

# SUSTAINABLE PERIOPERATIVE CARE

## Project Charter Summary

MINIMIZE DIRECT EMISSIONS

### Nitrous Oxide Waste Reduction

Nitrous oxide (N<sub>2</sub>O) is a greenhouse gas almost 300 times as toxic as carbon dioxide (CO<sub>2</sub>), and it contributes 75% of global medical gas greenhouse (GHG) emissions. N<sub>2</sub>O *remains in the atmosphere for up to 150 years, and has ozone-depleting properties.* However, the principle source of N<sub>2</sub>O emissions is not the administration of the gas itself, but rather its wastage. N<sub>2</sub>O is notorious for leaking out of gas manifolds, outlets with Schrader valves, and aging pipe infrastructure: really anywhere that the gas is stored, piped, or delivered.



**PROJECT CHARTER:** See the full version of the project charter for more change ideas, details, and a complete list of references.

In the United Kingdom's [Nitrous Oxide Project](#), institutions that took the simple steps to evaluate and address aging infrastructure and leaking systems were able to reduce their N<sub>2</sub>O consumption by 75-100%.

Similar initiatives have begun to be implemented at a variety of Canadian hospitals, including Vancouver General Hospital (Vancouver Coastal Health) and Sunnybrook Health Sciences Centre (Toronto, ON), to capitalize on the tremendous opportunity to reduce wasted N<sub>2</sub>O.

Most N<sub>2</sub>O purchased by hospitals leaks into the atmosphere without every being used.

Administered to Patients

Wastage

**GOAL:** Reduce nitrous oxide wastage by addressing sources of consumption beyond clinical use

**PROJECT SCOPE:** Institution-wide (as gas leaks can occur anywhere that N<sub>2</sub>O is stored, piped, or delivered)

**EMISSIONS SCOPE:** Scope 1 (direct GHG emissions originating from sources controlled & owned by the organization)

### ESTIMATING IMPACT

#### ACTIVITY/OUTCOME METRIC

Consumption (amount of N<sub>2</sub>O purchased by organization in, kg) and Clinical Use (amount of N<sub>2</sub>O used clinically in each clinical area A) by kg OR B) by hour.)

- Can be sourced from procurement data, vendor data, anesthetic gas machine logs, and or self-audits.
- Tips on calculating consumption can be found in the [Nitrous Oxide Briefing Note](#) from Sunnybrook Health Sciences Centre (Toronto, ON) and [Chang & Smith, 2022](#).

\*See [Project Charter](#) for references

#### RELATED ENVIRONMENTAL METRIC

Emissions from N<sub>2</sub>O in kg CO<sub>2</sub>e

- Option 1: N<sub>2</sub>O has an equivalency of **298 kg CO<sub>2</sub>e/1 kg**.
- Option 2: Delivered at a concentration of 50% with a fresh gas flow of 1 L/min, N<sub>2</sub>O has an equivalency of 15.8 kg CO<sub>2</sub>e/hr.

#### ENVIRONMENTAL IMPACT

Estimation of total impact in kg CO<sub>2</sub>e

- Tally the kg CO<sub>2</sub>e for both consumption and clinical use.
- Subtract clinical use total from consumption total for an estimate of the amount of the environmental impact of wasted N<sub>2</sub>O.
- There should be a reduction in this number over time as you address leakages in your center.

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## Root Causes and Change Ideas for Nitrous Oxide Waste Reduction



**PLAYBOOK:** View the playbook for other perioperative sustainability opportunities and resources.

**VIDEO:** Reducing N<sub>2</sub>O Wastage with the Sunnybrook team

Because N<sub>2</sub>O leaks are invisible, clinicians may not realize that N<sub>2</sub>O is being wasted. The discrepancy between N<sub>2</sub>O purchased by hospitals and actually delivered clinically is not widely known.

### EDUCATION & AWARENESS

- Develop education and key communication messages. (Resource: [Sunnybrook Briefing Note](#))
  - The GWP of N<sub>2</sub>O.
  - The causes and extent of N<sub>2</sub>O wastage.
  - The **dangers of unnecessary N<sub>2</sub>O exposure**.
- Engage stakeholders by sharing the key messages at the business meetings of the various clinical teams who use N<sub>2</sub>O in their practice.

Project teams may lack the technical expertise necessary to address issues of storage and piping (the expert in this area is Plant Operations). Because N<sub>2</sub>O is used in a variety of hospital settings, it can be challenging to engage with every relevant clinical team.

### CLINICAL WORKFLOW

- Compare usage information with consumption information to determine if there is a mismatch.
  - Identify clinical usage of N<sub>2</sub>O through qualitative and quantitative (if available) methods.
    - Identify and collaborate with the various clinical teams that use N<sub>2</sub>O.
    - 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 N<sub>2</sub>O with procurement/plant operations.

The clinical team may understand usage but not supply, while procurement sources supply without measurement of usage. Vendors have no financial incentive to participate.

### 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 N<sub>2</sub>O supply in large cylinder has been used as these are less likely to result in major wastage (no large tank, no pipes, etc.).

N<sub>2</sub>O delivery is complex: it is often stored in multiple places, and delivered in multiple ways to multiple areas. This can make it difficult to establish where leaks are coming from. In the OR, it can also be difficult to precisely measure the amount of N<sub>2</sub>O used during an operation.

### INFRASTRUCTURE

- Engage with the expertise of your institutional Plant Operations team, and seek to have their representation on the project.
- Ask Plant Operations to identify current gas management practices.
  - Review and document piped N<sub>2</sub>O 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 N<sub>2</sub>O pressures to address usage and residual volumes.
- Consider decommissioning the manifold and switching to individual cylinders at the point of care.
  - The [Intercollegiate Green Theatre Checklist](#) recommends that: “N<sub>2</sub>O 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](#))”.