Welcome to the 2024 MD Expo New England !

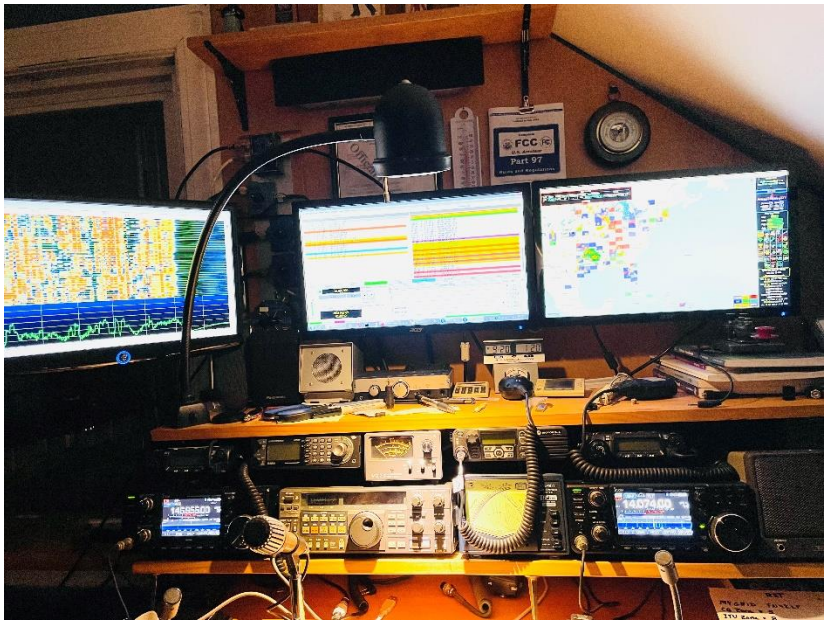
Who do we have in the room ?

What is your experience level ?

What are your key interests ?

- Experienced Anesthesia Biomeds? What Machines?
- Biomeds who don't service Anesthesia but want to?
- Biomeds or CEs thinking about taking anesthesia service In-House?
- Others? Third Party ? OEMs?

While we are waiting to start, Who has an interesting Hobby or Activity ?
Sailors ? Skaters? Kayakers ? Cyclists ?
My "other name" is N1JSM… QSL…?
Any Ham Radio operators in the audience ?



This is my Radio Shack featuring the ICOM 7300 HF Radio with Digital CPU Interfaces.

Note: If you are studying for CBET exam, the Ham Radio Technician Class License Exam will guarantee you pass the CBET electronics sections and help if you service Telemetry, WiFi and other R/F based Biomedical systems.

Anyone currently supporting the Draeger Apollo or Atlan?

Introduction to Anesthesia and how to be an O.R. / Anesthesia Biomed

In memory of Patrick K. Lynch 6/25/1953 - 3/1/2024
Pat once told me, "Anesthesia/OR Biomed was a favorite chapter in his career.

A Basic Overview of Anesthesia, the O.R. and Biomed

By J. Scot Mackeil CBET, ACCE, 2018 AAMI BMET of the Year
Senior Anesthesia Biomedical Equipment Technician
Massachusetts General Hospital

Outline – Scot's Presentation

- My Disclosures and Acknowledgments
- This talk is about Anesthesia – I will try not to put you to sleep…
- My Background and work history
- Overview of the Biomedical Technology Services Department at MGH.
- What is Anesthesia and how does it work.
- What are Anesthesiologists and what do they do.
- Overview of Anesthesia Biomed responsibilities, duties, and tasks.
- The Anesthesia and OR environment and how BMETs work in it.
- Equipment found in the Anesthesia zone and how to work with it.
- Slide show - tools and stuff I use on the job. – (Time permitting)
- Vaporizers and how to PM them – (Time permitting)
- Summary followed by questions and answers session.

Acknowledgments and Disclosures…

* Special thanks to MGH Biomedical Technology Services, Leadership and my coworkers for your mentorship, support contributions of slides, photos, and assistance.

* This presentation, my views and opinions are strictly my own and I am not speaking for my employer.
- This presentation should not be considered as "service training"
- I am not being paid for this presentation.
- I do not have any conflicting interests or financial connection to Draeger, Stabilant or any other equipment manufacturer.
- I am a proponent of Right to Repair and Repair.org and ECRI.org

- Special Acknowledgement to Jose Miranda-Rivas CBET and James Philip MD for their mentorship over the years.
- Thank you to MD Expo and Kristin Leavoy for inviting me here.
- Thanks to Draeger N.A. and Derek Norcross for the demo Apollo

At 16 years old in 1976, My first paying job was as a Bicycle mechanic at Landry's Schwinn in Framingham Massachusetts.

My boss **Peter Henry,** was very strict on Quality Control and Customer Service.

Quality was job #1 at Landry's and the lessons I learned have stuck with me throughout my career.

The turning point that brought me to the Biomed profession…

I was on track to have a 20-year career as an Army Aviator and a 2nd career as an airline pilot when In 1980, A drunk driver hit my van head on and changed the course of my life. Some things happen for a reason, My Biomed career has been very good to me.

My 1st medical equipment job in 1981 was as a clinical lab equipment technologist at Jasons and Sayles associates in Natick Ma

note: I worked four months as a dental equipment technician in 1980 up until my van crash.

Dick Davis and Richie Caso taught me the technical skills that are the foundation of my abilities today.

My bosses at J+S, **Dick Davis and Ritchie Caso** were ex-Navy electronics techs who had worked for Coulter Electronics. They taught me all about troubleshooting, chemistry, hematology, theory, physics and repairing lab equipment. They were great at giving me knowledge and challenging me to see how far I could take it. There were no limits. If I wanted do the job at hand they would provide the know how I needed. I started out there building wire and cable harnesses and in less than 2 years, I was doing frame up rebuilds on automated analyzers. To this day their lessons about critical thinking, work practices, quality control, troubleshooting and repair are part of my everyday practice as a Biomed.

I learned that having Comprehensive Factory Service Manuals for your Equipment is essential to doing quality work and developing high quality, reliable PM and Repair and Refurb processes.

At Bio-Lab International Equipment Company I was their Lead Analyzer Refurb and support Specialist from 1985 - 1991.

We sold and serviced refurbished lab analyzers and scientific equipment. I would take analyzers bought from the field, strip them down to their frames, rebuild, recertify them, deliver and install them to customer's labs. The Sales Manager there, **Al Jordan** would ask me *" Scot, I have a customer who want to buy a (_____) can you do the refurb?"* My answer was always the same: *"If you can get me a service manual, reagents, controls and parts, I can do it"* The power of talent and a can-do attitude combined with knowledge, parts and service manuals are essential elements of High Quality Biomedical work.

Circa 1988, can you Name this device?

Working at Bio-Lab built my skills to produce lab analyzers and maintain high quality. My customer service, logistics and phone support skills developed to new levels.

1991-2009 - Jordan Hospital, a 120 bed community Hospital. I started and ran their 1st modern Biomedical Engineering Department.

As A "one man show" I learned and performed all of the key Biomed, CE and HTM job functions. My role with Anesthesia was limited to what the Dave Gannon MD asked me to do. Mainly, I escorted Sandy Townsend from Baystate Anesthesia into the room to do the PMs. I learned a lot from Sandy back then.

1991, Vinnny Holland, The Director of Facilities, hired me and handed me a book called ASHE Maintenance Management for Medical Equipment. He said, "Just do everything this book says and you will be OK. We have these people called the "Jay-Co" coming in about 3 or 4 months, I need you to get this all done before then." I read the book, worked hard and I got it all done in time and passed the inspection.

Since February 1st 2010, I been a member of the "Anesthesia Clinical Engineering Team" in the Operating Room at Massachusetts General Hospital. I have been in HTM since 1980. 45 years in 2025 !

Today, I have one of the most amazing jobs in HTM, I support repair and maintain anesthesia systems in the place where anesthesia was invented.

Where I work now: Massachusetts General Hospital in Boston Massachusetts.

BTS – Biomedical Technology Services

An International cast of world class professionals who provide comprehensive support services for Anesthesia , Surgical, Peri-Op and I.T. systems in our nation's leading academic medical center.

The O.R. BTS Team is:
Jamie Sparling MD – Medical Director
Bill Driscoll – BTS Director
Brian Mclaughlin CCE – CE Project Manager
Rama Parchuri CCE - Tech Svc Manager
Team Leads
Mary Shine CCE
Adam Crowell CBET
Maximo Nicolas CE
Svetlana Montarroyos – CE ASCs
The O.R. Team BMETs
Jose Miranda-Rivas CBET
Rodrigo Lozano BMET
Paul Kruckas CBET
Cindy Bonilla BMET
Matt Beagan CBET
Jim Cook CBET
Tim Tyamayev CBET
Loa Abber BMET
Mekdes Worku BMET
Kerting Laurent BMET
Joshua Diaz BMET
J Scot Mackeil CBET
The Periop IT Systems Support Team
Mycah Flynn – Systems Team Lead

Jaymar Sealy - Logisitics and Supply Specialist

BTS Periop and Procedural Services: Our Leadership Team

Bill Driscoll
Executive Director

- Strategic Planning
- Departmental Oversight
- Scope of Services
- Priority setting
- Service level setting
- Resource allocation
- Budget and space

Brian McLaughlin
Senior project leader

- Ragon bldg. Point person for biomed
- Special project oversight
- Project scoping and advising
- Enterprise projects
- Project resource assignment
- Contract management

Rama Parchuri
Periop support Manager

- Operations management
- Technician oversight
- Regulatory Compliance
- Customer service
- Technical management
- Technician performance management and growth
- OR PM program

Micah Flynn
Connected Systems Manager

- Ensure Epic Help staffing support coverage
- Systems Call-coverage
- Team dynamics
- Systems manager
- Strategic planning for IT systems
- Vocera
- EPIC Optime /Anesthesia manager

Milcho Nikolov
Systems Engineering Manager

- Enterprise Anesthesia IT applications
- Technical support for HSE
- System admins for TMS and SPM
- Manage interfaces for periop systems
- Data engineering for Tableau

Natalia Tabares
CE Manager

- CE project assignment
- Quality and safety assignments
- New Model evaluations
- Project assignment and oversight across all MGH BTS sites

BTS Periop and Procedural Services: Our Team Leads

Vacant position
Team Lead (EPIC Help/Periop IT)

- Ensure staffing for Epic/Vocera help team
- Initial point of escalation
- Oversee Service Now ticket queue
- Oversee on call assignments

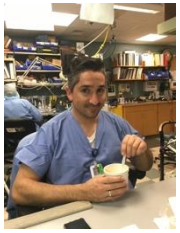
Mary Shine
CE Team Leader

- Project resource assignment
- Supervise interns and new engineers
- Contract management
- CE workload management
- Q&S rounds and tracers
- Delegation of recall management, and safety report follow-up

Maximo Nicolas
Team Lead (Main Campus)

- Ensure staffing support coverage
- Call-coverage
- Team dynamics
- Daily logistics and ops management
- Vendor management
- Resident training
- Anesthesia machine resource
- PACs/Radiology liaison
- Procedural services support escalation

Adam Crowell
Team Lead (Main Campus)

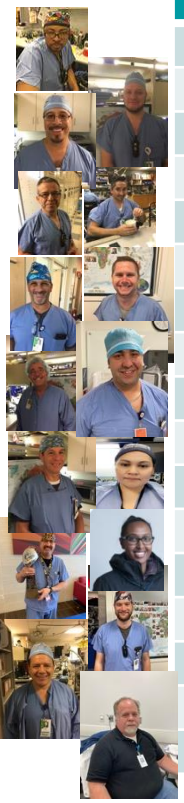


- Ensure staffing support coverage
- Call-coverage
- Team dynamics
- Daily logistics and ops management
- Vendor management
- Resident training
- Anesthesia machine resource
- PACs/Radiology liaison
- Procedural services support escalation

Lana Montarroyos
Team Lead (ASC's)

- Ensure staffing support coverage
- Call-coverage
- Team dynamics
- Daily logistics and ops management
- HLDS oversight
- Anesthesia expert
- Lead oversight of Biomed resources at ASC locations

BTS Periop and Procedural Services: Our BMET team….



Name	title	Resource area
Kerting Laurent	Senior BMET	Lasers, Video Towers, anesthesia
Jim Cook	Senior CBET	Meivators aers, anesthesia
Jose Mirada-Rivas	Master CBET	Ultrasound, Perfusion, anesthesia, Cath Lab
Adam Crowell	Senior CBET, Team lead	Microscopes, anesthesia
Rodrigo Lozano	Master BMET	Video systems, mounting, Endo, anesthesia
Lou Abber	Master BMET	OR Tables, Sterilization, monitoring
Matt Beagan	Senior CBET	Patient monitoring, tables
Tim Tyamayev	CBET	General OR equipment
Paul Kruckas	Master BMET	Anesthesia
Cindy Bonilla	BMET	General OR equipment, Endo
Scot Mackeil	Senior CBET	Radiology, Evening lead, Anesthesia, IONM
Mekdes Worku	BMET	Cath lab
Greg Sampson	Senior BMET	Danvers, Anesthesia
Chris Robertson	BMET	ASC's
Santiago Lozano	Senior BMET	Waltham, Anesthesia
Josh Diaz	BMET	ASC swing position Waltham 2nd tech
Mike Corriveau	Senior BMET	SNH iCare ASC

At MGH the O.R. Biomed Team's Scope of work is extensive:

* ~5,000+ unique devices in our inventory
* ~50 support calls per day
* 60 Main Campus OR anesthetizing locations
  * Lunder O.R. (2, 3, 4)
  * Legacy O.R. (3rd floor)
* 16 remote anesthetizing locations on main campus
* MGH West and MGH North ASC (remote support)
* 120 anesthesia Machines (#s approximate - expansion in progress)
* 60 Draeger Apollos
* 54 Draeger Tiros
* 6 Draeger MRI machines

Anesthesia makes modern Surgery possible.

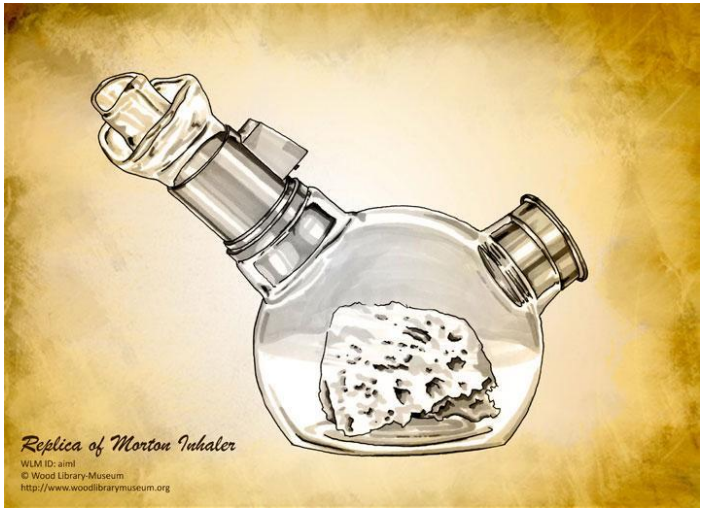
What is it Really?

What key things does it need to do ?

What major safety features does it have?

History of Anesthesia at MGH

- Anesthesia was first demonstrated at MGH
- October 16th 1846
  - Dr. John C Warren was the surgeon
  - Dr. William Morton was the anesthetist
  - Surgery was removal of a tumor in the neck
- Ether (aka Lethium) was the agent



What is Anesthesia ?

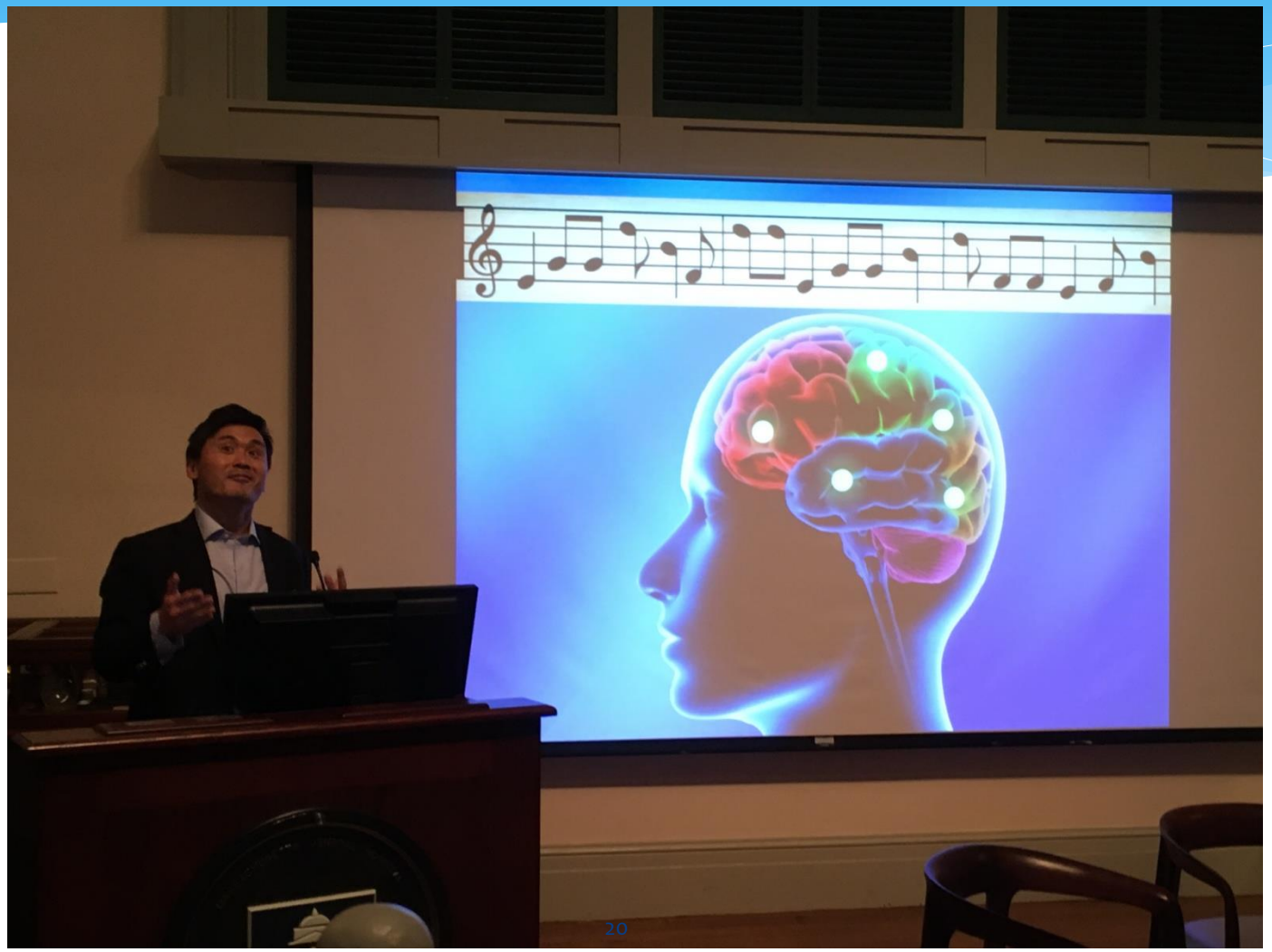
* In the practice of medicine **anesthesia** or **anaesthesia** (from the Greek "αναισθησία, anesthisia" meaning "no feeling") is a state of temporary induced loss of sensation and/or awareness.
* It may include analgesia (relief from or prevention of pain), paralysis (muscle relaxation), amnesia (loss of memory), and unconsciousness. A patient under the effects of anesthetic drugs is referred to as being **anesthetized**.

* Anesthesia enables the painless performance of medical procedures that would cause severe or intolerable pain or even death to an un-anaesthetized patient.

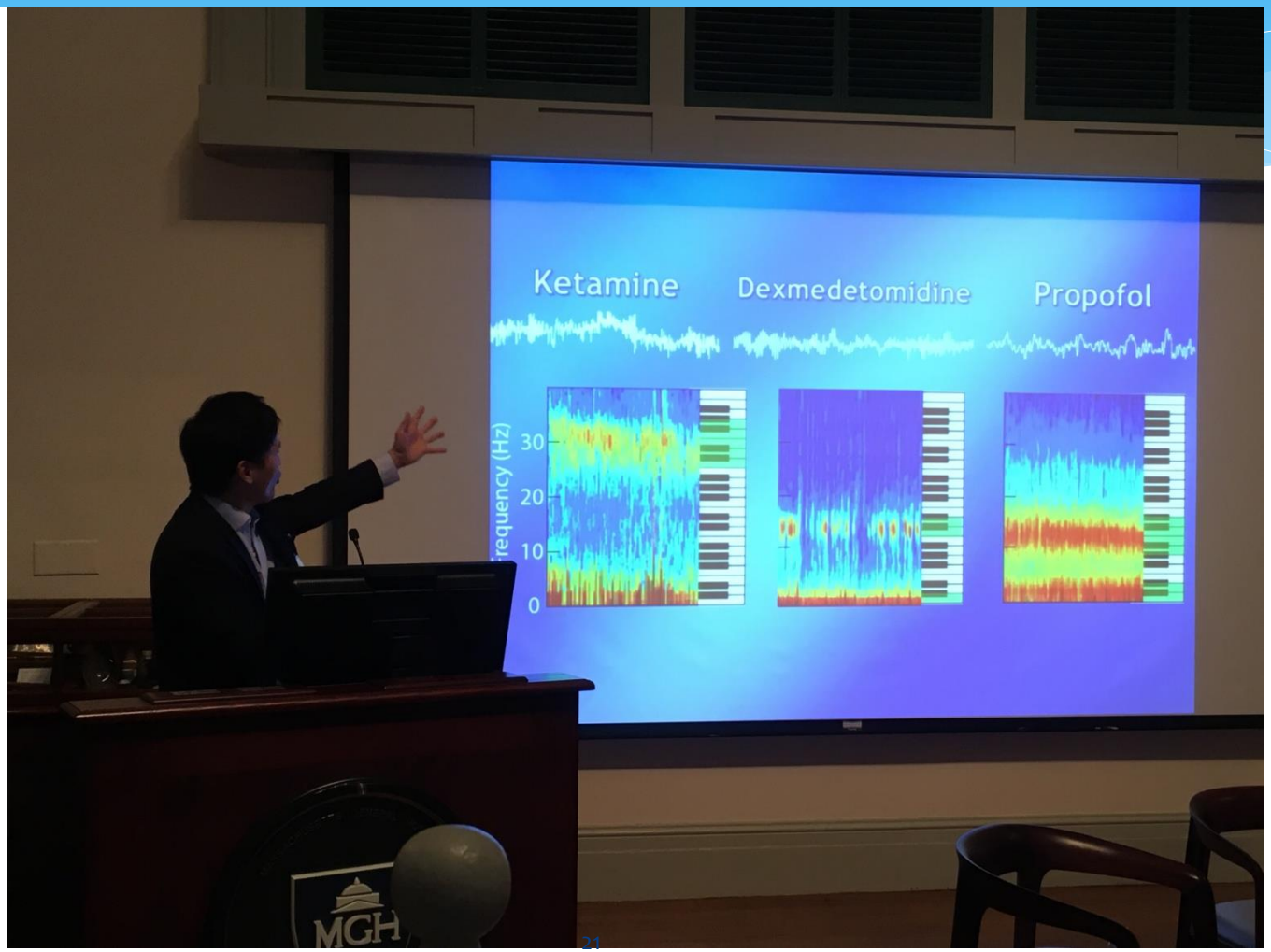
How does Anesthesia Work ?

* In the awake brain, many regions of the brain are communicating with each other producing consciousness, thinking, feeling pain and sensation, hearing, and seeing. Other regions of the Brain are controlling our body's functions like breathing.
* Nerve cells and neurons make all this happen.
* Anesthesia drugs, in different ways either, shut down modify or moderate the bioelectric communication in the brain and body to create the "anesthesia effect".
* Imagine your hospital information system, if you went around to network closets unplugged patch cables.

Patrick Purdon Phd explaining how Anesthesia works in the Ether dome



The Brain has different EEG characteristics with different drugs



How is Anesthesia Delivered ?
In Gaseous form by the Anesthesia Machine
Intravenously by pump or injection

Use of a colored dot on the PM stickers, that changes each year, can aid us in seeing when they expire.

Modes of Anesthesia

* The types of anesthesia care are:

* **General Anesthesia** suppresses central nervous system activity and results in unconsciousness paralysis and total lack of sensation. Uses an Anesthesia machine for ventilation and typically a combo of drugs and inhaled agents

* **TIVA – Totally intra-venous Anesthesia** – does not use inhaled agents, it depends on injected drugs like Propofol, Midazolam, Rocuronium, Phenylephedrine, Remifentanyl and others. Usually requires mechanical ventilation.

* **MAC – Monitored Anesthesia care** – provides the minimal anesthetic needed to accomplish the clinical goal. Similar to TIVA and conscious sedation, but should it become necessary, General anesthesia could be initiated if the clinical situation requires it. Usually does not require mechanical ventilation. Local surgeries are a common example.

* **Conscious Sedation** suppresses the central nervous system to a lesser degree, inhibiting both anxiety and creation of long-term memories without resulting in unconsciousness. Usually does not require mechanical ventilation. Colonoscopy is a common example. Propofol, Midazolam and Fentanyl are among the drugs commonly given by IV.

* **Regional anesthesia and local anesthesia,** block transmission of nerve impulses between a targeted part of the body and the central nervous system, causing loss of sensation in the targeted body part using local anesthetics such as lidocaine and bupivacaine.

* **Peripheral nerve block** inhibits sensory perception in an isolated part of the body, a nerve block will inhibit sensation in an entire limb using local anesthetics such as lidocaine and bupivacaine.

* **Central, or neuraxial, block** administers the anesthetic in the region of the central nervous system itself, suppressing incoming sensation from outside the area of the block. Examples include epidural anesthesia and spinal anesthesia.

Inhaled anesthesia agents – why they work, types, MAC, MH and POCD.

Compound	MAC in oxygen/ air	Solubility	Effect on CVS	Effect on RS	Effect on CNS	Comments
Sevoflurane	2.2%	Low; rapid changes of depth	↓ BP, vasodilatation	Depresses ventilation	Minimal effect on CBF at clinical concentration	Popular for inhalation induction
Desflurane	6.0%	Low; rapid changes of depth	↓ BP, ↑ HR	Depresses ventilation	Minimal effect on CBF at clinical concentration	Pungent, boils at 23 °C
Isoflurane	1.3%	Medium	↓ BP, ↑ HR, vasodilatation	Depresses ventilation	Slight ↑ CBF and ICP	Pungency limits use for induction

MAC: minimum alveolar concentration; CVS: cardiovascular system; RS: respiratory system; CNS: central nervous system; BP: blood pressure; HR: heart rate; CBF: cerebral blood flow; ICP: intracranial pressure; ECG: electroencephalograph.

Beware of the onset of MH aka Malignant Hypothermia ! 1st sign is elevated CO2

A potentially rare and life-threatening complication of inhaled agents.

1 MAC = the concentration of agent at which most adults will be anesthetized enough to not involuntarily flinch when a surgeon make a cut with a scalpel.

POCD = post operative cognitive dysfunction or dementia.

Drugs are the main component of Anesthesia care…

There are many drugs that can be used intravenously to produce general anesthesia or sedation. Other drugs paralyze, others raise blood pressure. The MD uses various drugs to control metabolic processes during surgery or codes.

Basic Anaesthetic Drugs

Doses are for an average adult. They are provided as a guide to the usual range of doses for fit ASA 1/2 adult patients only.

You should discuss these doses with your trainers and adjust the document as required according to local practice.

***= Titrate to effect.**

Induction Agents	Dose	Presentation
Propofol	2–3 mg/kg	10 mg/ml
Thiopental	3–5 mg/kg	25 mg/ml – Beware of antibiotics in 20 ml syringe

Opioids	Dose	Presentation
Fentanyl*	1 mcg/kg	50 mcg/ml
Alfentanil*	10 mcg/kg	500 mcg/ml
Morphine*	0.1 mg/kg	10 mg/ml

Muscle Relaxants	Dose (Intubation)	Top ups	Presentation
Atracurium	0.5 mg/kg	Approximately half intubating dose	10 mg/ml (stored in fridge)
Vecuronium	0.1 mg/kg		2 mg/ml
Rocuronium	0.6 mg/kg		10 mg/ml (stored in fridge)
Suxamethonium	1–1.5 mg/kg		50 mg/ml (stored in fridge)

Reversal for muscle relaxants	Neostigmine 2.5 mg + Glycopyrronium 500 mcg

Local Anaesthetics	Toxic Dose	Formulation/Max Dose
Bupivacaine	2 mg/kg	0.25% = 2.5 mg/ml (Max dose 0.8 ml/kg) 0.5% = 5 mg/ml (Max dose 0.4 ml/kg)
Lidocaine	3 mg/kg without adrenaline 6 mg/kg with adrenaline	1% = 10 mg/ml 2% = 20 mg/ml

Common Emergency Drugs	Use	Dose	Presentation
Suxamethonium	Laryngospasm	25–50 mg	50 mg/ml (fridge)
Atropine*	Bradycardia	20 mcg/kg	1 mg/ml
Glycopyrronium*	Bradycardia	200 mcg bolus	200 mcg/ml
Ephedrine*	Hypotension	3 mg bolus	30 mg diluted into 10 ml saline
Metaraminol*	Hypotension	0.5 mg bolus	10 mg diluted into 20 ml saline

Adrenaline*	Suspected anaphylaxis	50–100 mcg boluses titrated to effect 0.5–1 ml of 1:10,000

Other Emergency Drugs	
Intralipid 20%	Local anaesthetic toxicity – initial dose 1.5 ml/kg IV over 1 min
Dantrolene	Malignant Hyperthermia – initial dose 2.5 mg/kg IV (9 vials for 70 kg Px)

This is an example of what an Anesthesia MD may keep handy next to the machine control panel.

1. A paralytic to relax the airway
2. A stimulant to raise BP
3. Twist ties to manage IV lines/cables
4. A drug to limit oral secretions
5. A Drug to reverse paralysis.

Anesthesia, Allows surgeons to do extremely invasive procedures, following which, the patient will wake and recover. Modern surgery would not be possible without it.

Anesthesiologists, take a patient into the operating room and using a combination of technology and pharmacology, they put the patient to sleep, then keep them from dying while the surgeon does things that in most cases would cause extreme pain and suffering or even death. Then they wake the patient, mitigate pain and facilitate the recovery period in the PACU. Anesthesiologists, because of their skills, also serve in critical care units, working codes, guiding care, and helping bring critically ill patients thru their stay in the ICU.

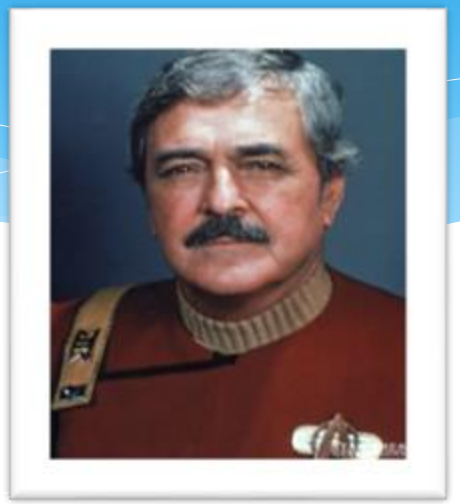
What is an Anesthesia Biomed, what does one do? Key concepts.

* We support Anesthesiologists and CRNAs in the OR as well as Surgeons and Nurses in real time when any aspect of their technology fails to meet their needs and expectations… or becomes "Broken".
* We are often called to the room urgently when they have questions about any technology used to care for the patient. Often, we arrive and "press the right button"
* We must either repair or swap out a malfunctioning device quickly and with minimal impact to care.

Anesthesia Biomeds don't always fix technology, We always fix clinicians with technology problems.

Biomeds are like the "White Blood Cells" of the Hospital.

Our Service Model is Simple, They Call, We respond, We take care of business, no stories.



There is never a dull day when you work in the OR.. Common calls are:

1. “leaks” - the machine fails the Leak test, circuit leaks, ET tube leaks, vaporizer leaks, loose inspiratory/expiratory valve housings, absorber leaks etc…
2. Gas Monitor failures – sample line and water trap issues or PGM gas bench failures.
3. Ventilator Failures – motors and their rotary encoders can fail.
4. A Machine fails power on self test, usually an operator error but sometimes not.
5. Various physical failures – flow cell failures, patient monitor mounts loose.
6. The Patient Monitor, BIS Monitor and Nerve Stim unit – Various issues.
7. The EPIC AIS Computer – PC/Monitor/Cable issues and Software use issues.

Communication Skills, People Skills and Clinical Knowledge are as important as Technical Skills.

Every Service call in the OR has 3 components. The Clinicians, The Patient and the Technology. You Must know how to work with all 3 as a system to solve Technology problems in the OR. Being able to "read the room" is a key skill.

Clear communication with Anesthesia, Nursing and the Surgical team is essential. Use all the communication skills you have when you enter the room.

Service to the Patient is the clinician's #1 priority.
Solving technology problems in support of the patient's care is our #1 job.

Clear communication with the surgical team is very important.
Announce your arrival, "Biomed is here for the ….."
Tell sterile staff if you pass close behind them or sneak between a cart or sterile table…

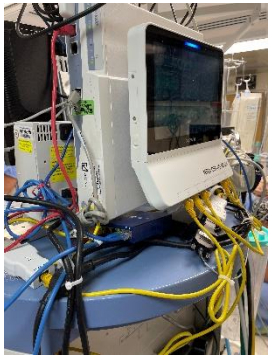
* Caring for a patient under Anesthesia is can be complex and difficult. We must do our job expertly and efficiently so that the Surgical team and Anesthesiologist's care and attention to the patient, their "cognitive matrix" and work-flow is not compromised.
* Use ***circular communication*** ie: "Biomed is here, I was told you are have an issue with the ECG trace, Correct?" The MD will reply, "the V-lead is not working" – "Ok, I will check the V-lead"
* We are expected to be ready to solve and mitigate any technology related challenge that caregivers may experience. Be prepared, be knowledgeable, be ready.
* Photo of 2 Anesthesia machines in one room to separate conjoined twins. The key task here was balancing all the power loads in the available circuits. Then all the digital connections to the EMR had to be mapped and defined in EPIC. Utilities management is part of our job too.

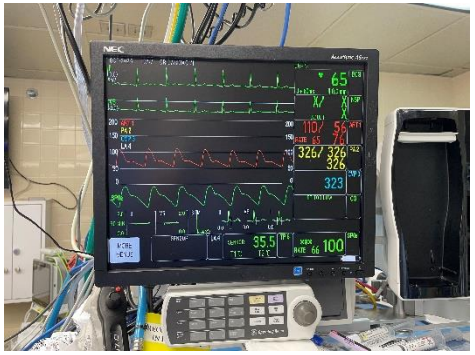
Everything in the O.R. is connected, Physically and digitally across multiple networks and servers. Today's clinicians are connected like never before…

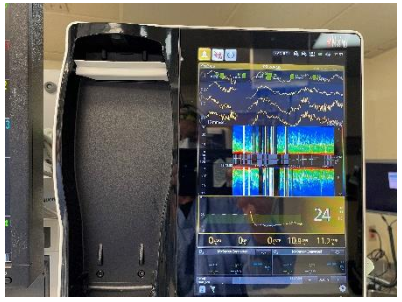
Connected Biomedical Systems create the Electronic Medical Record and build the MD's situational awareness and cognitive matrix. Biomedical Device integration systems are a digital house of cards with layers of systems like a giant Jenga game. When one thing fails, the down stream effects can have serious impact on what is happening in the O.R.

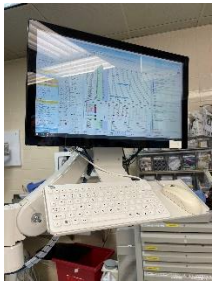
Knowing how to navigate and fix the complex web of systems and connections by isolating problems is a key skill of today's O.R. Anesthesia BMET. You must "know where the digital bodies are buried" You must know who to talk to, about what when something fails. The contact list in your Iphone and cheat sheets saved in Ibooks are important tools when data does not flow… Its all about connections, physical, digital and organic. Know your team and who to call when you need help. **Don't hesitate to ask for help.**



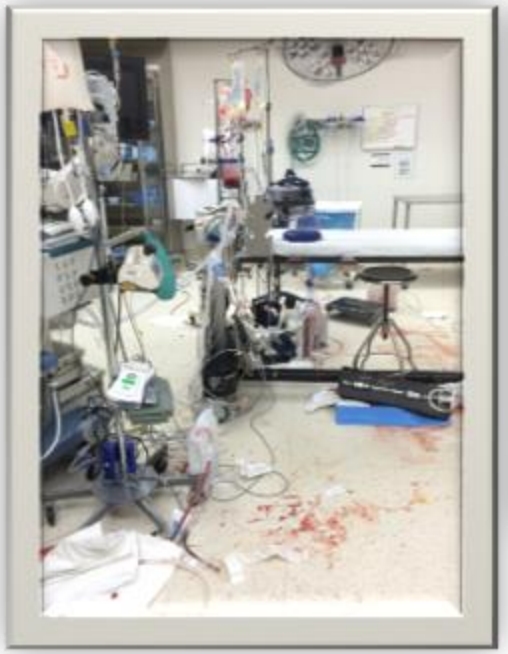




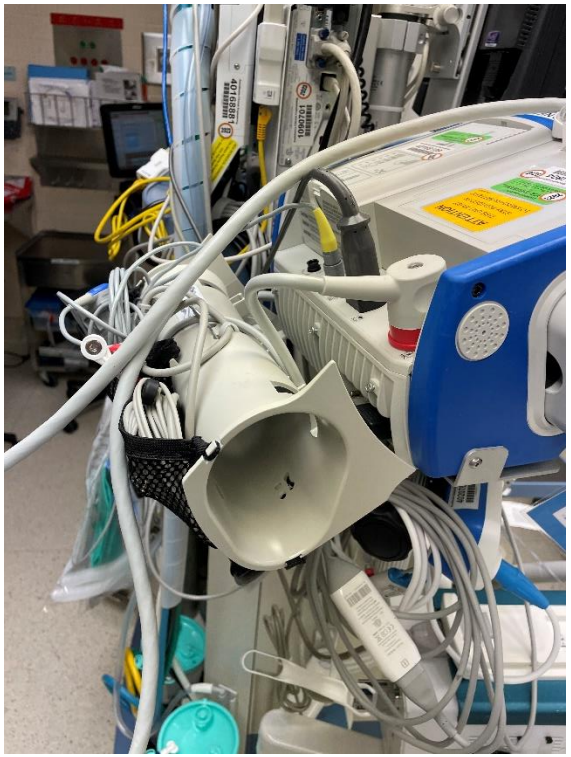


The OR environment:
Doctors, Nurses, Techs, Equipment and a lot of blue stuff you can't bump up against. And, don't forget Blood Borne Pathogens.

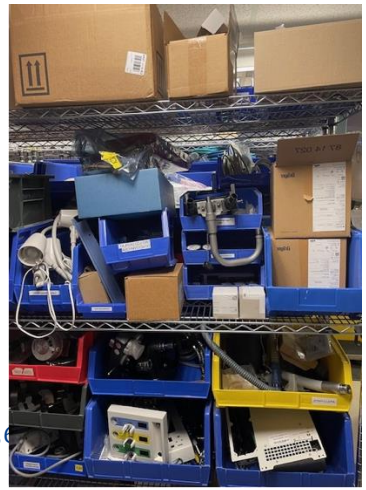


The OR environment is a minefield of do's and don'ts and safety hazards.
A serious healthcare acquired infection could have major impact on your life.

Whenever you work in the O.R., Always be Vigilant ! You can be called into the room for one thing and find other stuff that is BROKEN and not reported. Always pick up pens and items that can cause falls. Always stop to clear blocked fire doors.



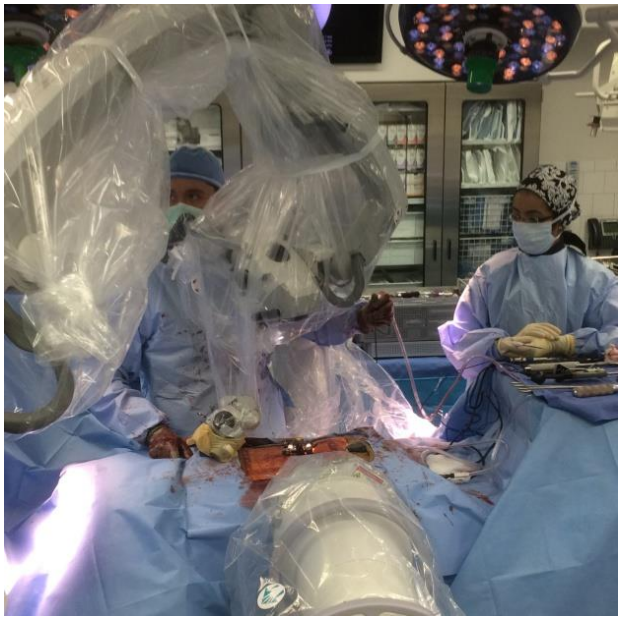
Logistics, Parts and PM Kits
These are essential keys to success.



Having a robust supply of mission critical parts, supplies, cables and assemblies for all the mission critical technologies we support is essential.

The Anesthesia Machine –

With training, teamwork, skill and experience, it is a relatively simple device to understand. Its ventilator combined with A computer, a gas mixer and a closed loop rebreather. The difficult part is fitting into and working in the very challenging clinical environment in the OR. One must have a good understanding of the clinical context around the machine and be able to solve problems in emergent situations that occur when a failure happens during a complex surgery.



Microscope head fell off into the drape. Yikes !

Jose Miranda's Pro Tips for Anesthesia OR Calls

1. When you suspect a leak in the ET Tube, Cuff or Circuit - Turn the fresh gas flows down below 1 liter to 700-800 cc's and see if the breathing bag starts to collapse. If it does, then check the cuff pressure, tube connections and circuit connectors.
2. If the bag does NOT collapse, suspect the electronic flow sensors may be failing or need calibration. Restart the machine to do CAL during POST. Or run sensor CAL.
3. When you have random Vt and Airway pressure alarms, Autoset Limits is your friend !!! (Then have the MD re-check parameters and values)
4. When your Anesthesia machine is behaving badly, press "Restore Defaults"
5. Volume Auto flow mode is a combination of Pressure and Volume mode.
6. When the patient monitor is behaving badly, "new case setup" is your friend.
7. When you have ECG trace problems – View All and Relearn are your friends.

Photos of tools and other items that are essential to doing the job .

* This slide is here as a place holder. Here I may pause the power point to go thru a series of current photos and talk to the audience about the resources, tools and other things I use in real life to be an effective and efficient Anesthesia and O.R. Biomed.
* OR time costs around $200/minute. Being prepared and able to solve issues quickly is a core skill for an O.R. Anesthesia BMET.
* Are you dressed for work?
* When technology issues hold up the case, the patient is experiencing more anesthesia than necessary.
* What key questions do you have about how to do what ?
* And What you need to do it ?
* Folder Name is Scot's OR BMET pics 10-2024

Patient Monitoring – Its all about the numbers and the story they tell…

Regarding patient monitors, waveforms and numbers: (a topic unto itself)

Anesthesia "turns off" normal autonomic functions so MDs delivers IV drugs to control metabolic functions based on a complex matrix of variables. The numbers from NIBP/Art line pressures, ECG, SPO2 C.O. CO2, etc, all drive clinical decisions to dose with various drugs, fluids or blood and/or take specific actions.

Ie: Delta down – A concurrent droop of the art wave and the ECG waveform can indicate a patient is becoming Hypovolemic. Metabolic state, blood pressure, heart rate and circulatory fluid management is based on a large matrix of displayed parameters.

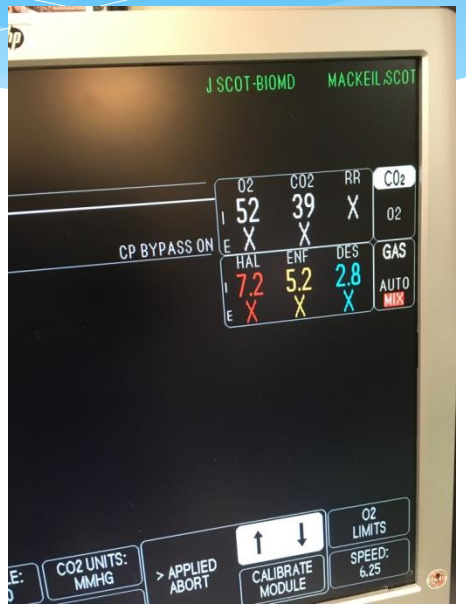
Epic computer tech support calls:

- The EPIC (AIS) computer, An Anesthesia Information Management System or AIS, gives us service calls for PC/Monitor/Cable issues and Software user issues.
- Some issues are as easy to solve as plugging in a displaced cable, are some not.

- High level software support is provided by a team of highly skilled software analysts.

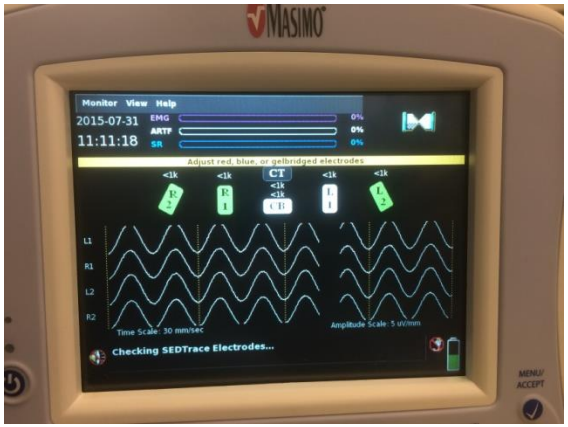
Agent Analyzers – seeing the light.

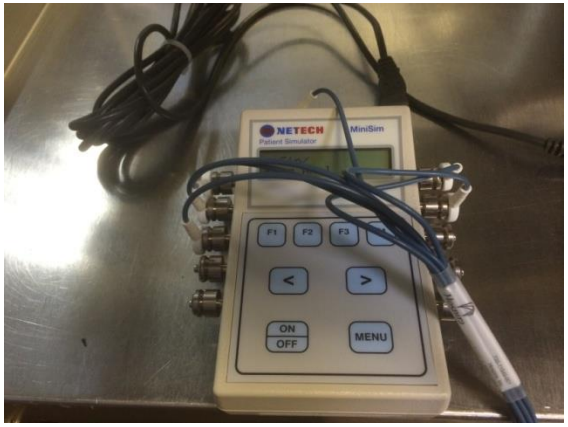
Repairing, PMing and supporting gas analyzers is critical and important.
Key tasks: Changing moisture filters, doing gas calibrations. If they have a moisture error, I find that if I put them in the blanket warming cabinet for 2-4 days, they dry out and the error resolves. For irresolvable fatal failures, I send them to MedEquip Biomedical for Depot repair.



It is very important the MD knows and maintains the optimal MAC value for the patient during surgery. Not enough and the patient may experience awareness or the surgeon gets upset if the patient is reacting to surgery. Too much agent can cause temporary neuro toxicity and result in long emergence times, Post operative delirium, or post operative cognitive disorder.

The Sedline monitor uses EEG waveform data, analyzes the frequencies and energy, and displays the data graphically. Different anesthesia drugs have characteristic patterns on the display. The number represents the patient's depth of Anesthesia. With this monitor the MD can have an Idea if his patient is under or over anesthetized. Many patients do not fit the curve of the classic MAC value. The sedline is a valuable tool. I test them with my EEG simulator and a test cable.

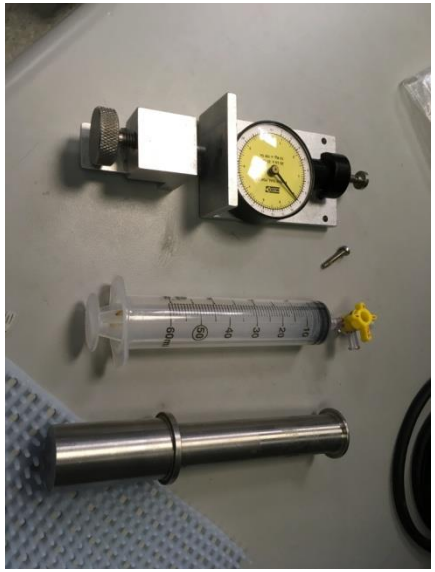




Pumps and more Pumps
Anesthesia MDs use a lot of pumps.

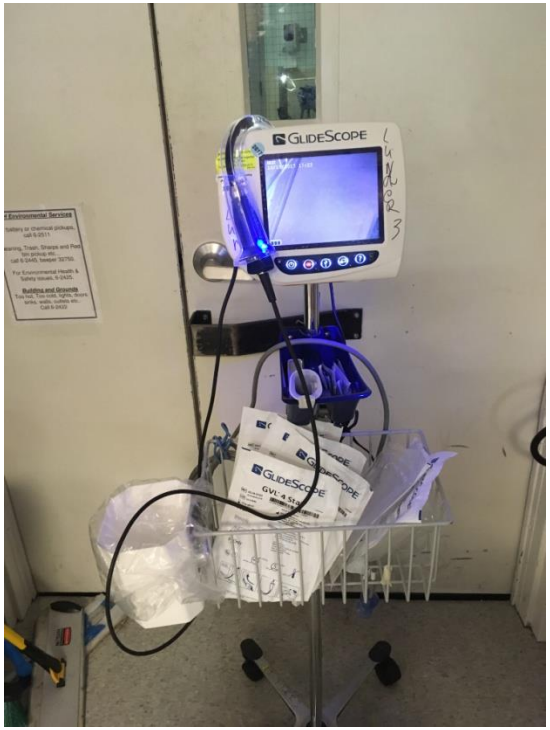
IV pumps are used to deliver essential Anesthesia Meds

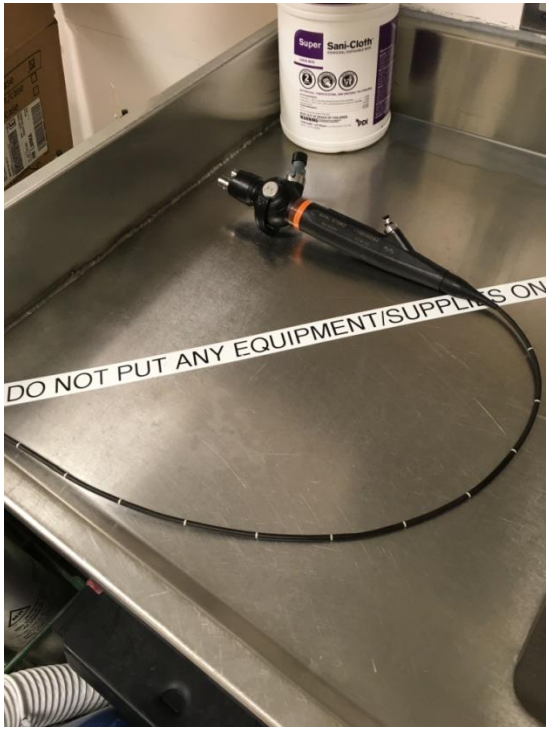
PM and repair of pumps is always an ongoing task and a never-ending challenge.



Airways and Scopes and Endotracheal Tubes. Is it in yet?

Supporting intubation scopes and video laryngoscopes is part of the job. Repair exchanging cameras, lamp replacements and physical damage.

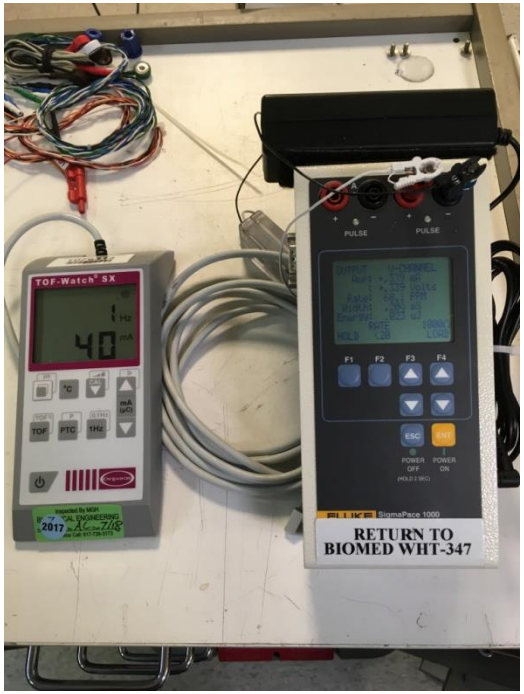




Twitch monitors and nerve stimulators - The shocking facts…

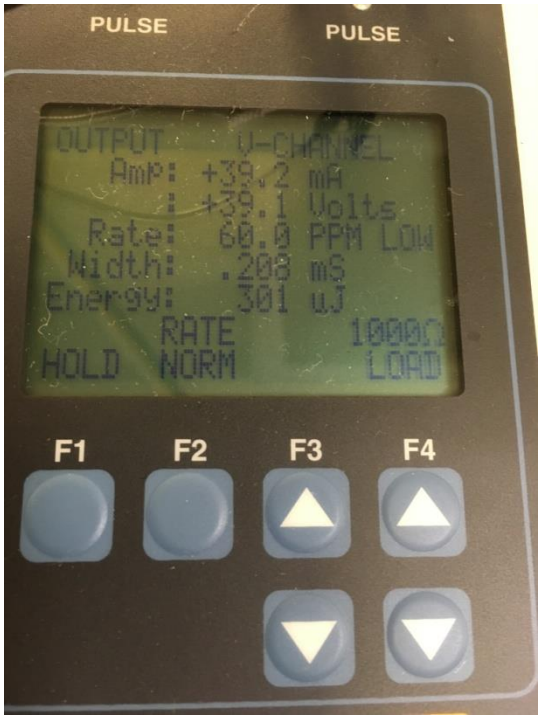
Nerve stimulators measure the depth of paralysis. These monitors are key to maintaining paralysis during surgery and reversing paralysis during emergence. We PM them annually and we have to be ready to diagnose a failed lead or accelerometer. Roc Verc Sux and Neo and Sugamadex Train of four

The fluke Sigma Pace analyzer is great for testing the output of nerve stimulators. These device twitch the PTs thumb and indicate how well the paralytic drugs are working or if the reversal drug has taken effect.



Use 1000 ohms and the V input. V and A should "match"

It can only go up to 50mA, for higher values, put another 1000 ohms across the input and multiply values by 2.



Temperature management – Warm patients are the hot topic

the patient must kept warm at all times. Metabolic function, clotting and other vital functions work best at 37.5 Celsius. If the patient gets cold during the case the risk of complications and mortality increases. There are QA consequences for the MD who sends a cold patient to the PACU after surgery.

Build an efficient set up to test and PM all your warming devices.

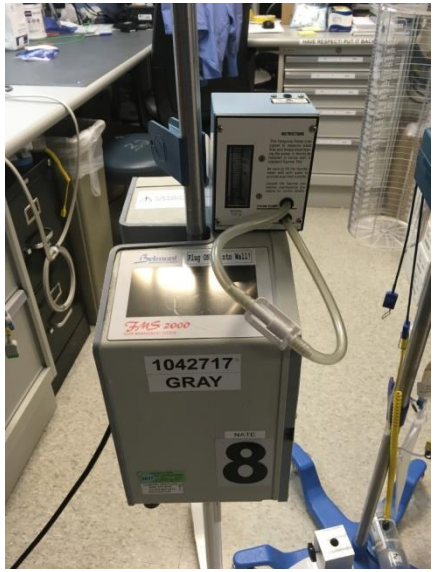
Blood/Fluid warmers have to be checked for correct temperature output to avoid thermal damage to blood products per the AABB.

Rapid Infusers – the MD's #1 defense against Hypovolemia.

If the patient looses blood then, that blood must replaced by fluid or blood transfusions. The Belmont warms and filters blood and fluid. Maintaining fluid balance during surgery is one of the most critical tasks the MD does.

The Belmont rapid infuser

I use a Gaymar flow meter to test the flow rates.



Wire and Cable failure Calls:

A never ending source of service calls, Wire and cable issues, loss and failures. How it happens is still a mystery but we often have to re-seat, repair or replace loose, lost, disconnected or failed cables, power cords and connectors.

Good cable management is essential to reduce service calls due to cable failures.

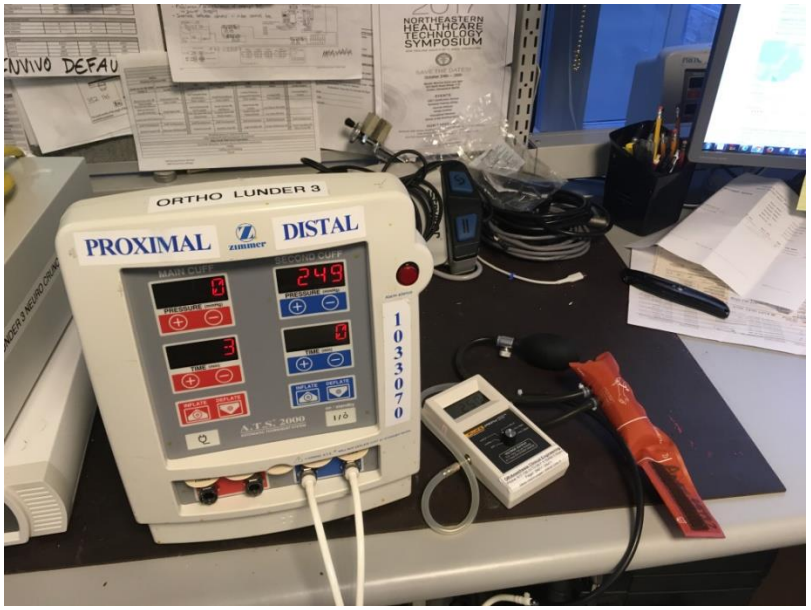
The OR table – It's remotely interesting

Hand controls and cables and power cords. "virex poisoning" skirt damage. All the usual problems.

Keep the tools needed to tighten brakes on drifting OR lights in your pocket. A folding bike tool works well

Always have a supply of spare hand controls. MDs are always damaging the cords or dropping them.

Tourniquets - here to pump you up!



A Manometer and a cuff wrapped around a gas cylinder for test and CAL

Power strips – do you have a Woodhead ?

If you have AIV Powermates, be sure you have a Woodhead tester to PM them. I always find receptacles with little or no pin retention pressure.

Do you have an AEM for RPTs ?

The Ideal Sure Test is a great tool for quick and accurate EST of RPTs

A test device to use on “urgent BP not working calls.

“no it’s not broken, your patient has no blood pressure”

Stabilant-22 making a PDM dock comm with the transport pro.

I can attach a BP hose directly to this and do a leak check, or let the MD do a manual BP.

Stabilant-22 for the win !

Stabilant 22 – to electronics, what antibiotics are to medicine. Enhance and create conductivity, don't be without it. www.stabilant.com

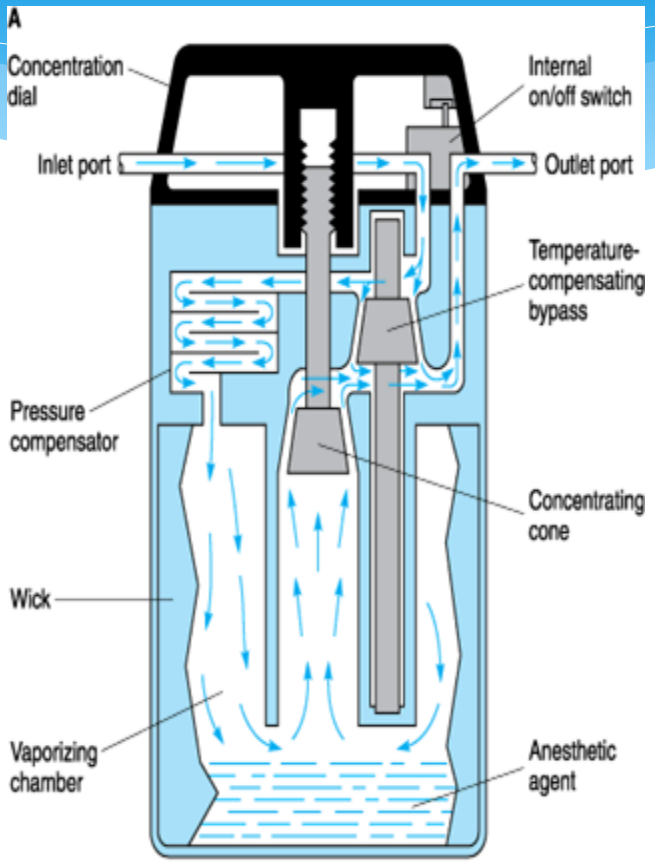
Questions?

Thank you for attending the 2024 Northeast MD Expo.

Vaporizers – Yes you can PM them In-house with a few simple tools. PM, concentration and leak checks

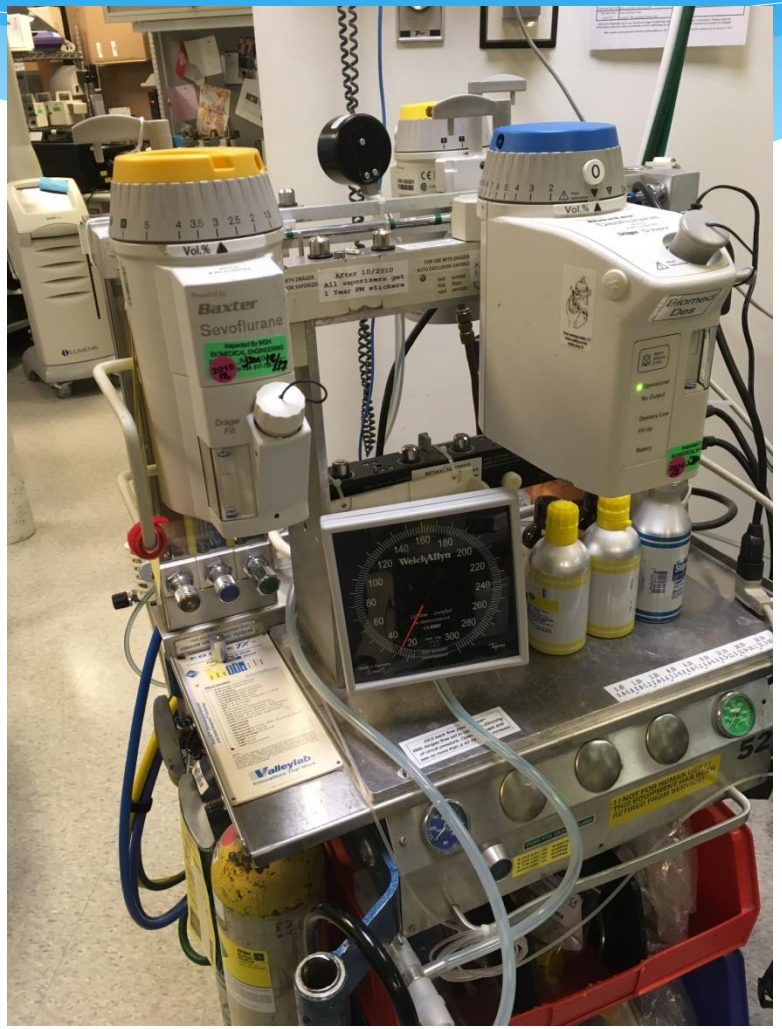
I am N1JSM, an FCC general class HAM radio operator. I recommend BMETs get the FCC Tech license. It is a great ($35) credential to have if you are working with telemetry, ESUs or wireless technologies.

The Draeger Vapor 2000 anesthesia vaporizer supplies anesthetic agent to the fresh gas stream. a MAC (minimum aveolar concentration) of 1, is the molecular concentration of an anesthesia agent that causes 50% of adults to be anesthetized to the point where the surgeon's cut will not cause a response stimuli in the anesthetized patient. Each different agent and drug has a unique MAC. Not all patients respond to the agent equally. Each agent has different mechanisms of action. As time has gone by, starting with Ether, agents have become better and safer at lower and lower MAC values. Anesthetic drugs and agents induce hypnosis, amnesia, analgesia, and muscle relaxation with corresponding changes in blood pressure, pulse or breathing. Choosing the correct drug or agent for the patient is a key part of the MD's plan for the patient under anesthesia during surgery.



The Test Rig

I use an old anesthesia machine to generate fresh gas. I flow AIR thru the vaporizer manifold, to the vaporizer under test at 2.5 liters a minute. I Have a Draeger scavenger hooked to wall suction for waste gas. I Tee into the gas line downstream of the vaporizers and send the gas to a GE SAM module to monitor agent % I monitor upstream of the manifold, for back pressure with a Welch-Allyn gage. I also use this to PM and test SAM modules as I can generate gas and agent mixes to test the SAM. (agent monitor)



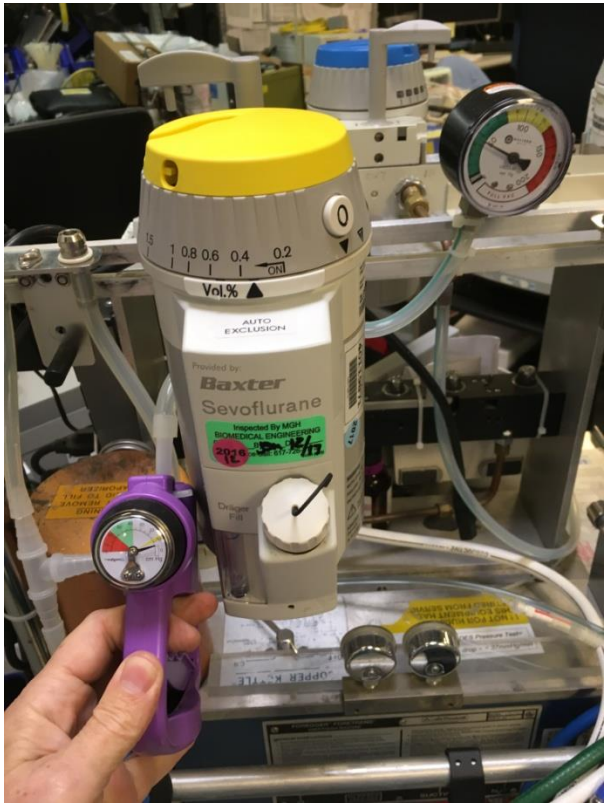
Pressure test with a BP gage

Do it with the vape off first to be sure the manifold does not leak.

Pressurize to 80mmHg and see no pressure drop for 5-10 seconds.

Negative pressure testing, if the sight glass is cracked, it will fill with bubbles…

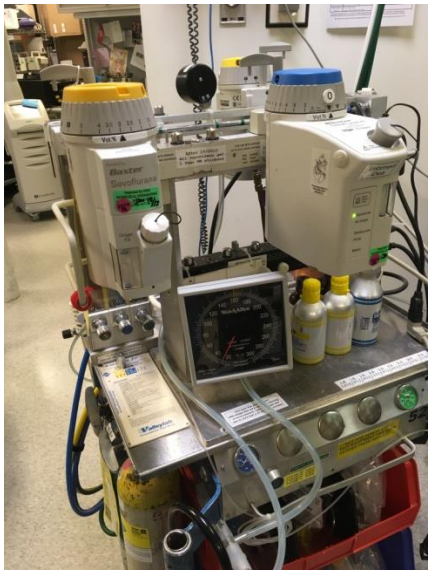
The purple pump comes from L/D it is a disposable suction device used to help the baby emerge. The suction gage id from a gomco. I pull 50mmHg of vacuum and wait 10 seconds for a drop.

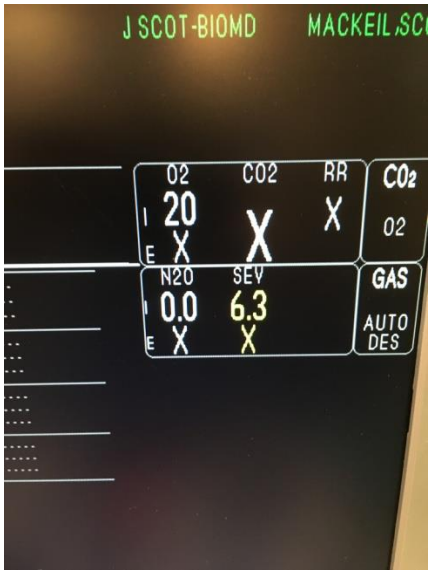


Testing a vaporizer

Put it on the manifold and turn the dial to 6% at 2.5 LPM of AIR flow. (note : run the SAM module on cardiac bypass mode when testing vapes)

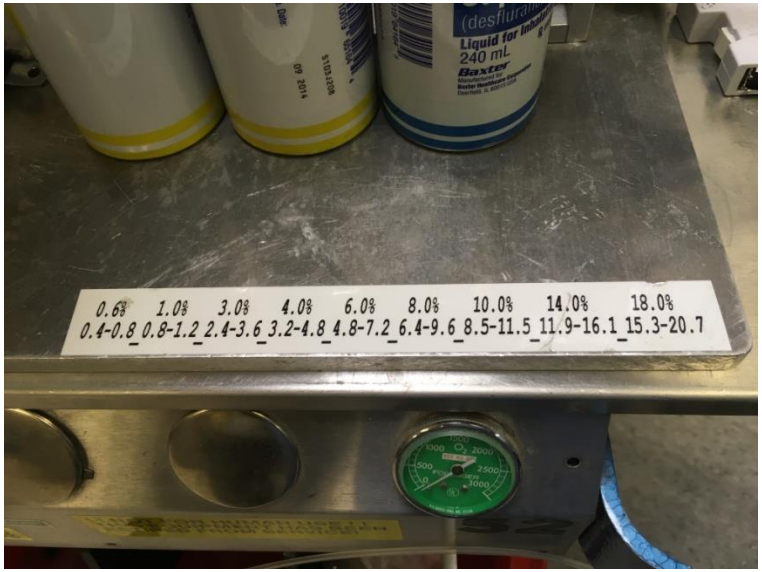
See 200cc for gas flow going into the SAM and see the result read out from the SAM on the Solar monitor.



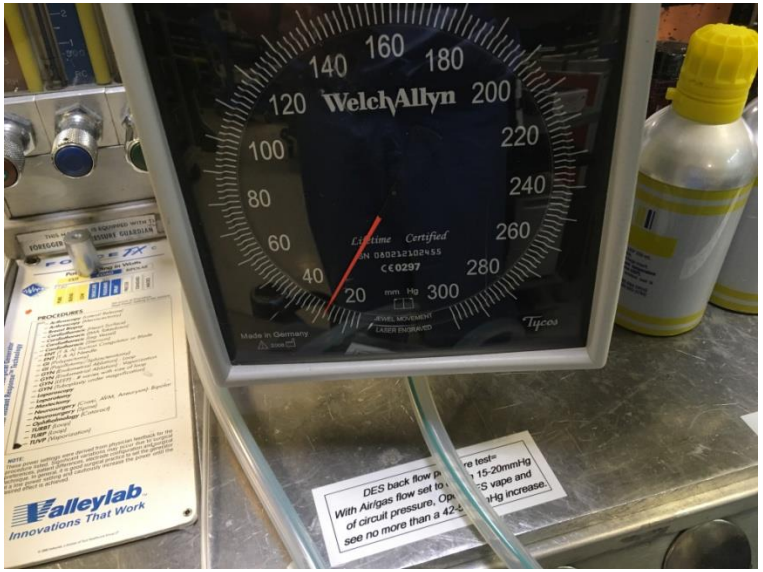


I start at 6% and go down 1 at a time checking the values against the tolerances on the sticker on my test machine. (DES is different)

The test values have a broad range



Typical back pressure is between 20-40 at 2.5 LPM of flow.



Fill out your 1 year PM sticker. I vary the position of the sticker on the front of the vape from cycle to cycle. I use a colored dot under the sticker cover to mark the year. You should be able to see an expired vape from the doorway of the O.R. just be seeing the position of the sticker and color of the dot on it.

After all 12 vapes are pressure tested and flow % tested, I keep a list of the CE#s and enter them the next day. I don't waste valuable nigh time work hours on data entry.

I push the cart back to the OR's I took them from and return them to their machines based on the room numbers I wrote on the old sticker on the %dial

One of the common problems are vaporizer “leaks” These are usually user errors involving cross threading the cap or getting the string caught in the threads after a refill. The other big issue, is they drop them on the floor and damage them. This calls for Depot service by G.A.S. for ISO vapes. SEVO and DES vapes are owned by Baxter and are depot serviced as part of your agent contract by contacting Draeger who will repair exchange it.

Normal Cap

Cross threaded

String caught in threads