

C.6 Nitrous oxide – EML and EMLc

Reviewer summary	<input checked="" type="checkbox"/> Supportive of the proposal <input type="checkbox"/> Not supportive of the proposal <p>Justification (based on considerations of the dimensions described below):</p> <p>The proposed addition to the WHO Model List of Essential Medicines highlights the environmental harm of using centrally piped nitrous oxide (N₂O) systems in healthcare. These systems are major contributors to greenhouse gas emissions due to widespread and often undetectable leaks, with studies from countries such as the UK, Australia, and the U.S. reporting losses of 70–95% of N₂O before it reaches patients. N₂O is a potent greenhouse gas—273 times stronger than CO₂—and a leading ozone-depleting substance, with a lifespan exceeding 100 years.</p> <p>Real-world experiences reinforce these findings. Facilities in the U.S. (NYC Health + Hospitals), Canada (Vancouver General), Australia (Westmead Hospital), Kenya (Aga Khan University Hospital), and India have decommissioned piped systems or detected severe inefficiencies, shifting instead to point-of-care cylinders. These changes have resulted in significant emission reductions and improved cost efficiency.</p> <p>Professional bodies, including the Royal College of Anaesthetists and the American Society of Anesthesiologists, now recommend avoiding central piped N₂O systems. Transitioning to cylinder-based delivery maintains clinical utility while enhancing environmental and health system sustainability. The proposed statement aligns with global climate targets and WHO's commitment to environmentally responsible healthcare. Its inclusion on the EML is both scientifically justified and operationally feasible.</p>
Does the EML and/or EMLc currently recommend alternative medicines for the proposed indication that can be considered therapeutic alternatives? (https://list.essentialmeds.org/)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
Does adequate evidence exist for the efficacy/effectiveness of the medicine for the proposed indication? (e.g., evidence originating from multiple high-quality studies with sufficient follow up. This may be evidence included in the application, and/or additional evidence identified during the review process;)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
Does adequate evidence exist for the safety/harms associated with the proposed medicine? (e.g., evidence originating from multiple high-quality studies with sufficient follow up. This may be evidence included in the application, and/or additional evidence identified during the review process;)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
Overall, does the proposed medicine have a favourable and meaningful balance of benefits to harms?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
Are there any special requirements for the safe, effective and appropriate use of the medicines? (e.g. laboratory diagnostic and/or monitoring tests, specialized training for health providers, etc)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
Are there any issues regarding price, cost-effectiveness and budget implications in different settings?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable

<p>Is the medicine available and accessible across countries?</p> <p>(e.g. shortages, generics and biosimilars, pooled procurement programmes, access programmes)</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable</p>
<p>Does the medicine have wide regulatory approval?</p>	<p><input type="checkbox"/> Yes, for the proposed indication</p> <p><input type="checkbox"/> Yes, but only for other indications (off-label for proposed indication)</p> <p><input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable</p>
<p>In Additio:</p> <p>Justification for Inclusion</p> <p>1. Environmental Impact and Climate Relevance</p> <p>Nitrous oxide (N₂O) is a potent greenhouse gas with a global warming potential (GWP100) 273 times that of CO₂, and an atmospheric lifetime of over 100 years. N₂O is currently the largest ozone-depleting substance emitted in the 21st century.</p> <p>c.6_nitrous-oxide.</p> <p>Healthcare facilities contribute 1–3% of global N₂O emissions, with piped N₂O systems being major culprits due to pervasive system leaks.</p> <p>2. Evidence of Systemic Leakage and Waste</p> <p>Multiple studies (Scotland, Australia, USA) have found that 70–95% of N₂O in piped systems is lost through infrastructure leaks before clinical use. This loss translates into unnecessary financial costs, occupational hazards, and avoidable environmental degradation. Infrastructure aging makes it difficult and often unfeasible to detect and fix all leak points.</p> <p>3. Global Expert and Institutional Support</p> <p>The Royal College of Anaesthetists (UK and Ireland) and the American Society of Anesthesiologists recommend deactivating central piped systems in favor of point-of-care cylinders. Point-of-care systems are already proving feasible and effective in facilities that have transitioned globally.</p> <p>4. Practicality and System Resilience</p> <p>Portable cylinders reduce loss, simplify monitoring, and improve supply chain resilience. Transitioning does not restrict clinical use but improves efficiency and sustainability.</p> <p>There are multiple real-world reports from various countries that corroborate the environmental concerns associated with central piped nitrous oxide (N₂O) systems in healthcare facilities. These reports highlight significant leakage issues, leading to environmental harm and prompting transitions to point-of-care cylinder systems.</p> <p>International Case Studies on N₂O Leakage and Mitigation</p> <p>1. United States</p> <ul style="list-style-type: none"> • NYC Health + Hospitals: Deactivated central piped N₂O systems across its network, resulting in over a 50% reduction in anesthesia-related carbon emissions. This move was part of a broader initiative to enhance environmental sustainability in healthcare delivery. NYC Health + Hospitals • Practice Greenhealth: Developed a comprehensive playbook detailing the discontinuation of piped N₂O systems. Hospitals that adopted portable E-cylinder systems reported a reduction in N₂O purchases and associated greenhouse gas emissions by 87–99%. PMC+2practicegreenhealth.org+2BJA Anaesthesia+2 <p>2. Canada</p> <ul style="list-style-type: none"> • Vancouver General Hospital: Identified that approximately 95% of its N₂O supply was leaking before reaching patients. By decommissioning the central 	

supply system, the hospital achieved a reduction in greenhouse gas emissions equivalent to removing 57 cars from the road annually.

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3. Australia

- Children's Hospital at Westmead: Implemented custom-built flow meters to detect N₂O leaks, discovering that about 50% of the gas was lost due to system inefficiencies. This finding prompted initiatives to identify and rectify leakage points within the facility. [PMC+1Agency for Clinical Innovation+1](#)
- Australian Government Report: Released a practical guide outlining methods to detect and reduce N₂O leaks in healthcare facilities. The report emphasizes the environmental impact of N₂O and provides strategies for healthcare providers to mitigate emissions. [Health.gov.au](#)

4. Kenya

- Aga Khan University Hospital, Nairobi: Decommissioned its piped N₂O system after recognizing that nitrous oxide accounted for over 95% of the hospital's anesthetic gas emissions. Transitioned to using portable Entonox cylinders in operating rooms, effectively reducing greenhouse gas emissions and improving supply chain resilience. [healthprocanada.com+2Attach Community+2BJA Anaesthesia+2](#)

5. India

- Tertiary Healthcare Center: An observational study revealed that between 49% to 63% of N₂O was lost due to leaks in the central piping system. The study highlighted the substantial environmental impact, with annual emissions equating to over 10,000 tons of CO₂ equivalents. [PMC](#)