

Date published: 2 March, 2023

Date last updated: 2 March, 2023

Guidance on minimising time weighted exposure to nitrous oxide in healthcare settings in England

[Publication \(/publication\)](#)

Content

[Summary](#)

[Mitigations](#)

[Risk assessment](#)

[Monitoring and assurance](#)

[Supporting legislation and guidance](#)

Summary

This guidance outlines the mitigations that NHS trusts should consider to protect staff by limiting their occupational exposure to nitrous oxide (N₂O) and recommended governance arrangements for board assurance of occupational exposure to N₂O.

N₂O – otherwise known as ‘gas and air’ (and also by its tradenames Entonox and Equanox) – is commonly used as an analgesic. If, following clinical review, an NHS trust decides to use gas and air, staff risk of exposure to N₂O should be established through a clinically led Control of Substances Hazardous to Health (COSHH) risk assessment of each space in which gas and air is administered, and the following mitigations should be put in place where appropriate:

environmental ventilation

local extract ventilation (LEV)

rebreather facemasks with gas scavenging

staff positioning relative to exhaust N₂O and the direction of ventilation flow

awareness of the COSHH risk assessment and its controls

training in the administration of gas and air

adherence to the mitigations

awareness and review of monitoring results.

The efficacy of these mitigations must be demonstrated by monitoring exposure to N₂O in line with the following regulations:

[Control of Substances Hazardous to Health \(COSHH\) Regulations 2002](#)

(<https://www.legislation.gov.uk/uksi/2002/2677/regulation/7/made>).

[HSG 173 Monitoring strategies for toxic substances 2006](#) (<https://www.hse.gov.uk/pubns/books/hsg173.htm>).

[EH40/2005 Workplace exposure limits, fourth edition \(2020\)](#). (<https://www.hse.gov.uk/pubns/books/eh40.htm>).

Removal of gas and air provision for patients should be a measure of last resort and only following appropriate risk assessment, clinical consultation, and mitigation, accompanied by clear communication with all service users who may be affected by a change in provision.

Mitigations

The key mitigations that organisations should consider when carrying out clinically-led COSHH risk assessments are as follows.

Prevention

When N₂O is used as an anaesthetic in theatre suites, staff exposure is prevented with the use of closed circuit breathing apparatus attached to gas scavenging units, which patients will comply with because they are anaesthetised; ventilation air change rates are also high in theatres.

However, when N₂O is used as an analgesic, the efficacy of closed-circuit breathing apparatus is reduced through imperfect patient usage – most commonly, taking the rebreather mask/rebreather tube away from their mouth when exhaling.

If ventilation is insufficient, human factors are critical in reducing staff exposure, such as:

providing clear instructions to patients on correct use of equipment being used, including exhaling into the rebreather mask or out through the mouthpiece

staff positioning relative to exhaust N₂O and the direction of ventilation flow

turning gas and air off when not in use

unplugging regulators from outlets when not in use

monitoring the condition of equipment for leakages.

Ventilation

Rooms where gas and air is to be used as an analgesic should be designed in line with the relevant Health Building Note (HBN) specific to their purpose; and engineered and operated in line with the specific Health Technical Memorandum (HTM), namely:

[HTM03-01: Specialised ventilation for healthcare premises Part A: Design and validation \(2021\)](https://www.england.nhs.uk/publication/specialised-ventilation-for-healthcare-buildings/)

(<https://www.england.nhs.uk/publication/specialised-ventilation-for-healthcare-buildings/>).

[HTM 02-01: Medical gas pipeline systems Part A: Design, installation, validation and verification \(2006\)](https://www.england.nhs.uk/publication/nhs-estates-guidance-for-medical-gas-pipeline-systems-htm-02-01/#part-a)

(<https://www.england.nhs.uk/publication/nhs-estates-guidance-for-medical-gas-pipeline-systems-htm-02-01/#part-a>).

[Medical gases HTM 02-01: Medical gas pipeline systems Part B: Operational management \(2006\)](https://www.england.nhs.uk/publication/nhs-estates-guidance-for-medical-gas-pipeline-systems-htm-02-01/#part-b)

(<https://www.england.nhs.uk/publication/nhs-estates-guidance-for-medical-gas-pipeline-systems-htm-02-01/#part-b>)(terms of reference amended).

The function of the ventilation in this circumstance is to dilute the concentration of N₂O, such that it does not exceed the maximum time weighted exposure limits for staff. This is done through:

minimum of 10 air changes per hour

high level air inlet in combination with low level air outlet to create air movement across the zone of occupation, and effective extraction of N₂O, which is heavier than air

patient located between the air inlet and the air outlet

air outlet to a gas scavenging system or to outside space

ensuring ventilation is turned on and unobstructed

annual testing and validation of the ventilation

validation of the gas scavenging system in line with manufacturer's recommendations, at least once a year.

The following should be avoided, and if unavoidable there should be enhanced monitoring:

environments with fewer than 10 air changes per hour

hit and miss make-up air (that is, extract ventilation with presumed inlet)

hit and miss air outlet (that is, fresh air make-up with presumed outlet)

staff located between the exhaling patient and the air outlet

Risk assessment

It is recognised that some spaces will predate current design guidance and have insufficient air changes ventilation/scavenging such that occupational time exposure limits could be exceeded. This must be recorded in the COSHH room risk assessment and greater emphasis put on mitigations such as:

equipment housekeeping (isolation and turning off)

rebreather compliance

staff positioning

staff training in the use of gas and air and awareness of the risk assessment

Monitoring and assurance

The efficacy of the ventilation system should be annually tested and validated in line with [HTM03-01 Specialised ventilation for healthcare premises Part A: Design and validation \(2021\)](https://www.england.nhs.uk/publication/specialised-ventilation-for-healthcare-buildings/) (<https://www.england.nhs.uk/publication/specialised-ventilation-for-healthcare-buildings/>). This should be audited by the authorising engineer (AE) Ventilation and reported to the ventilation safety committee.

The efficacy of the gas scavenging systems should be tested and validated in line with the manufacturer's instructions and operated in line with the [Medical gases HTM 02-01: Medical gas pipeline systems Part B: Operational management \(2006\)](https://www.england.nhs.uk/publication/nhs-estates-guidance-for-medical-gas-pipeline-systems-htm-02-01/#part-b) (<https://www.england.nhs.uk/publication/nhs-estates-guidance-for-medical-gas-pipeline-systems-htm-02-01/#part-b>). This should be audited by the AE Ventilation and reported to the ventilation safety committee.

Medical gas committees should provide oversight of the trust's monitoring and assurance process, as outlined in Section 5.8 of the HTM 02-01 Part B. In line with the guidance on the chair and membership of the committee as in the [Performance of healthcare cryogenic liquid oxygen systems, Appendix C: Guidelines for establishing a medical gas committee \(MGC\) \(2021\)](https://www.england.nhs.uk/publication/performance-of-healthcare-cryogenic-liquid-oxygen-systems/) (<https://www.england.nhs.uk/publication/performance-of-healthcare-cryogenic-liquid-oxygen-systems/>), committees should include clinical members and be chaired by the trust chief pharmacist.

The efficacy of the equipment, environment, clinical practices, training of staff and all other mitigations should be tested at least annually and validated by N₂O time-weighted occupational exposure sampling measures in adherence with [EH40/2005 Workplace exposure limits, fourth edition \(2020\)](https://www.hse.gov.uk/pubns/books/eh40.htm) (<https://www.hse.gov.uk/pubns/books/eh40.htm>) and in line with [Control of Substances Hazardous to Health \(COSHH\) Regulations 2002](https://www.legislation.gov.uk/ukksi/2002/2677/regulation/7/made) (<https://www.legislation.gov.uk/ukksi/2002/2677/regulation/7/made>).

The results should be reported to:

clinical leadership of tested department

health and safety committee, who report to the trust board

medical gas committee, who should in turn liaise with the ventilation safety committee

integrated with the board assurance framework

Supporting legislation and guidance

[Control of Substances Hazardous to Health \(COSHH\) Regulations 2002](https://www.legislation.gov.uk/ukksi/2002/2677/regulation/7/made)

(<https://www.legislation.gov.uk/ukksi/2002/2677/regulation/7/made>).

[Health and Safety Executive EH40/2005 Workplace Exposure Limits, fourth edition \(2020\)](https://www.hse.gov.uk/pubns/books/eh40.htm)

(<https://www.hse.gov.uk/pubns/books/eh40.htm>).

[HTM 02-01: Medical gas pipeline systems Part A: Design, installation, validation and verification. The Stationery Office \(2006\)](https://www.england.nhs.uk/publication/nhs-estates-guidance-for-medical-gas-pipeline-systems-htm-02-01/#part-a)

(<https://www.england.nhs.uk/publication/nhs-estates-guidance-for-medical-gas-pipeline-systems-htm-02-01/#part-a>).

[HTM 02-01: Medical gas pipeline systems Part B: Operational management. The Stationery Office \(2006\)](#)

(<https://www.england.nhs.uk/publication/nhs-estates-guidance-for-medical-gas-pipeline-systems-htm-02-01/#part-b>); Terms of Reference amended

[HTM03-01 Specialised ventilation for healthcare premises Part A: Design and validation. NHS England \(2021\)](#)

(<https://www.england.nhs.uk/publication/specialised-ventilation-for-healthcare-buildings/>).

[Performance of healthcare cryogenic liquid oxygen systems, Appendix C: Guidelines for establishing a medical gas committee \(MGC\). NHS England \(2021\)](#) (<https://www.england.nhs.uk/publication/performance-of-healthcare-cryogenic-liquid-oxygen-systems/>).

[Health and Safety at Work \(etc\) Act 1974](#) (<https://www.legislation.gov.uk/ukpga/1974/37/contents>).

[Management of Health and Safety at Work Regulations 2002](#)

(https://www.legislation.gov.uk/uksi/2002/2174/pdfs/uksi_20022174_en.pdf).

[Health and Social Care Act 2008 \(Regulated Activities\), Regulations 2014: Regulation15](#)

(<https://www.legislation.gov.uk/ukdsi/2014/9780111117613/contents>).

[HSG 173 Monitoring strategies for toxic substances \(2006\)](#) (<https://www.hse.gov.uk/pubns/books/hsg173.htm>).

[NICE Clinical Guideline CG190: Intrapartum care for healthy women and babies \(2014, updated 2017\)](#)

(<https://www.nice.org.uk/guidance/cg190>).

Additional resources are available for NHS estates teams on the [FutureNHS platform](#)

(https://gbr01.safelinks.protection.outlook.com/?url=https%3A%2F%2Ffuture.nhs.uk%2Festates_and_facilities_hub%2Fview%3FobjectID%3D14457328&data=05%7C01%7Calewilkes%40nhs.net%7C27fd312726ca4015823208db1a6345e1%7C37c354b285b047f5b22207b48d774ee3%7C0%7C0%7C6381327

including case studies describing trusts' individual monitoring and assurance processes for gas and air, and their standard operating procedures (SOPs) for staff working in maternity settings. Trusts may find these resources useful when considering their own development of SOPs and monitoring methodologies.

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[▲ Back to top](#)