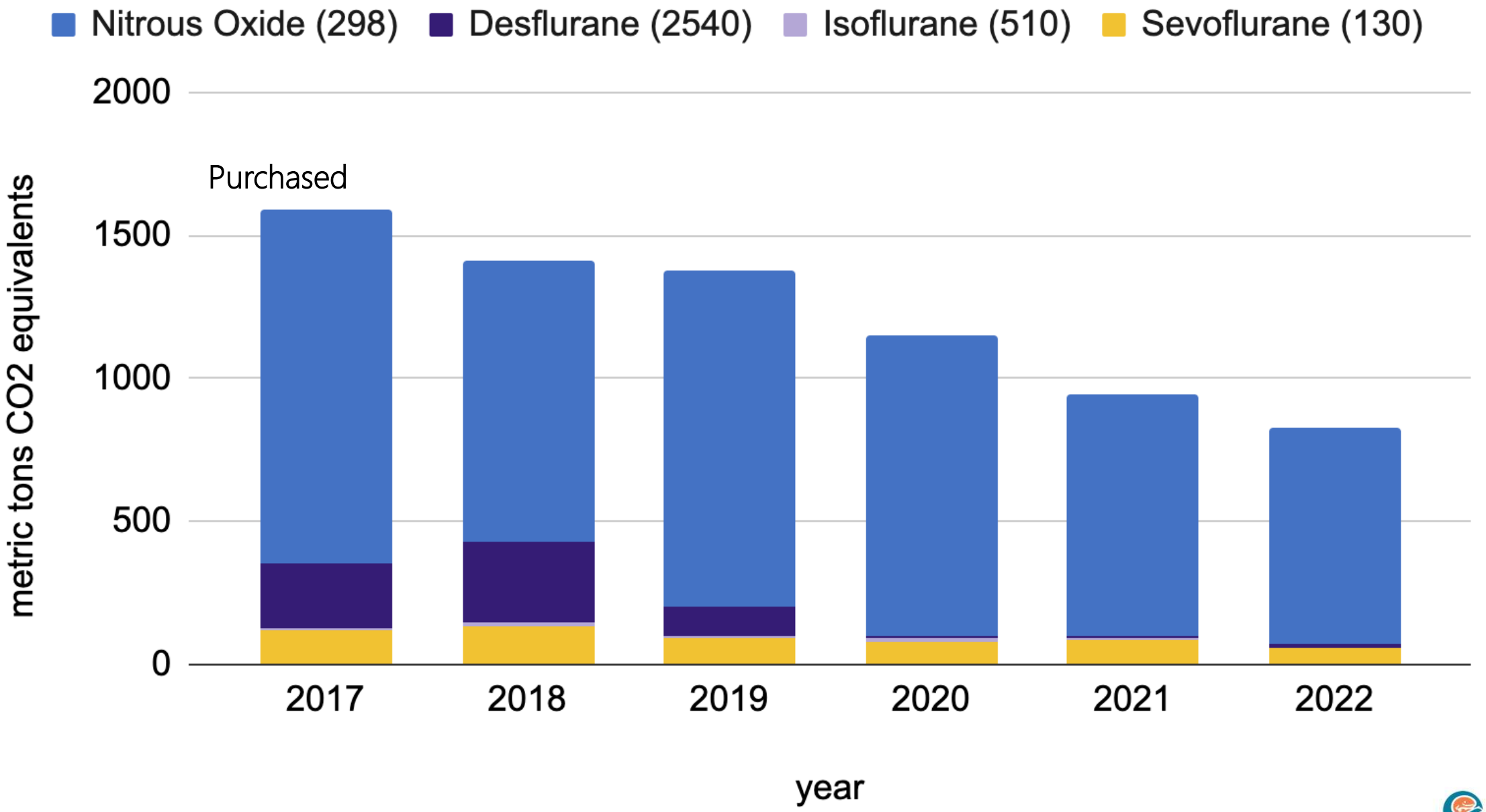
- Launch of Project SPRUCE (Saving our Planet by Reducing Carbon Emissions): Sharing the data with AdaptX
- Identification of high emission cases
- Celebration of low emitter (solicit success stories from your team)

Main hospital Emissions from inhaled anesthetics over 5 years – 87% reduction

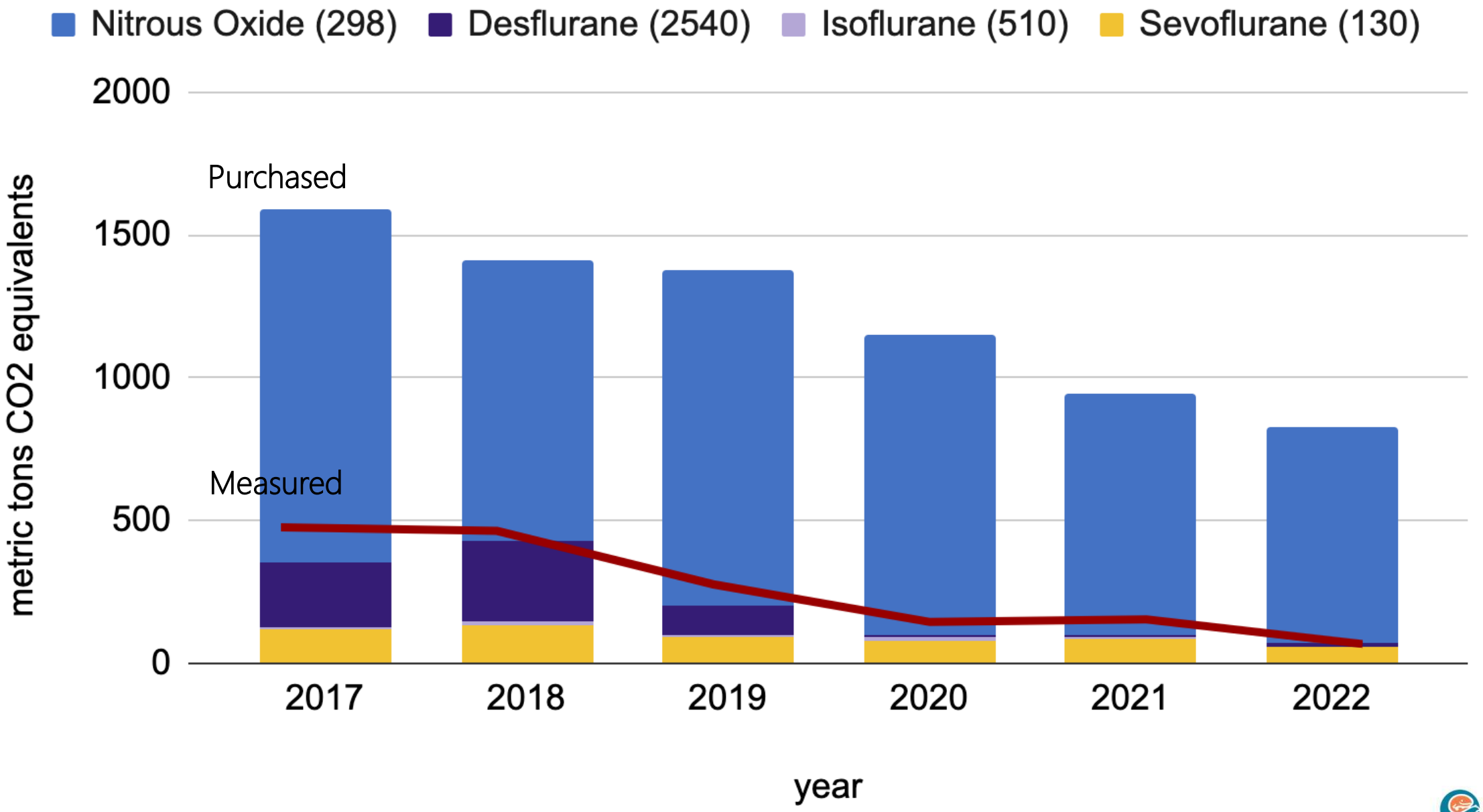


www.projectspruceforest.com

Greenhouse Gas Emissions by Anesthetic Agent (GWP100)



Greenhouse Gas Emissions by Anesthetic Agent (GWP100)



Lessons learned from Seattle Children's Hospital experience

- Nitrous oxide is not necessary for pediatric anesthesia care – kids do well with alternatives!
- Central supply decommissioning project revealed how even straightforward efforts require broad support from multiple stakeholders
- Infrastructure supporting the environment of care has a number of embedded policies and design standards that are challenged by new best practices
- Decommissioning a central supply takes leadership buy-in, engineering support and execution
- Like any project that could involve presenting to regulators and pulling a permit, there will be unexpected requirements of time and effort
- In the end, it's worth it for the future of medicine, healthcare, and our children

Srini Pendikatla, Mike Bigelow, Colleen Groll, and SCH leadership team

Polling Question

What resources or support do you feel would be most helpful to drive the decommissioning of nitrous oxide medical gas systems in your organization?

1. Introductory remarks
2. Providence's research, assessment and solutions
   - Dr. Brian Chesebro, Anesthesiologist
   - Andy Mason, Regional Facility Director
3. Q&A with Dr. Chesebro and Mr. Mason
4. Hospital case studies
   - Vancouver General Hospital – Dr. Stewart Brown, Anesthesia Fellow
   - Virginia Mason Medical Center – Dr. Wyn Strodtbeck, Anesthesiologist
   - PeaceHealth Southwest Medical Center – Brian Nelson, Sustainability Mgr.
   - Seattle Children's Hospital – Dr. Liz Hansen, Anesthesiologist
5. Opportunity for post-webinar implementation assistance – Adam Lough, UW Executive MHA program
6. Discussion and continued Q&A

UW School of Public Health Project

- Assistance with…

  Normalizing, analyzing and trending data

  Scheduling periodic check-ins

  Sharing of N2O Medical Gas System Playbook

  Setting up time with members of this group to transfer knowledge/lessons learned

UNIVERSITY of WASHINGTON
SCHOOL OF PUBLIC HEALTH

Webinar Survey

Q & A FOR ANY MEMBERS OF THE COLLABORATIVE

AND OPEN DISCUSSION

Final Thoughts

To achieve our vision of transforming the delivery method of nitrous oxide in hospitals and ambulatory surgery centers across the region…

- Please share our webinar recording and tools with your counterparts at other organizations who can benefit from the research, assessment, and solutions presented here.
- Please consider participating in our post-webinar support offer. We want to help you accelerate this work and measure the impact across the region.

THANK YOU

Cascadia Nitrous Oxide Collaborative Members

- Dr. Stewart Brown, Vancouver General Hosp.
- Dr. Brian Chesebro, Providence Health
- Geoff Glass, Providence Health
- Hillary Greenwood, Practice Greenhealth
- Dr. Liz Hansen, Seattle Children's & UW
- John Leigh, CommonSpirit Health
- Adam Lough, Allegheny Health & UW
- Andy Mason, Providence Health
- Brian Nelson, PeaceHealth SW Medical Ctr.
- Srini Pendikatla, Seattle Children's Hospital
- Kaeleigh Sheehan, Legacy Health
- Dr. Wyn Strodtbeck, Virginia Mason Med. Ctr.