PROJECT CHARTER

Extended Breathing Circuits

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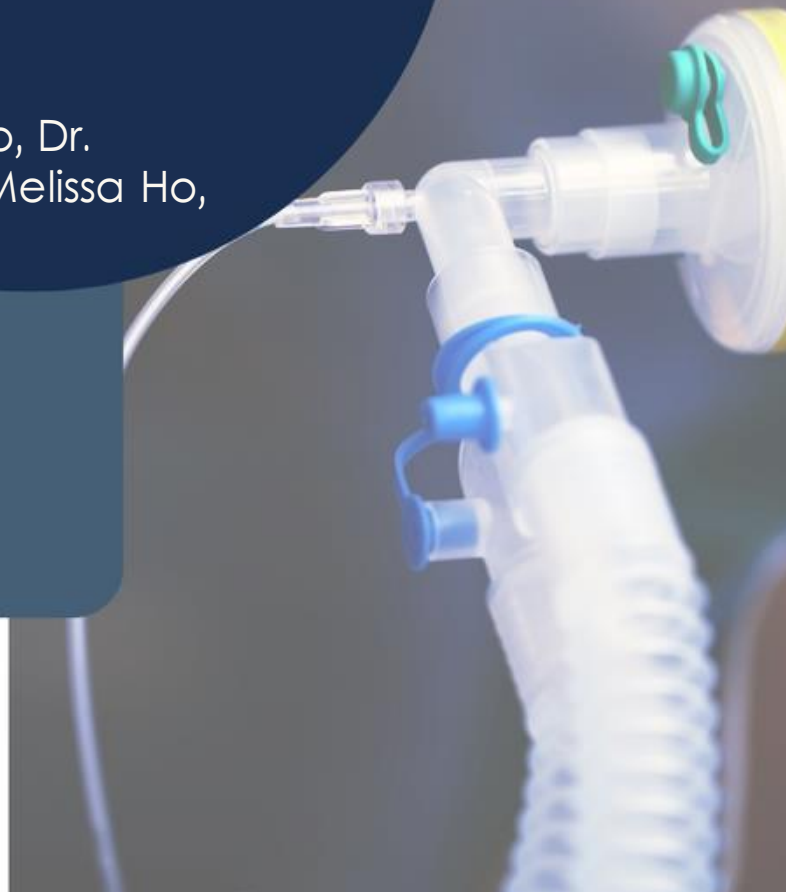
Executive Sponsor:



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NAVIGATION

Goal & Scope

1 What do you want to achieve?

Reduce waste associated with anesthetic breathing circuits by:

a) extending the use of disposable breathing circuits to seven days, or;

b) switching from disposable to reusable breathing circuits, and

c) where reusable circuits are already in use, extending the time between washes to seven days.

2 Define the limits of what you want to be included in the project and consider the environmental impacts you are targeting for change.

Project Scope: Extend use of all breathing circuits and replace disposable breathing circuits with reusable circuits amongst all anesthesia delivery units within the hospital, prioritizing operating rooms (ORs).

Emission scope: Scope 3; these emissions arise from activities or products that are related to health sector activities, but not owned or controlled by the organization, such as pharmaceuticals and other medical products and devices.

Problem/Opportunity Statement

3 Briefly state the problem you want to solve or the opportunity you want to realize.

Anesthetic breathing circuits are an essential component of anesthetic airway management, yet disposable breathing circuits are a source of plastic waste that contributes to the OR's sizable environmental footprint (1). While reusable breathing circuits offer a more sustainable alternative, these devices are often sterilized more frequently than necessary, wasting water and electricity. There are therefore three pathways to improve the sustainability of breathing circuits; a) extend the use of disposable breathing circuits from 24 hours to seven days; b) use reusable breathing circuits in place of disposable ones; and c) ensure the time between sterilizations for reusable breathing circuits is appropriate.

At most institutions, breathing circuits are customarily removed for decontamination at the end of a day/24 hour period. However, when breathing circuit use is extended to seven days (with circuit condensate emptied and patient–filters discarded after each case), there is no observed increase in bacterial contamination (2, 3). A site that uses disposable breathing circuits should ensure they are using each circuit for as long as safely possible to reduce waste. Costs will also be reduced as fewer disposable breathing circuits will be required.

Problem/Opportunity Statement

3 Briefly state the problem you want to solve or the opportunity you want to realize.

Replacing disposable breathing circuits with reusable ones, which can be used for approximately 12 months (4), is the next step toward improving their environmental performance. A life cycle assessment (LCA) comparing single-use and reusable anesthetic equipment, including breathing circuits, found that in countries with renewable electricity generation (such as Canada), using reusable devices could lead to more than an 80% reduction in emissions (5).

Ensuring that reusable breathing circuits are sterilized at appropriate intervals is also key. Extending use from 24 hours to seven days decreases electricity and water usage by over 50% (2). Furthermore, as in the case of extending the use of disposable breathing circuits, the ability to keep reusable breathing circuits in rotation for a longer period of time means fewer need to be purchased to be on hand, resulting in cost savings and increased resilience against supply chain shortages.

Current State of the System/Process

4 What do things look like today?

(A) For institutions that use disposable breathing circuits/use them for less than seven days:

- Breathing circuits are labelled as "single-use" and can be either generic or custom ordered for the institution.
- Disposable anesthesia breathing circuits are often procured as a just-in-time inventory item to reduce storage capacity.
- Prior to induction of anesthesia ventilation, patients undergoing surgery are preoxygenated through a mask that is connected to an anesthetic machine through a breathing circuit.
- Patients that require ventilation through a laryngeal mask airway (LMA) or endotracheal tube (ETT) are connected to the anesthesia gas machine through the breathing circuits.
- Additional filters are used on patient and inspiratory side.
    - Heat and moisture exchanger (HME) efficiency filters are placed at the patient-end of the circuit to both protect machines from contamination and to retain heat and moisture in the patient.
    - Since the COVID-19 pandemic, a second microbial filter is placed on the machine-end of the circuit's expiratory limb as an added precaution to prevent contamination of the innards of the machine.
- Depending on the institution, the breathing circuits are either disposed of at the end of the case in the general waste bins or disposed of at the end of the day. They are left in the OR for custodial staff to remove and are taken to the landfill by the waste haulers.
    - If patients have confirmed or suspected respiratory infections, breathing circuits are disposed of at the end of the case.

Current State of the System/Process

4 What do things look like today?

(B) For institutions that use reusable breathing circuits for less than seven days (from Ontario's Anesthesiologists (3)):

- Anesthesia circuits are changed daily before OR start by anesthesia tech / anesthesia assistant prior to the machine check.
- Anesthesia face mask and HME filter are changed per case.
- The average lifespan of breathing circuit tubing is approximately 12 months.
- "Dirty" Anesthesia circuits are sent to the central processing department (CPD) for reprocessing– circuit components are dismantled and sorted into specific washing apparatus and undergo a preprogrammed wash/rinse sequence.
- The preprogrammed sequence ensures breathing circuits are pasteurized automatically in washer disinfectors based on manufacturer instructions.
- Circuit pieces are hang dried in designated anesthesia dryers by component parts.
- When dry, circuits are assembled for anesthetic gas machines.

Root Cause Analysis

5 What gets in your way?

(A) For institutions that use disposable breathing circuits/use them for less than seven days:

Education & Awareness

- Lack of awareness of amount and environmental implications of plastic waste.
- Lack of awareness that it is safe to extend the use of disposable breathing circuits.
- Lack of awareness that when it comes to breathing circuits, 'single use' is a claim made by manufacturers.
- Infection prevention and control concerns exist from the misbelief that single-use breathing circuits provide higher quality and sterility assurance.
- Infection prevention and control concerns exist from the misbelief that extending the use of disposable breathing circuits increases the risk of infection in all scenarios.

Clinical Workflow

- Need to have a clear process to change a disposable circuit (day of week; after anesthesia for patients with respiratory infections or precautions).

Finances & Procurement

- Upfront costs of reusable breathing circuits are more expensive than single-use circuits, despite per use costs being much less with time.
- Hospitals may have existing contracts with a single-use vendor.

Root Cause Analysis

5 What gets in your way?

(B) For institutions that use reusable breathing circuits for less than seven days

Education & Awareness
- Lack of awareness that it is safe to extend use of reusable breathing circuits between washes.

Clinical Workflow
- If there is a mix of disposables and reusables on site, the reusables may be confused for disposable due to their similar appearance, and inadvertently thrown out.

Infrastructure
- Coordination required with the medical device reprocessing department (MDRD) to ensure that infrastructure is in place for cleaning, drying, and storing of circuits.
- While reprocessing equipment may be already in place, specific holders may be required to hold circuit components for cleaning.
- Specific circuit component dryer equipment may need to be purchased and installed.

Finances & Procurement
- Upfront costs of reusable breathing circuits are more expensive than single-use circuits, despite per use costs being much less with time.
- Hospitals may have existing contracts with a single-use vendor.

Design the Improvement & Define Change Ideas

6 What are your ideas to achieve your goals, address your root causes and close the gap from your problem statement?

(A) For institutions that use disposable breathing circuits/use them for less than seven days

Education

- Create an educational campaign that demonstrates the benefits of extended use, alleviates safety concerns, and aids in recognition of circuits designated by manufacturer for seven day use.

Clinical Workflow

- Develop a robust process for all team members to know when a disposable circuit needs to be changed (day of week; after anesthesia for patients with respiratory infections or precautions).
- Ensure involvement of Anesthesia Assistants, and OR Staff to integrate procedures such as changing filters.

Finances & Procurement

- Create a business case to show the cost savings of purchasing breathing circuits attested for seven day use compared to single use (optional: breathing circuits not attested for seven day use can be used for an extended period with precautions)
  - If a disposable circuit is used for an extended period (while keeping the same supplier), no initial cost.
  - If switching to a product where the manufacturer attested to the safety of extended use, cost per circuit will be higher, however total cost will be reduced.
- Contact the current supplier of the hospital's breathing circuits to determine how long use can be extended for; most circuits can be extended for 7 days. **(Resource: Letter from manufacturer attesting to safety of extended use for disposable breathing circuits)**

Design the Improvement & Define Change Ideas

6 What are your ideas to achieve your goals, address your root causes and close the gap from your problem statement?

(B) For institutions that use reusable breathing circuits for less than seven days

Education

- Create an educational campaign that indicates environmental benefits of switching from disposable to reusable anesthetic breathing circuits, demonstrates the benefits of extended use and alleviates safety concerns, and aids in the recognition of reusable breathing circuits and extended use breathing circuits that are designed for seven day use.

Clinical Workflow

- Develop a system to facilitate routine exchange of reusable breathing circuits for cleaning (after extended use).
- Ensure involvement of MDRD, Anesthesia Assistants, and OR Staff to integrate procedures of changing filters and face masks, cleaning external surface of breathing circuits, and exchanging reusable breathing circuits.
- If needed, transition using a hybrid model during a short period (i.e., 3 months) to ensure that there are breathing circuits in the institution when needed as training is occurring.

Infrastructure

- Ensure that supply volume accounts for enough circuits for active clinical use and those in the cleaning/drying process.
- Ensure there is an anesthesia/respiratory rack that can be used in the washer washer/disinfector in MDRD.
  Note: Collingwood General and Marine Hospital (CGMH) in Ontario uses this model to clean their anesthesia equipment.

Design the Improvement & Define Change Ideas

6 What are your ideas to achieve your goals, address your root causes and close the gap from your problem statement?

(B) For institutions that use reusable breathing circuits for less than seven days

Finances & Procurement

- Create a business case to show the cost savings of purchasing reusable breathing circuits compared to single use.
    - Note: One study concluded that switching from disposable to reusable breathing circuits in a six operating room hospital would result in a 46% decrease in costs (5)
    - Depending on actual pricing, up front cost of reusable tubing may equate to a few months supply of disposable tubing, leading to overall decreased per case cost with reusable tubing
- Consider switching other devices (such as anesthesia face masks) to reusables as well to justify autoclaving expenses.
- Contact the current supplier of the hospital's breathing circuits to determine how long use can be extended for prior to cleaning; most circuits can be extended for 7 days.
- Create a business case to show the cost savings of extending the time between washes of reusable breathing circuits to 7 days between decontamination
    - Note: One study reported an annual cost savings of $4,846 USD associated with reduced water and electricity use (2)

Measure & Test Impact

7 How will you estimate the environmental impact of your changes?

Activity/Outcome Metric		Related Environmental Metrics		Environmental impact
# reusable breathing circuits used per month Source(s): • Procurement data • MDRD • Self-audit Considerations: • Monthly counts are recommended to observe progress, but data can be processed for any given time frame.	X	**4.68 kWh electricity** **78.14 litres of water** Source(s): • McGain F, et al. 2014. (2) Considerations: • There are no known figures that would allow for a calculation of GHG emissions associated with disposable or reusable anesthetic breathing circuits. However, the figures here will allow for an estimate of the electricity and water savings associated with scenario C (extending the use of reusable breathing circuits to seven days). • The metrics above have been calculated based on a 2014 study that provides the total annual kWh of electricity and litres of water associated with washing 90 reusable breathing circuits. These annual figures have been divided by the number of circuits (90), then further divided by 12 months to arrive at estimates of the kWh electricity and litres of water required to reprocess an individual circuit. • This data does not come from a Canadian source and may therefore have limited applicability to the Canadian context.	=	Considerations: • These should be a REDUCTION in this number over time if you are extending the period between sterilizations. • **Calculations will yield ESTIMATES only**

Embed & Spread

8 What steps have been taken to ensure lasting change? How could it be spread to other contexts?

Micro (What can you do?)

- Build training for handling reusable breathing circuits into anesthesiologist and nursing orientation for all new hires, residents, fellows, and staff.
- Document your learnings to be shared with others (e.g., lessons learned that could be improved, what you learnt from your failures, how you course corrected, etc.).

Meso (What can you do within your organization?)

- Create an organization-wide policy to ensure all new supplies purchased for the hospital meet specific environmental sustainability standards.
- Reinvest any funds saved into other sustainability initiatives.

Macro (What can your organization do?)

- Advocate/lobby governments and corporations to make reusable breathing circuits more readily available and enforce extended producer responsibility for end-of-life management of waste.
- Advocate that vendors change the instructions on their products to reflect the safety of extended use of breathing circuits.
- Consider liaising with other hospitals to form coalitions with combined contracts.

References

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