Sustainable Anesthesia Initiatives

Lauren Berkow, MD
Associate Professor, Anesthesia and Critical Care Medicine
Johns Hopkins School of Medicine
Disclosures

• Member, Masimo Corporation Scientific Advisory Board
• Member, Teleflex Medical Scientific Advisory Board
• NO relevant conflicts of interest related to this lecture
Lecture Objectives

• Discuss barriers and obstacles to physician engagement in sustainability initiatives
• Show some examples of OR initiatives that have worked
• Provide tools, evidence and pearls for success to help you succeed at your institution!
Know your Speaker!

- Associate Professor, Neuroanesthesia
- Assistant Residency Director
- Director of Supplies and Equipment
- Member of ASA Task Force on Greening the OR
- Recently invited to speak at Clean Med 2013
- Recently appointed physician representative of my hospital systems Sustainability Leadership Council
Know your Audience...

• How many in the audience are...
  — Physicians? Anesthesiologists?
  — Nurses?
  — Administrators?
  — Other roles?
• How many are involved in greening initiatives in the OR?
Barriers/Obstacles to Physician Engagement

- Lack of education and knowledge
- Physicians are already too busy....
- Where is the data? Show me the evidence..
- Clinical priorities
- Educational Priorities
- Fear of legal liability
Australian Survey of Anesthesiologists

- Surveyed physician attitudes towards recycling
- 95% supported increase in recycling
- Perceived barriers:
  - Inadequate recycling facilities (49%)
  - Negative staff attitudes (17%)
  - Inadequate information about recycling (16%)

Barriers/Obstacles to Physician Engagement

• Lack of education and knowledge
• Physicians receive no formal education on climate change or sustainability
• NOT part of the medical school curriculum
• Physicians are already too busy....
  – Focused on patient care
  – Pressure to increase efficiency
  – Focused on educating residents
Barriers/Obstacles to Physician Engagement

- Where is the data? Show me the evidence..
- Clinical priorities
- Educational Priorities
- Fear of legal liability
Show Me the Data....
Why Should Physicians Care?

• Sustainability Initiatives:
  – Save hospitals money
  – Protect the environment
  – Improve patient health and healing
  – Improve staff health and well being
  – Remember as physicians, we vowed to
  – “First, do no harm”
Potential Impacts of Global Climate Change on Human Health

Global climate change effects:
- Temperature
- Sea level
- Precipitation

- Storms & flooding: Morbidity / mortality / displacement
- Heat: Morbidity / mortality
- Vector biology: Infectious diseases
- Air pollutants: Respiratory diseases
- Food supply: Malnutrition
- Civil conflict: Morbidity / mortality / displacement
Environmental benefits of recycling

• Promotes sustainable use of natural resources
• Saves energy
• Reduces pollution
• Stimulates green technology
• Decreases need to build landfills and incinerators
Lots of things can be recycled in the OR...

• Supply packaging
  – Paper
  – plastics
• Blue Wrap
• Unused, opened endotracheal tubes
• Empty glass medication vials
• Batteries
Why is Greening the OR Important?

• The Operating Room has a large footprint:
  – 30% of the supplies used in the hospital
  – Generates 20-30% of hospital waste
  – High use of plastics (30% of OR waste)
  – Largest producer of Red Bag Medical Waste
  – RMW disposal costs 4 times more than clear bag waste
Why is Greening the OR Important?

• Healthcare responsible for 8% of greenhouse gas emissions
• Inhalational Anesthetic Gases and Nitrous Oxide are greenhouse gases
• Scavenged Anesthetic Gas waste vented to the atmosphere and not regulated
Relative global warming impact of 1 MAC-hour of 3 inhaled anesthetics at 2 L fresh gas flow

### Tropospheric Lifetime and 20-Year Global Warming Potential of Inhaled Anesthetics

<table>
<thead>
<tr>
<th>Compound</th>
<th>Lifetime (y)</th>
<th>GWP$_{20}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide$^{15}$</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sevoflurane</td>
<td>1.2</td>
<td>349</td>
</tr>
<tr>
<td>Isoflurane</td>
<td>3.6</td>
<td>1401</td>
</tr>
<tr>
<td>Desflurane</td>
<td>10</td>
<td>3714</td>
</tr>
<tr>
<td>Nitrous oxide$^{15}$</td>
<td>114</td>
<td>289</td>
</tr>
</tbody>
</table>

8 MAC-hours of desflurane at 1-2 L FGF = 58-116 days of auto emissions
8 MAC-hours of sevoflurane at 2 L FGF = 4.8-9.6 days of auto emissions

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What about Propofol?

**Pros**
- Less greenhouse gas emissions than inhalational anesthetics

**Cons**
- Does require use of plastic tubing
- Disposal of unused propofol liquid not without risk:
  - Potential water and land contamination
How can we do better?

• Avoid Nitrous Oxide
• Consider inhalational anesthetics with lower green house gas potential (isoflurane)
• Consider use of IV agents (propofol)
How can we do better?

• Use regional anesthesia when appropriate
• Use Low flows-less waste vented to the atmosphere
• Consider anesthetic gas waste collection devices that reduce the amount vented to the atmosphere
An added Bonus:

• Isoflurane is less expensive than Sevoflurane and Desflurane
• Low flow usage can decrease overall inhalational gas usage
• This green initiative can also save your hospital money!
The Disposable vs. Reusable Debate

**Disposables**

- Often billable to patient
- No need for cleaning or sterilization
  - Potential cost savings
- No cross-contamination risk
- More landfill waste!
  - May release toxins if incinerated
- Solution:
  - Recycling
  - Reprocessing

**Re-usables**

- Often higher cost
- Require cleaning and sterilization
  - Water and energy use
  - Provider time
  - Toxicity of cleaning agents?
- Cross contamination concerns
- Do NOT add to landfill

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Cradle to Grave Concept

- Looks at entire life cycle of products
  - Manufacturing
  - Transport
  - Usage
  - Disposal
- Environmental impact of all steps considered
Cradle to Grave Concept

• Life cycle assessment often not applied to anesthesia supplies
• Expensive to perform
• Industry resistance to provide data-fear of their device being labeled “ecotoxic”
• Reusable items may be more favorable if disposal and toxicity of disposable items factored in...

Waste Reduction in the Operating Room

• Important not only for sustainability but also for cost containment
• Recent medication shortages
DO THIS!  NOT THIS!
Syringe Management

• Use prefilled syringes-less waste
• Also JCAHO compliant if prelabeled!
• Draw up only what will be administered
  – Reduces waste and disposal of vials, syringes
  – Reduces amount of unused medication requiring disposal
  – Saves money
  – Positive effects during medication shortages
What about Pharmaceuticals?

• Medications assigned a PBT score
  – Persistence, Bioavailability, Toxicity (PBT)
  – Assigned up to 3 points for each
• Propofol has a PBT score of 9
  – Must be incinerated to avoid water and land contamination
• Pharmaceutical waste has contaminated our water supply and soil
# Environmental Hazards of Anesthesia Medications

<table>
<thead>
<tr>
<th>Medication</th>
<th>Persistence(P)</th>
<th>Bioaccumulation(B)</th>
<th>Toxicity (T)</th>
<th>PBT Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propofol</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Labetalol</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Ondansetron</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Midazolam</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Ketorolac</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Metoprolol</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Lidocaine</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Morphine</td>
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<td>unknown</td>
<td>unknown</td>
<td>unknown</td>
</tr>
<tr>
<td>Succinylcholine</td>
<td>unknown</td>
<td>unknown</td>
<td>unknown</td>
<td>unknown</td>
</tr>
</tbody>
</table>
What about Pharmaceuticals?

- Studies have found drugs in drinking water and wastewater in 24 states
  - Antibiotics, anti-convulsants, mood stabilizers found

- Why?
  - Over-prescribing and over-use of medications
  - Disposal of medications by patients
    - Usually flushed down the toilet!
  - Disposal of medications by hospitals
  - Leaching from landfills
What about Pharmaceuticals?

• How can we help?
  – Prefilled syringes to reduce waste
  – Draw up only what you intend to use in the OR
  – Don’t empty unused medications into the scrub sinks—they enter the water supply eventually
  – Prescribe only truly needed medications
  – Educate patients not to flush unused medications

• Dispensary of Hope
  – Collects unused medications/samples and provides them to patients in need
PVC and DEHP

- DEHP: Di(2-ethylhexyl) phthlate, used to make PVC plastic soft and pliable
- DEHP present in IV tubing, catheters, blood bags, etc
- Concern that it may leach into solutions
- Many products now DEHP-free
- Potential health risk, especially to male neonates
  - 2002: FDA released public health notification on DEHP, recommend DEHP-free products when available
  - Many countries advocating DEHP-free products
Why PVC is Bad….

- Requires lots of chlorine and electricity to manufacture
- PVC components are carcinogens, heavy metals added to stabilize PVC
- Rarely recycled
- Releases dioxin when incinerated or placed in landfills
Green Efforts for the Anesthesia Provider

- Join the recycling and reprocessing efforts in the OR...or start them!
- Collect unused supplies for medical missions
- Improve efficiency and reduce waste
  - Draw up only medications and supplies to be used
  - Use low flow anesthesia
  - Use safer anesthetics when possible
    - TIVA
    - Regional anesthesia
• Anesthesia/Operating Room Initiatives
The first successful waste reduction effort....
Our Results!

Red Blood Cell Usage Results

• Red blood cell wastage reduced by 61%
• $800,000 in cost savings
• Wastage of blood in the operating room reduced to almost zero
• Did not take into account:
  – Savings from reduction in use of tubing, plastic
  – Savings from reduction in red bag waste

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The Next Project: Low Flow Anesthesia

• Stage 1: data collection from the electronic medical record about inhalational gas selection and flow rates
• Stage 2: Education about low flow and appropriate usage
• Stage 3: removal of Sevoflurane vaporizers from low use areas (available upon request)
• Stage 4: Data collection post-intervention
Our Results!

Gas Expense per FY

- 2009: $694,181
- 2010: $632,401
- 2011: $531,180
- 2012: $407,908
- Annualized: $477,4

Dollars

Fiscal Year

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Our Results!

Gases Monthly Spend

- DESFLURANE
- ISOFLURANE
- SEVOFLURANE
- Grand Total

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Ideal Utilization (Low Flows) greatly Improved for Desflurane

Desflurane Ideal Utilization

- Percentage: 0% to 100%
- Month: Baseline, May-11, Jun-12, Dec-12

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And For Sevoflurane-Low Flow and Short Case Duration

Sevoflurane Utilization all OR's

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Total misuse: how the next project started:
Purpose and Goals

• To develop a culture of:
  ➢ Sustainability in the peri-operative environment
  ➢ Waste reduction to promote cost savings
  ➢ Environmental stewardship in the peri-operative environment

• 5 components:
  ➢ Red Bag Trash Reduction
  ➢ Recycling
  ➢ Reprocessing
  ➢ Supply waste reduction
  ➢ Linen waste reduction
Pre-Interventions

• 50% of the trash at Johns Hopkins was red bag waste—more than 4 TIMES the national average

• In FY11, we documented $242,548 in wasted supplies from the operating room

• No recycling existed inside the operating room
Barrier #1: Lack of Knowledge

- Pre-intervention, we quizzed our residents and faculty on their knowledge of what should be placed in a red medical waste bag...
- They performed VERY poorly!
- This was not a surprise, based on our surveillance:
Clear Lack of Knowledge

• Anesthesia providers asked 7 questions related to what should go into a red waste bin
• Only 16% of respondents got all correct
• The majority of respondents got 50% of the questions wrong!
Another Barrier: Size and Scope

• 1200 bed hospital
• Over 300 anesthesia providers
  – 200 anesthesia attending physicians
  – 75 anesthesia residents
  – 40 CRNAs
• 60 operating rooms in Five different buildings
• Multiple remote anesthetizing locations
First Step: Education

Regulated Medical Waste

- Liquid or Semi-Liquid body fluids
- Soaked material that releases blood when compressed
- Plastic bags with the biohazard symbol

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Green Bag Recycling

What goes in:
- Paper
- Cardboard
- Bottles and beverage cans
- Mixed plastic
- Sterile outer Blue wrap
- Clear plastic
- All plastic bottles and caps

What does not:
- Waxed cardboard
- Carbon paper
- Tissues
- Plastic cups
- Styrofoam
- Egg-crate foam
- No gowns, gloves, masks

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Keep **RECYCLING** simple

**YES**

- Paper
- Plastic
- Cardboard
- Anesthesia circuits/masks
- Nasal cannulas
- Green O2 masks
- LMAs and ETTs
- Oral airways
- Empty glass vials

**NO**

- Gloves
- Gowns: yellow or blue
- Caps, masks, shoe covers
- Blue table drapes
- Blue OR bed covers
- Gauze/lap pads
- Chux
- **anything saturated with blood**
Second Step: Implementation

- Signage in ORs
- Phase 1: red bag use reduction
- Phase 2: recycling bins in the OR
- Added linen bins in the OR to reduce linen waste
- Added reprocessing bins in OR and PACU (for pulse oximeters)
Resident Recycling Survey

• 56 participants (75 residents in program)
• 86% recycle at home
• 95% aware of the OR recycling initiative
• Do you actively participate? 95% said yes
• Do you feel it makes a positive impact?
  – 50% “agreed strongly”, 50% “somewhat agree”
• Do you feel the recycling initiative is?:
  – Simple: 44.6%  confusing: 51.8%
  – A waste of time: 3.5%
Resident Recycling Survey

• Perceived Barriers:
  – Bins not easily accessible to the anesthesia team
  – Available bins in operating rooms not consistent
  – Affects efficiency in the OR
  – Takes additional time and effort during an already busy day
Reprocessing

Remanufacturing, cleaning, quality testing, repackaging, and sterilization

**Single use devices**
- Trocars
- Pneumatic tourniquets
- Harmonic scalpels
- External fixation
- Bits, burrs and saw blades
- Pulse oximeters

Services are provided by a Third Party Reprocessing vendor who is regulated by the FDA.
Results!

• Reduction in number of red bag trash cans in the OR
• More recycling in the OR (previously there was none!)
• Increased use of reprocessed items
  – Pulse oximeters
  – Surgical supplies
  – Pneumatic sequential devices
Reprocessing Program Benefits

• Participation
  o Five hospitals within the Johns Hopkins Health System participating
  o JHH Cardiology – reprocessing catheters for 15 years

• Medical waste reduction
  o National annual average of 100,000 lbs. or more per hospital
  o JHM CY11 actual collected devices = 27,000 lbs.
  o Weinberg CY11 OR actual collected devices = 4,200 lbs

• Cost Reduction
  o Average 40% reduction in product costs
  o JHM savings for CY 2011 over $1.2 million dollars
  o Projected savings for JHH OR is $500,000 for 2012
Johns Hopkins Hospital: 2012 Sustainability Success Report

• Reusable sharps container program diverted 150,422 pounds of plastic from the waste stream annually

• Reduced Regulated Medical Waste from 33.62% in January 2010 to 10.63% of total waste in January 2013

• Saved $1.1 million from reprocessing surgical supplies in 2012
Savings From Reprocessing!

Hopkins Healthcare Savings

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Johns Hopkins Hospital:
2012 Sustainability Success Report

• Other recycling efforts:

• Recycled 322,480 pounds of shredded paper since January 2012, with a 24% increase from Feb 2012 to May 2012.

• The recycling program has more than doubled the recycling rate from 7% in January 2012 to 14.6% in December 2012.

• Recycled 427.9 Tons of paper utilizing NexCut shredding in 2012.
Other Things you can do...

• Donate to medical missions:
  – REMEDY www.remedyinc.org
  – MedShare International www.medshare.org
  – Operation Giving Back
    www.operationgivingback.facs.org

• What can be donated:
  – Unused surgical supplies (sponges, gowns, gloves)
  – Used medical equipment
Get Involved!

• Find out what is being done at your hospital
  – Other departments may already have initiatives you can join
  – Or-start one in the OR!

• ASA Environmental Task Force
  – Focused on greening initiatives
  – Website with resources for ASA members:
    • Greening the OR manual
    • http://www.asahq.org/For-Members/Clinical-Information/Greening-the-Operating-Room.aspx
Get Involved!

• Practice Greenhealth
  – Lots of resources
  – CleanMed meeting
    • 2014 meeting:
    • June 2-5
    • Cleveland, Ohio
Ongoing Challenges

• Tracking!
  – Lots of data to analyze
  – Need to convert data into forms people will understand and respond to
  – Data needs to be measured and accessible to have an impact
The Leader in Sustainability Management Software

1. Automatically imports most data (no more spreadsheets!)
   – Credible data directly from the utility/vendor

2. Benchmarking, dashboards, scorecards, and reporting
   – Benchmark your facility nationally and within your system
   – Consistent system-wide reporting

3. All sustainability metrics (energy, waste, water, and food) tracked in one place

4. Supports multiple users in easy to use web based format

5. Designed specifically for hospitals
Ongoing Challenges

• **Compliance!**
  – The OR is a busy place—takes time to recycle

• **Space constraints**

• **Additional trash/recycling bins added to an already cluttered operating room**

• **Education Drift**
  – Education needed for new providers
  – Reminders needed for all providers
Pearls For Success

• Find Champions “in the trenches”
  – Nursing, support staff, residents, faculty
• You also need a Champion at the leadership level
• Start Slow-one implementation at a time
• Education is Key!
  – Increase awareness
  – LOTS of signage and reminders
• Culture Change is slow-be patient!
Summary

- Healthcare is a larger contributor to waste and global warming
- There are many steps we can take to reduce our carbon footprint in the OR
- These steps are also cost saving!
- The next generation is very “sustainability” savvy...they grew up with recycling
CHANGE

"Change is the essence of life. Be willing to surrender what you are, for what you could become".

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Don’t just sit in a OR STOOL....

Get Involved!