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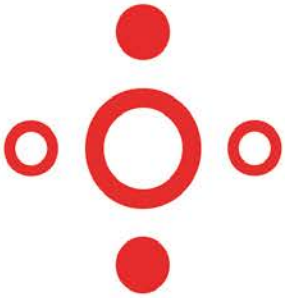

Policy for the sustainable procurement, management, administration and disposal of medical gases within the hospital setting to achieve decarbonisation

May 2025

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Purpose

This document sets out the policy for the procurement, management, administration and disposal of medical gases within the hospital setting to achieve decarbonisation. This policy is relevant to all medical gases through its' principles.

While the principles and recommendations could be applied to many medical gases, this policy focuses on nitrous oxide (N_2O) and 50% nitrous oxide and 50% oxygen mix commonly known under the tradename Entonox®, as these gases have the highest impact due to high global warming potential and high-volume usage. It has been demonstrated that more than 90% of N_2O is wasted before it reaches a patient[1]. Significant efforts are now being made to work on the NHS carbon footprint of Entonox®. It is a potent Greenhouse Gas (GHG) and dominant ozone-depleting substance with an atmospheric life close to 115 years[2]. Therefore, the most impactful actions to support decarbonisation point to those aimed at reducing wastage of Entonox® and N_2O.

The NHS Wales 2018/19 Carbon Footprint has been calculated as ~1 million tonnes of carbon dioxide equivalence (tCO_2e)[3]. The NHS Wales decarbonisation target for 2025 is 845,600 tCO_2e, a 16% reduction, and target for 2030 of 661,500 tCO_2e, a 34% reduction, as set out in NHS Wales decarbonisation strategic delivery plan[4].

The policy intends to prevent environmental harm such as carbon dioxide ($CO_{2)}$ emissions, pollution and negative impacts on biodiversity. This aligns to the Net Zero Policy for Public Sector by 2030 (WHC/2021/024)[5] and NHS Wales Decarbonisation Strategic Delivery Plan, 2021-2030[4]. The policy utilises the five sustainable development principles, which are collaboration, integration, involvement, long term and prevention in creating the below recommendations and actions[6].

This policy intends to drive sustainable value through preventing waste, empowering staff and patients, lean service delivery and using low carbon alternatives, in alignment with the principles of sustainable healthcare[7]. Economic savings might ensue, but this is not the policy's primary aim.

The key principle of this policy incorporates 'Sustainable Development' (Well-being of Future Generations Act, 2015)[6]; "Public bodies need to make sure that when making their decisions they take into account the impact they could have on people living their lives in Wales in the future"[6].

This document will be imperative to anyone involved in the four steps of procurement, management, administration and disposal of medical gases, as well as being important information for the medical gas industry.

This work is aligned with NHS Wales Decarbonisation Strategic Delivery Plan[4], specifically Approach to Healthcare Initiatives 40 and 41; the decarbonisation of medical gases. Further association can be made with Net Zero Policy for Public Sector by 2030 (WHC/2021/024)[5], A Healthier Wales[8], Well-being of The Future Generations Act, 2015[6] and Prosperity for All: A Low Carbon Wales[9].

Scope

The policy provides a set of recommendations and example actions that promote best practice for procuring, managing, administering and disposing of medical gases within the hospital setting.

This policy will focus on 50% nitrous oxide and 50% oxygen - Entonox® and N_2O - building upon previous work undertaken regarding sevoflurane, isoflurane and desflurane (hydrofluorocarbons used solely by anaesthetists). This policy places emphasis on decarbonisation; a focus on population health whilst ensuring excellent, high quality individual patient care within a hospital setting.

Background

Medical gases are damaging to the environment through their Global Warming Potential (GWP). GWP is a measure of the relative contribution of mass of inhalational anaesthetic agents to an equivalent mass of CO_2, their potential to damage the ozone layer and the carbon footprint associated with manufacturing, procurement, administration to the patient and disposal of medical gases[10].

GHG emissions can be broken down into scope 1, scope 2 and scope 3, with scope 1 and scope 2 being mandated and scope 3 optional[11]. Scope 1 can be defined as direct emissions of an organisation, including combustion of fuels and fugitive emissions. Scope 2 is indirect emissions of an organisation, including purchased electricity and heat. Scope 3 is other indirect emissions associated with an organisation, including the procurement chain, transport and distribution, business travel and commuting, use of products, waste, investments and other leased assets or franchises[4].

With respect to decarbonisation, the initial work in NHS Wales on medical gases has focussed primarily on desflurane with some health boards attempting and achieving to reduce N_2O usage and wastage. Desflurane has the highest GWP of all medical gases and has been removed from the All-Wales formulary[12].

Decarbonisation of N_2O can be achieved via termination and minimalisation of a piped system and moving to a transportable point of use cylinder option. Recent literature has highlighted waste into the atmosphere through current systems of 83-100% in the UK[13,14]. This is supported by a consensus statement led by the Royal College of Anaesthetists in 2024[15] and the sustainability policy of the Royal Pharmaceutical Society[16] to reduce the carbon footprint of all medical gases. This change of practice will lead to a reduction of the total volume of N_2O on each hospital site improving upon decarbonisation goals and reducing ongoing costs associated with this such as rental, maintenance and servicing, but will not impact patient care as it will still be available. This transition has been recommended to be completed by 31st March 2027.

Other reduction options should be explored such as mobile destruction units and catalytic destruct units which aim to reduce the emissions and promote safer working environments for staff. It is known that N_2O has a Control of Substances Hazardous

to Health recommended long-term workplace exposure limit of 100 ppm or 183 mg/m^3 8-hour time weighted average[17]. Scavenging and catalytic destruction devices have been demonstrated to reduce these N_2O levels between 70-80%[18]. The challenge of catalytic destruction devices are affordability and the size of the machines. However, a recent trial in NHS Wales utilising one of these machines for Entonox®, has been positive. Future research is required to verify its value in mitigating N_2O emissions.

Another aspect which will be explored is the importance of obtaining robust economic impact/value data as well as environmental impact/value data which would help highlight the benefits and drive change for a more sustainable route to delivery.

Recommendations

- Recommendation 1 (R1): When considering the value of a medical gas, its carbon footprint (GWP and Ozone depleting effects) will be considered in addition to clinical and economic values.
- Recommendation 2 (R2): Medical Gases Committee (MGC), also known as Medical Gas Group, must have a standing item to monitor usage levels on medical gases dashboard, to minimise wastage and 'carbon' emissions. Use this data to drive reduction such as decommissioning manifolds where necessary and streamlining manifolds where necessary (high volume Entonox®).
- Recommendation 3 (R3): Normal practice for the purchasing of medical gases to occur through centralised procurement via pharmacy.

To achieve the above recommendations (R1, R2, R3) we have several suggested actions linked to each recommendation that can be undertaken to aid implementation which are listed in the appendix.

References

1. Thomas M, A, F., Ward C, J., Sinnott M, E. et al. Nitrous Oxide Manifold and Other Reduction of Emissions (NoMoreGas): a multicentre observational study evaluating pre-utilisation loss of nitrous oxide. *British Journal of Anaesthesia.* 2024;133:1427-1434. Available at: https://pubmed.ncbi.nlm.nih.gov/39389833/. Accessed Nov 2024.
2. Chakera A, Harrison S, Mitchell J et al. The Nitrous Oxide Project: assessment of advocacy and national directives to deliver mitigation of anaesthetic nitrous oxide. *Anaesthesia.* 2024;79:270-277. Available at: https://pubmed.ncbi.nlm.nih.gov/38205565/. Accessed Nov 2024.
3. Welsh Government. NHS Wales carbon footprint 2018 to 2019: Report on greenhouse gas emissions by each NHS Wales' health board. 2020. Available at: https://www.gov.wales/nhs-wales-carbon-footprint-2018-2019. Accessed Nov 2024
4. Welsh Government. NHS Wales decarbonisation strategic delivery plan 2021-2030. 2021. Available at: https://www.gov.wales/nhs-wales-decarbonisation-strategic-delivery-plan#:~:text=NHS%20Wales%20decarbonisation%20strategic. Accessed Oct 2024
5. Welsh Government. Welsh Health Circular 2021/024 NHS Wales' contribution towards a net-zero Public Sector by 2030: NHS Wales Decarbonisation Strategic Delivery Plan. Available at: https://www.gov.wales/sites/default/files/publications/2021-09/nhs-wales-contribution-towards-a-net-zero-public-sector-by-2030.pdf. Accessed Jan 2025.
6. Welsh Government. Well-being of Future Generations (Wales) Act 2015: the essentials. 2025. Available at: https://www.gov.wales/well-being-future-generations-act-essentials-html#:~:text=Learn%20about%20the%20law%20that%20gives%20a%20common. Accessed Jan 2025
7. The Centre for Sustainable Healthcare. Sustainability in Quality Improvement (SusQI). What is SusQI? Available at: https://www.susqi.org/the-susqi-education-project. Accessed Nov 2024.
8. Welsh Government. A healthier Wales: long term plan for health and social care. 2024. Available at: https://www.gov.wales/healthier-wales-long-term-plan-health-and-social-care. Accessed Jan 2025
9. Welsh Government. Prosperity for all: Low carbon delivery plan. 2019. Available at: https://www.gov.wales/low-carbon-delivery-plan. Accessed Nov 2024
10. Ryan S, M., and Nielsen C, J. Global warming potential of inhaled anesthetics: application to clinical use. *Anesthesia and Analgesia.* 2010;111:92-98. Available at: https://pubmed.ncbi.nlm.nih.gov/20519425/. Accessed Oct 2024.
11. Welsh Government. Welsh Public Sector Net Zero: Baseline and recommendations. 2022. Available at: https://www.gov.wales/sites/default/files/publications/2022-05/public-sector-net-zero-data-recommendations.pdf. Accessed Nov 2024
12. All Wales Medicines Strategy Group, and Welsh Anaesthetic Green Network (WAGN). Withdrawal of national desflurane contract in Wales. 2023. Available at: https://awttc.nhs.wales/files/guidelines-and-pils/withdrawal-of-national-desflurane-contract-in-wales-pdf/. Accessed Oct 2024.

13. The Centre for Sustainable Healthcare. The Nitrous Oxide Project. 2024. Available at: https://sustainablehealthcare.org.uk/activity/the-nitrous-oxide-project/. Accessed Nov 2024.
14. Centre for Sustainable Delivery NHS Scotland. Decommission of Nitrous Oxide Manifolds – Opportunity for Change. Programme., NGT. 2023. Available at: https://www.nhscfsd.co.uk/media/jwtnthuz/ngtp-n20-manifolds-v20-sept-2023.pdf. Accessed Oct 2024
15. Royal College of Anaesthetists. Consensus statement on the Removal of Pipeline Nitrous Oxide in the United Kingdom and Republic of Ireland. 2024. Available at: https://rcoa.ac.uk/sites/default/files/documents/2024-07/Consensus%20statement%20on%20removal%20of%20pipeline%20nitrous%20oxide.pdf. Accessed Oct 2024.
16. The Royal Pharmaceutical Society. Sustainability Policies - Improving prescribing and medicines use: Anaesthetic gases. 2021. Available at: https://www.rpharms.com/recognition/all-our-campaigns/policy-a-z/sustainability-policy/policies. Accessed Mar 2025.
17. Health and Safety Executive. Using nitrous oxide (gas and air) safely in maternity units. 2024. Available at: https://www.hse.gov.uk/healthservices/using-nitrous-oxide-safely.htm. Accessed Oct 2024
18. Pinder A, Fang L, Fieldhouse A et al. Implementing nitrous oxide cracking technology in the labour ward to reduce occupational exposure and environmental emissions: a quality improvement study. *Anaesthesia.* 2022;77:1228-1236. Available at: https://pubmed.ncbi.nlm.nih.gov/36108342/. Accessed Oct 2024.
19. NHS England and NHS Improvement. Reducing waste emissions from piped nitrous oxide products: A toolkit for actue NHS hospitals v1.8 draft awaiting pulblication. Accessed Jan 2025.
20. Chakera A, Ralph M, Roberts S et al. Technical update: Anaesthetic nitrous oxide system loss mitigation and management. Available at: https://www.publications.scot.nhs.uk/files/anaesthetic-nitrous-oxide-system-loss-v2.pdf. Accessed Mar 2025.
21. Specialist Pharmacy Service. Medical Gas Committees: their role, responsibilities, and membership. 2021. Available at: https://www.sps.nhs.uk/articles/medical-gas-committees-their-role-responsibilities-and-membership/. Accessed Mar 2025.
22. NHS England. Health Technical Memorandum 02-01: Medical gas pipeline systems. Available at: https://www.england.nhs.uk/publication/nhs-estates-guidance-for-medical-gas-pipeline-systems-htm-02-01/. Accessed Mar 2025.
23. The Royal College of Surgeons of Edinburgh. Intercollegiate Green Theatre Checklist. Available at: https://www.rcsed.ac.uk/policy-guidelines/sustainability/environmental-sustainability-and-surgery/green-theatre-checklist. Accessed Jan 2025.
24. Pearson F, Sheridan N, and Pierce JMT. Estimate of the total carbon footprint and component carbon sources of different modes of labour analgesia. *Anaesthesia.* 2022;77:486-488. Available at: https://associationofanaesthetists-publications.onlinelibrary.wiley.com/doi/pdf/10.1111/anae.15678. Accessed Jan 2025.

Appendix

Examples of actions that could be taken to support the decarbonisation of medical gases, with the alignment of policy recommendation in brackets:

- Regular inquiry (based on standing item agenda) of procurement, management, administration and disposal of medical gases by Medical Gases Committee (MGC). (R1, R2, R3)
- Regular inquiry of cylinder returns, focussing on reason for return e.g. out of date and if partial filled by Pharmacy. (R1)
- Regular inquiry by the MGC who should consider whether existing manifolds for delivery of medical gases are necessary. Where the MGC considers that alternative delivery is suitable then manifolds should be decommissioned using a standard methodology[19,20]. The MGC must contain representatives from pharmacy, clinical engineering, estates, porters, and clinical staff. Recommendations of membership, roles and responsibilities are highlighted by Specialist Pharmacy Service[21] and HTM 02-01 part B, operational management[22]. The group must report to their senior leadership team to allow reporting in quality and safety committee for each health board or equivalent. (R1, R2, R3)
- All sites' medical gas pipeline authorised persons (MGPS AP), as part of MGC**,** should carry out a system loss assessment of piped nitrous oxide and Entonox® within 6 months of receiving this document unless they have already done so. Thereafter, in accordance with planned preventive maintenance, all terminal units, the manifold, line valve assemblies, and area valve service unit (AVSU) should be checked annually for leakage. Pendent hoses are recommended to be changed as per manufacturer recommendations, such as every 5 years in line with hose replacement programmes to minimise leaks. (R2)
- MGC to work with the Welsh Government Value and Sustainability Medicine Steering Group to promote spread and scale of work already started on N_2O and extrapolate this to Entonox®. (R1, R2, R3)
- Work with the Welsh Government Value and Sustainability Medicine Steering Group and All Wales Therapeutics and Toxicology Centre (AWTTC) to develop modelling comparing the costs ('carbon' and economic) of manifold systems versus cylinder. This will enable clinicians and health board MGCs to decide on the appropriate method to deliver medical gases. (R1, R2, R3)
- Work with NHS Wales Specialist Estates Services (NWSSP-SES) during the revision of the Welsh version of medical piped gas system (MPGS) HTM02 parts A and B[22] to ensure that more effective maintenance schedules by estates for MPGSs' are developed and appropriately balanced with the economic and work force implications of that work. (R1, R2, R3)
- Five yearly audit cycles by anaesthetic departments looking at low-flow anaesthesia as best practice by all anaesthetic departments where medical gases with high GWP are being used in closed circle systems. (R1)
- Scavenging systems and medical vacuum are included within this work as the pipework, maintenance and clinical usage are linked to the Medical Gas and Pipework System. These systems have very high energy usage. Develop strategies and communicate via MGCs to ensure that the anaesthetic gas scavenging systems (AGSS) are turned off when there is no theatre activity

expected in the next 4 hours in all health boards; part of Green Theatre Checklist[23]. (R2)

- Work with Pharmacy teams within each health board to facilitate quality improvement projects to reduce the disposal of partially empty cylinders. (R2, R3)
- Work with AWTTC to develop the existing medical gases dashboard, enabling MGCs to access the data they need to drive down the wastage of these gases which are contributing the most to their scope 1 emissions. (R2 and R3)
- MGCs to ensure N_2O manifolds should be decommissioned by the end of financial year 2026/2027 in line with RCoA recommendations[15]. Portable cylinders to be in a robust supply in low usage areas to allow facilitation if required. (R2 and R3)
- MGCs to ensure Entonox® manifolds should be shut in areas of low volume usage, and in areas of high-volume usage such as in obstetrics, if not practical to decommission manifolds, they should be maintained and leaks repaired. Use should be monitored monthly locally and bench marked against other similar sized centres to help identify leaks. Portable cylinders are a robust supply in low usage areas. (R2 and R3)
- Once manifold efficiency has been optimised by MGCs there is a role for gas capture and cracking technology. The highest use areas e.g., maternity for Entonox® should be the priority areas to use this technology. Guidance and recommendations for maternity units can be found from the Health and Safety Executive (HSE)[17]. Articles have shown the potential for carbon reduction[24] - a reduction of about 70% using cracking (One method which may reduce its carbon footprint is to 'crack' the exhaled gas into nitrogen and oxygen using catalytic destruction) at the bedside has been demonstrated[18]. (R2 and R3)
- Target all stakeholders involved with procurement, management, administration and disposal of medical gases (Entonox® and N_2O for this policy) to undertake educational training opportunities available regarding medical gases and sustainability in quality improvement[7]. (R1)
- Creation of a robust All Wales tracking system for medical gas cylinders to support data collection and dashboard, whilst ensuring clear traceability (R2 and R3)