**Information about you and the project:**

**Contact name:**

**Dr Jason Lie**

**Dr Baillal Shahid (ST6 Anaesthetics Registrar NW)**

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**Role:**

**Dr Jason Lie (Consultant Anaesthetist and Sustainability Lead ELHT)**

**NHS organisation: East Lancashire Teaching Hospital NHS Foundation Trust**

**Location & NHS England Region: Royal Blackburn Teaching Hospital & Burnley General Teaching Hospital, North West England**

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**Greener NHS Workstream: Medicines – Anaesthetic Gases**

**Key message:** The climate health emergency is a worldwide problem that we all have a responsibility to address. NHS England contributes to 4-5% of the country’s total carbon footprint, with anaesthetic gases making up 5% of this2. The Greener NHS Campaign has set a target for the NHS to achieve net zero carbon footprint by 2040. Reducing the use of specific anaesthetic gases such as nitrous oxide in clinical practice is an absolute necessity in order to achieve the net zero carbon footprint goal.

**Primary audience: Trust sustainability leads, medical gases teams, anaesthetic departments**

**Risks/ Red Flags: Nil red flags identified**

**Has this case study or story been made public in any form before?A full and complete case study surrounding the nitrous oxide project conducted at ELHT (Royal Blackburn Hospital and Burnley General Teaching Hospital) has not been published before. Elements of the project have been or will be presented in various forms at the following:**

1. **World Congress of Anaesthesiologists September 2021 (Blackburn arm)**
2. **E-SAT 5/9/21**
3. **AHSN Network – reducing the carbon impact of anaesthetic gases 28/9/21**
4. **Greener NHS regional roadshow 10/11/21**
5. **Manchester Medical Society 10/2/22**
6. **CLEAR NW 2/2/22 (Burnley arm)**
7. **Anaesthesia 2022 (Blackburn and Burnley combined)**
8. **American Society of Anesthesiologists Conference – November 2022 (Blackburn & Burnley combined)**

**Sign-off steps required before this case study can be made public:**

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**CASE STUDY**

Title

Nitrous Oxide: The Great Escape at ELHT

What was the problem?

NHS England is estimated to contribute 4-5% of the country’s total carbon footprint. The NHS has set targets of achieving net zero emissions by 2040 with an 80% reduction in carbon footprint by 2028. It is estimated that anaesthetic gases contribute to 5% of the total NHS carbon footprint.

Nitrous oxide (N2O) is a medical gas that has been part of anaesthetic use since its discovery in 1772. Although its widespread use has mostly been superseded in modern practice with the availability of superior pharmacological agents, it is still used commonly in anaesthetic practice.

The use of N2O comes with a significant environmental cost. The global warming potential (GWP) of N2O is 310x that of CO2 with a physical atmospheric presence of 150 years. As such, the use of N2O represents a relatively large proportion of both anaesthetic and NHS CO2 footprints.

The Nitrous oxide mitigation project in NHS Lothian identified that trust usage of N2O can be significantly reduced without impacting clinical practice. The project found that leaks within the often very old, manifold systems can contribute massively to trust N2O usage and subsequent CO2 footprints.

What was the solution?

The Nitrous Oxide Mitigation Project was launched in 2021 by Alifia Chakera in NHS Lothian, Scotland. This project recognises the declining use of N2O in routine anaesthetic practice and its significant environmental impact.

The project identified waste via significant leakages in the N2O storage systems at multiple trusts covering NHS Scotland. At Lothian a significant pipeline leak was demonstrated resulting in the decommissioning of the N2O manifold reducing N2O consumption by 98% for the same clinical use.

At ELHT, we aimed to replicate the nitrous oxide mitigation project with the following specific aims:

1. Evaluate the size and suitability of the nitrous oxide manifold to current clinical requirements at ELHT.
2. Evaluate our environmental impact in relation to N2O use.
3. Identify areas of waste i.e. leakage in the storage and distribution infrastructure.
4. Emphasise growing need for dedicated commitment to environmental sustainability going

forward as a department.

Our nitrous oxide use was evaluated via the following methods:

1. Review of manifold designs and logbooks at each ELHT site
2. Review current anaesthetic usage by assessment of anaesthetic machine logbooks
3. Survey of ELHT anaesthetists to review current practice regarding N2O use.

What were the challenges?

As expected with a project of this size and scale, we had a significant number of challenges which required addressing. The main challenges that we encountered are as follows:

* Locating the correct main stakeholders in the correct departments to investigate crucial items of information related to our investigation of the problem
* Communicating with and involving the major key stakeholders when gathering information and presenting our findings. The main stakeholders included the anaesthetic department, pharmacy, estates, medical gases department and ultimately trust level executives.
* Implementing a unified solution, with agreement from all involved across multiple departments in a large NHS organisation. The challenge here was fostering agreement on the solution between all involved departments and stakeholders in a relatively quick timeframe.
* Enforcement of annual hazardous gas monitoring in all clinical areas at both sites in accordance with COSHH guidelines

What were the results/Impact?

At the Blackburn site we found extremely high manifold N2O turnover of **8,262,000L in 2 years**, equating **to 5,031 tonnes in CO2e**. In comparison, anaesthetic machine usage data produced an extrapolated yearly usage of approx. **11,000L.** Clinical use is **0.26%** of manifold turnover. The pipeline was formally tested and **demonstrated a large leak.** In Q2 2021 the pipeline was **isolated and decommissioned** as repair was deemed to be unjustifiable.

At the Burnley (BGH) site we found high manifold N2O turnover of **198,000L in 1 year** equating to **121 tonnes of CO2e. I**n comparison, anaesthetic machine usage data produced an extrapolated yearly usage of approx. **42,960L.** Clinical use is **21.6%** of manifold turnover.

The pipeline at BGH has been decommissioned as of 18/05/22.

N2O remains available at both sites via directly attached machine cylinders.

The N2O leak at Blackburn is an enormous environmental and financial burden to the tune of **£12,500 and an estimated CO2e of 2,515 tonnes per annum.** A 10-year extrapolation equates to **£126,000 & 26,000 tonnes of CO2e**.

Size E portable N2O cylinders are estimated to cost the trust **£87 and generate a CO2e of approximately 7.6 tonnes per annum if fully discharged.**

What were the learning points?

The main learning point that has stemmed from this project is that tight communication between involved departments is crucial to identifying and solving problems early. There has been a generalised feeling that had there been closer communication between the anaesthetics department (nitrous oxide end users), pharmacy department (responsible for ordering nitrous oxide cylinders) and estates (responsible for changing nitrous oxide cylinders) the scope of the problem could have been identified much earlier. This would have led to significant cost and environmental savings and an earlier solution to the problem (pipeline leak and enormous waste of nitrous oxide) that was ultimately discovered.

Furthermore, the following learning points have been identified:

* The need for a dedicated sustainability lead to promote not just departmental sustainability efforts but to promote sustainable practice across the entire organisation. This role has now been fulfilled by Dr Jason Lie as a new director in sustainability for ELHT.
* Momentum towards targeting reducing use of other anaesthetic gases such as desflurane and to a lesser extent sevoflurane with a focus on promoting low flow anaesthesia

Next steps

ELHT as an organisation aims to continue to promote sustainable healthcare and greener anaesthesia. The goals for ELHT in the near future are as follows:

* Promoting a culture of environmental sustainability and encouraging environmentally friendly practice
* Regular audit and review of departmental consumption of volatile anaesthetic agents, use of N2O manifold efficiency, total departmental CO2 footprint
* Promoting strategies to minimise CO2e emissions from volatile anaesthetics and N2O use including introducing volatile recapture devices into anaesthetic practice, trialled in September 2022
* Implementing departmental strategies to minimise total waste and promote appropriate disposal of recyclable material i.e. plastic and paper packaging – Recycling QI Project completed
* Publication of bi-annual departmental ‘green newsletter’ promoting environmental sustainability and good practice
* Sustainability link with other sustainability leads across the North West deanery – Dr Jason Lie part of North West group

Want to know more?

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