

PROJECT CHARTER

Nitrous Oxide Waste Reduction

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Team Members: [insert the departments who will lead the project] Dentistry; Mother and Babies Unit; Operating Room; Anesthesia; Plant Operations; Vendor; Procurement (e.g., Plexxus)

Executive Sponsor:

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Canada





A modifiable PPT version of this project charter can be [downloaded](#) to be applied to your own healthcare setting. To access all downloadable project charters featured in this playbook, click [here](#).

Please contact CASCADES@utoronto.ca if you have any questions.

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Goal & Scope

1 What do you want to achieve?

Reduce nitrous oxide (N₂O) wastage by __% over the next ___ months.

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: The entirety of the hospital, as since gas leaks can occur anywhere that N₂O is located. Examples include:

- Within individual ORs, Labour & Delivery wards, dentistry clinics, etc.
- Gas manifolds
- Outlets with Schrader valves
- All N₂O piped infrastructure
- Tanks/storage containers of N₂O

Emission Scope: Scope 1; these emissions are direct GHG emissions originating from sources controlled and owned by an organization, such as on-site boilers and certain medical gases.



Problem/Opportunity Statement

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

Nitrous oxide (N₂O) as a greenhouse gas is almost 300 times as toxic as carbon dioxide (CO₂), and it contributes 75% of global medical gas greenhouse (GHG) emissions. It remains in the atmosphere for up to 150 years, and has ozone depleting properties.⁽¹⁾ Along with eliminating desflurane from formulary, addressing high N₂O emissions is a key component of addressing anesthesia related GHGs in perioperative care and beyond.

While N₂O poses environmental problems, the principal issue associated with its use in health care is not the administration of the gas itself, but rather its wastage – specifically via leaks at the manifold, outlets with Schrader valves, leaks in operating rooms (OR) and leaking in aging piped infrastructure, as well as poor stock management and flaws in system design.⁽¹⁾ A series of micro-leaks can result in huge wastage over time. Indeed, wastage is suspected to be the principle source of N₂O consumption in the hospital environment; this damages the environment unnecessarily and wastes money.⁽²⁾ There are also potential exposure risks to staff and patients that may be mitigated by reducing N₂O wastage.⁽³⁾



Problem/Opportunity Statement

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

Several efforts to address this issue are already underway in the United Kingdom as part of the Nitrous Oxide Project. Participating sites have uncovered huge wastage; at National Health Service (NHS) Lothian, for example, wastage through leaks and long pipe systems was determined to be responsible for 98% of N₂O use; they were able to reduce N₂O consumption by 75–100% per institution through addressing infrastructure and leakage. Similarly, Providence Health in the United States (US) determined that 95–98% of their medical N₂O was wasted through leaks. By switching to smaller tanks in their OR and procedure rooms, they decreased this to less than 1%. (4) Similar initiatives are now in the planning or implementation stages at some Canadian hospitals, with Sunnybrook Health Sciences Centre in Toronto, Ontario, leading the way. In the past five years, Sunnybrook has purchased 32,599 Kg of N₂O – equivalent to nearly ten million kg of CO₂ in terms of global warming potential (GWP). Initial enquiries with clinicians suggest – anecdotally – that current clinical use is low, indicating tremendous opportunity to reduce N₂O use by uncovering and addressing leaks.

Such work requires the collaboration of a multidisciplinary team, including clinicians, pharmacists, facilities managers, and others.



Current State of the System/Process

4 What do things look like today?

- N₂O is used throughout the hospital, including ORs.
- Wastage occurs when there are leaks at the manifold, outlets with Schrader valves, leaks in OR and leaking in aging piped infrastructure, as well as poor stock management and flaws in system design (1).
- Micro-leaks result in huge wastage over time, such that there is a mismatch between clinical use and total consumption.



Root Cause Analysis

5 What gets in your way?

Education & Awareness

- Clinicians have no idea N2O is being wasted as leaks are not visible.
- The discrepancy between overall N2O consumption and actual clinical use is not known.
- Where clinicians are informed of efforts to reduce N2O wastage, there is provider resistance due to lack of awareness of the scope of the project (many clinicians think the project is aiming to prevent them from administering N2O).

Clinical Workflow

- Project team lacks expertise required to address the issue as plant operations is the expert in this area and often not included in quality improvement projects.
- Difficulty engaging with every clinical team since N2O is used throughout hospital.



Root Cause Analysis

5 What gets in your way?

Infrastructure

- Complexity of system (N2O provided via multiple systems, multiple sites and to multiple areas at each site via different mechanisms) makes it difficult to establish where leaks are coming from.
- Difficult to measure average amount of N2O used through a case.

Finances & Procurement

- No mechanism for clinical team to report clinical usage vs total consumption; procurement sources supply without understanding how much is being wasted.
- Vendor (and purchasing agent) lack of engagement.



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?

Education & Awareness

- Develop education and key communication messages. (**Resource: Sunnybrook Briefing Note**)
 - The GWP of N₂O.
 - The causes and extent of N₂O wastage.
 - The **dangers of unnecessary N₂O exposure**.
- Engage stakeholders by sharing the key messages at the business meetings of the various clinical teams who use N₂O in their practice.

Clinical Workflow

- Compare usage information with consumption information to determine if there is a mismatch.
 - Identify clinical usage of N₂O through qualitative and quantitative (if available) methods.
 - Identify and collaborate with the various clinical teams that use N₂O.
 - Develop and implement a survey for clinicians on usage (qualitative).
 - Determine if it is possible to quantify usage volumes for average cases with chart reviews; conduct chart reviews if feasible (quantitative).
 - See if EMR can log usage.
- Review volume of purchased N₂O with procurement/plant operations.



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?

Infrastructure

- Collaboration of Plant Operations – engage the expertise of Plant Operations, and seek to have representation on the project team.
- Ask Plant Operations to identify current gas management practices.
 - Review and document piped N₂O schematics with Plant operations.
 - Determine stock rotation processes in manifold banks.
- Identify sources of waste within the system through audit of:
 - Manifold logs.
 - Gas company sales and delivery data.
 - Manifold leak tests.
- Determine if it is possible to adjust N₂O pressures to address usage and residual volumes.
- Consider decommissioning the manifold and switching to cylinders at point of use (6,7):
 - Note: in the [Intercollegiate Green Theatre Checklist](#), the authors recommend that: “N₂O manifolds for theatres should be decommissioned and replaced with local cylinders to combat widespread issues with pipeline and manifold leakage, as well as stock control (guidance for decommissioning can be found on the Association of Anaesthetists’ Nitrous Oxide project page)”(6). **(Resource: [Piped Nitrous Oxide Waste Reduction Strategy](#))**



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?

Finances & Procurement

- Engage with vendor early on to gauge their willingness to assist with project (i.e., help audit leakages or identify new products to reduce leaks).
- Purchase small canisters once N₂O supply in large cylinder has been used as these are less likely to result in major wastage (no large tank, no pipes, etc.).



Measure & Test Impact

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

Activity/Outcome Metric

1. Consumption: Total amount of N2O purchased by organization in kg
2. Clinical Use: Total amount of N2O used clinically in each clinical area A) by kg OR B) by hour.

Source(s):

- Procurement data
- Vendor data
- Machine log
- Self audit

Considerations:

- Review the **Nitrous Oxide Briefing Note Template** for guidance from Sunnybrook Health Sciences Centre on how to calculate #1 (see below)
- Chang and Smith offer the following methodology for #1 and #2:

"The N2O supply data provided by the pharmacy team was over a period of 10 months for the year 2021–22. To quantify the clinical usage...we captured the cumulative N2O usage over a 20-day period, using the data obtained from the service mode on each anaesthetic machine. From there, we extrapolated and calculated the annual estimated supply, usage, and wastage amount." (7)



Related Environmental Metric

1. 286 kg CO2e (per kg N2O)
2. A) 266 kg CO2e/kg N2O;
B) 15.8 kg CO2e/hour

Source(s):

- Muret, et al. 2019 (8)

Considerations:

- For 2: The GWP100 of 1 h of 50% N2O at a FGF of 1 L min⁻¹ is 53.2 g x 298=15.8 kg of CO2. (8)

To calculate your purchase data, contact your vendor or plant operations to find out how much N2O you have purchased in the past number of years you want to look at – (e.g., 5 years).



Environmental Impact

Considerations:

- Tally the kg CO2e for consumption (#1)
- Tally to kg CO2e for clinical use (#2)
- Subtract #2 from #1; this number is the discrepancy between amount consumed vs amount used clinically
- There should be a REDUCTION in this overall number over time as you address leakage
- To translate your results to stakeholders:
 - Use the [Natural Resources Canada Greenhouse Gas Equivalencies Calculator](#)
- **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?)

- Embed the importance of reducing N2O wastage for the environment in anesthesia/clinician onboarding.
- Once wastage is addressed, consider shifting attention to more environmentally friendly N2O alternatives.

Meso (What can you do within your organization?)

- Perform regular audits of N2O consumption vs. clinical use to facilitate early identification of leaks, and establish areas for improvement.
- Shift to use of small canisters.

Macro (What can your organization do?)

- Share findings with other organizations such as ONSQIN and CASCADES.



References

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