

Reducing the Environmental Impact of Hospital Operations: A Review of Targeted Clinical Interventions

Clinical Practice · Environmental Health · Healthcare Sustainability

Background: Healthcare systems are significant contributors to national greenhouse gas emissions, accounting for approximately 10% of total emissions in the United States. This evidence summary examines four high-impact intervention areas: anesthetic gas management, operating room waste segregation, pressurized metered-dose inhaler substitution, and telehealth expansion. We investigated the current evidence on emission reductions and implementation barriers.

| INTERVENTION AREA | ENVIRONMENTAL & FINANCIAL IMPACT | BARRIERS TO IMPLEMENTATION |
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| Anesthetic gas management | <p>Tertiary academic hospital in Boston: Retrospective analysis on all surgical cases in which inhalational anesthesia was received from 2014 to 2022 (n= 124,428) with gradual removal of desflurane (6/2018) and complete elimination in (1/2020). Average CO₂e-emissions went from 83.1 to 14.3 kg per patient, with overall savings of 900 metric tonnes per year.</p> <p>3x Academic hospitals in France: total IV anesthetics (TIVA) associated with less emissions per hour (0.4 kg CO₂e/hour) compared to automated administration system (TICA; 3.1 kg CO₂e/hr) and manually-administered sevoflurane (3.8kg CO₂e/hr) .</p> <ul style="list-style-type: none"> Transition from volatile inhaled anesthetics to TIVA where clinically appropriate Where inhaled agents are required: avoid desflurane and nitrous oxide; use minimum effective fresh gas flow rates Replace central piped infrastructure with portable, contained canisters to eliminate fugitive gas leakage <p><i>Sources: Anaesthesia — doi:10.1111/anae.15785; Anesthesia & Analgesia — doi:10.1213/ANE.0000000000005600; Anaesthesia Critical Care & Pain Medicine — doi:10.1016/j.accpm.2021.100979</i></p> | <ul style="list-style-type: none"> Capital expenditure and operational disruption associated with decommissioning existing central piping systems Requires coordinated buy-in across anesthesiology, surgical teams, and facilities management Clinical familiarity and perceived risk associated with changes to established anesthetic practice |
| OR regulated medical waste (red bag waste) | <p>An estimated 50–80% of operating room (OR) waste is incorrectly classified as regulated medical waste. This misclassification increases both environmental and financial burden, as disposal costs range from \$0.20–\$4.00/lb for regulated waste compared to \$0.02–\$0.06/lb for standard waste.</p> <p>Regulated medical waste generates around 2.8kg CO₂ per kg compared to 0.2-0.6kg CO₂ per kg for municipal waste, representing roughly a 5–10x higher carbon footprint due to energy-intensive treatment processes like high-temperature incineration and autoclaving.</p> <ul style="list-style-type: none"> Education on waste disposal: behavioral nudges, training, and real-time reminders Standardized bin placement, clear signage, and audits to reduce red bag misuse Open only procedure-confirmed supplies; use custom surgical packs to limit unused item waste <p><i>Sources: Environmental Science & Technology — doi:10.1021/es504719g; JAMA Surgery — doi:10.1001/jamasurg.2014.1821; BMJ Open — doi:10.1136/bmjopen-2017-017224</i></p> | <ul style="list-style-type: none"> Entrenched default behavior among OR staff (“when in doubt, red bag it”) Knowledge gaps regarding regulatory definitions of what constitutes regulated medical waste Time pressure during procedures limits capacity for deliberate waste classification decisions |
| Inhaler substitution (pMDI → DPI) | <p>Transition from pressurized metered-dose inhalers (pMDIs) to dry powder inhalers (DPIs). From 2014-2024, 1.6 billion inhalers dispensed generated 24.9 million metric tons CO₂e, with pMDIs accounting for 98% of emissions. DPIs produce ~0.8 kg CO₂ per inhaler versus 22.1 kg for pMDIs. Using the lowest emission inhaler in each drug class could reduce emissions by 92% and lower social costs from \$5.7B to \$470M.</p> <p>Across 44 RCTs (24,710 participants), there are no significant efficacy/safety differences between pMDIs and DPIs when used correctly.</p> <ul style="list-style-type: none"> Shift prescribing from pMDIs, which use hydrofluoroalkane (HFA) propellants, to DPIs that do not require propellants Advocate for market entry of DPI budesonide-formoterol, which is widely available in Europe but absent in the US; critical because albuterol and budesonide-formoterol together account for ~80% of emissions. <p><i>Sources: JAMA — doi:10.1001/jama.2025.16524; NPJ Prim Care Respir Med — doi:10.1038/s41533-026-00488-4; JAMA Intern Med — doi:10.1001/jamainternmed.2025.2299; JAMA — doi:10.1001/jama.2019.0131</i></p> | <ul style="list-style-type: none"> No DPI formulation of budesonide-formoterol in the U.S. VHA formulary transition study: forced transition from pMDI to DPI was associated with increased healthcare utilization Peak inspiratory flow requirements: DPIs need >40-60 L/min (vs. >20L/min for pMDIs) |
| Telehealth & virtual care delivery | <p>Telemedicine substantially reduces the carbon footprint of healthcare, primarily by eliminating patient and provider travel to in-person appointments.</p> <p>One large US study estimated median CO₂ savings of 20 kg per telemedicine session, with a median round-trip travel distance of 49 miles avoided. When extrapolated nationally, telemedicine use in 2021-2022 prevented emissions equivalent to removing approximately 61,000-130,000 gasoline-powered vehicles from the road for a month.</p> <ul style="list-style-type: none"> Set carbon targets (patient miles saved) as a key performance indicator in an annual sustainability report. Optimize triage for telehealth to identify patients who can be treated/managed virtually. Select hardware and software vendors for telehealth infrastructure that have committed to 100% renewable energy for their data centers. If a patient lacks home internet, healthcare systems can partner with local libraries or pharmacies to create telehealth centers <p><i>Sources: Journal of Medical Internet Research — DOI: 10.2196/53437; The American Journal of Managed Care — DOI: 10.37765/ajmc.2025.89714; JAMA Network Open —doi:10.1001/jamanetworkopen.2022.53788</i></p> | <ul style="list-style-type: none"> Technological/infrastructure limitations, including poor internet connectivity, particularly in rural areas where many Americans adults lack broadband access. State-by-state licensure requirements create significant barriers. Multistate licensure is costly and time-consuming. Workflow disruptions may bias clinicians against telehealth, including concerns about limitations in physical examination capabilities, technology expertise, and lack of standardized methods for assessing telehealth quality |