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The CoA-MSA Consensus Statement on Green Anaesthesia: a starter toolkit for sustainable practice in Malaysia

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Abstract

The healthcare sector contributes approximately 4%–5% of global greenhouse gas emissions, with anaesthetic practice identified as a notable source. Recognising the urgent need for environmentally sustainable approaches, the Malaysian Society of Anaesthesiologists (MSA) and College of Anaesthesiologists (CoA) have developed a national consensus statement to guide green and sustainable anaesthesia practice in Malaysia.

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This consensus statement was formulated through a literature review, aligned with the principles of the World Federation of Societies of Anaesthesiologists (WFSA), and expert deliberation within the CoA-MSA Green Anaesthesia Working Group. It proposes practical strategies across the 3 carbon emission scopes: direct emissions (Scope 1), indirect energy-related emissions (Scope 2), and indirect supply chain-related emissions (Scope 3), while integrating workforce well-being as a core dimension of sustainability.

The statement recommends low-flow anaesthesia, restricted use of nitrous oxide, and preference for volatile agents with lower GWP. It promotes total intravenous and regional anaesthesia where clinically appropriate and encourages monitoring of anaesthetic depth to reduce unnecessary consumption of volatile agents. Scope 2 interventions include optimising energy use in operating theatres, deactivating systems outside operational hours, and transitioning towards renewable energy. Scope 3 focuses on reducing single-use items, implementing recycling, conducting life-cycle assessments, and strengthening sustainable procurement. Importantly, the consensus statement acknowledges the physiological and psychological challenges climate change imposes on anaesthesia providers, advocating institutional measures that safeguard staff health, hydration, and mental resilience.

This CoA-MSA statement represents Malaysia's first national initiative to integrate sustainability into anaesthetic practice. By balancing environmental responsibility with patient safety and provider well-being, it calls on every anaesthesiologist to make the operating theatre a place that heals both patients and the planet. The document provides a roadmap for climate-resilient, resource-efficient, and compassionate anaesthetic care in Malaysia.

Keywords: climate resilience/change, environmental sustainability, green anaesthesia, healthcare emissions, perioperative care,

Introduction

The term "global warming" refers to an increase in the Earth's temperature as a result of greenhouse gases. It has emerged as the most pressing challenge of the twenty-first century, with far-reaching consequences, including health concerns, economic instability, and environmental degradation. Extreme weather events, such as droughts, floods, heatwaves, and wildfires, have become more frequent in recent years, and these events are directly related to global warming. This event affects not only the economy but also biodiversity, food security, energy systems,

and public health.[1] The degradation of ecosystems, the declining capacity of oceans to sequester carbon, and an almost 1°C rise in mean global temperature over the past century underscore the pressing need for collective action to reduce carbon footprints and transition to sustainable practices.[2]

Carbon dioxide, methane, and nitrous oxide are the primary contributors to greenhouse gases, with a significant portion originating from human activities, including transportation, manufacturing, construction, agriculture, and the oil and gas industries. The health sector has been shown to contribute to 4%–5% of global greenhouse gas emissions worldwide.[3] The National Health Service (NHS) of England calculated that its carbon footprint was 25 megatonnes of CO_2 in 2019: 62% from the supply chain, 24% from the direct delivery of care, and 10% from workers, patients, and visitors travelling to and from work. This value includes approximately 5% from anaesthetic gases and metered-dose inhalers.[4] These findings highlight the need to reframe sustainability initiatives in healthcare by moving beyond a narrow focus on anaesthetic gases and clinical practice alone. Instead, the entire perioperative and healthcare ecosystem must be addressed. Positioning anaesthesia within this broader ecological footprint is critical to the development of targeted, sustainable strategies that can reduce the sector's overall carbon footprint.

Several key concepts are central to understanding the role of anaesthesia in climate change. Global warming potential (GWP) is a standardised measure that compares the climate impact of greenhouse gases over a defined time horizon, usually 100 years, with carbon dioxide serving as the reference gas, which has a GWP of 1.[5] The carbon footprint refers to the total direct and indirect greenhouse gas emissions associated with an individual, organisation, product, or activity, and it is typically expressed in kilograms or tonnes of carbon dioxide equivalents. Radiative forcing describes the imbalance between incoming solar radiation absorbed by the Earth and outgoing energy released into space, measured in watts per square metre.[5] Together, these concepts provide the framework for quantifying and comparing the environmental impact of anaesthetic practice.

Equally important is an understanding of the 3 scopes of healthcare-related emissions. Scope 1 encompasses direct emissions from controlled sources, such as anaesthetic gases. Scope 2 refers to indirect emissions from energy use, which are particularly significant in energy-intensive operating theatres. Scope 3 includes indirect emissions across the supply chain, from the manufacture and transport of medicines and medical devices to the use of single-use consumables and waste disposal. Addressing all 3 scopes is essential if meaningful and sustainable reductions in perioperative and healthcare-related emissions are to be achieved.

Education in sustainability equips anaesthetists with the knowledge and skills to practise environmentally responsible anaesthesia without compromising patient safety. This paper presents the consensus statement on green anaesthesia developed by the Malaysian Society of Anaesthesiologists (MSA) and the College of Anaesthesiologists (CoA). In alignment with the World Federation of Societies of Anaesthesiologists (WFSA), the *CoA-MSA Consensus Statement on Green Anaesthesia* (see full document at the end of the article) provides evidence-based and practical strategies tailored to the Malaysian context. Its aim is to provide anaesthetists in Malaysia with a structured framework for practising green anaesthesia that balances environmental sustainability with patient safety and clinical efficiency.[6]

Scope 1: Reducing direct emissions

All anaesthetic gases are greenhouse gases, with nitrous oxide and isoflurane exhibiting ozone-depleting properties. It has long been postulated that anaesthetic gases contribute significantly to GWP. Andersen *et al.* estimated the emission of inhalational gases to be equivalent to that of 1 million cars.[7] The WFSA recommends the use of inhalational agents with the lowest GWP, such as sevoflurane over desflurane.[6] Desflurane should be employed in limited circumstances, including elderly patients, long surgeries, morbid obesity, and specific neurosurgical cases, where it has been demonstrated to enhance patient safety and outcomes.[8-11] However, according to the latest Intergovernmental Panel on Climate Change (IPCC) consensus, using the GWP metric to measure the impact of anaesthetic gases may not accurately reflect their true contribution to climate change. The GWP metric does not account for the short atmospheric lifespan of these gases. The IPCC defines short-lived climate forcer pollutants with lifetimes of less than 20 years, and all anaesthetic gases fall into this category, including desflurane.[12] Besides that, the small value of radiative forcing of all anaesthetic gases (< 0.0003) made the value small and will be lost within the natural variability of the climate system.[13]

On the other hand, nitrous oxide contributes significantly to climate change, with an atmospheric lifetime of approximately 123 years and a radiative forcing value of 0.21. It is also an ozone-depleting agent.[13] Most of the nitrous oxide production originates from agricultural activities and the combustion of fossil fuels. Although the amount of nitrous oxide used in hospitals is small, only 5% is metabolised, and the rest is exhaled and released to the environment.[14] The impact of nitrous oxide is the most pronounced in comparison to other volatile anaesthetic agents. Consequently, we suggest that the use of nitrous oxide be restricted to parturients in labour because it is still a viable option for analgesia, particularly in remote hospitals.

Low-flow anaesthesia was introduced more than 10 years ago and is defined as a fresh gas flow of 1 l/min. Virtue *et al.* describe a fresh gas flow usage of 0.5 l/min and call it minimal gas flow.[15,16] The fear regarding the use of low flow was derived from concerns about the accumulation of Compound A and carbon monoxide, which are specifically produced in CO_2 absorbents that contain potassium hydroxide.[17] Such absorbents are no longer available in the market at this point in time. The prerequisite for low-flow anaesthesia is a closed-circuit system with a leak-free connection and calibrated flow meters, capable of measuring flow rates as low as 50 ml/min. However, the anaesthetist must not neglect patient safety when using low-flow anaesthesia. Continuous monitoring of inspired oxygen is essential for a vigilant anaesthetist. Low-flow anaesthesia not only reduces emissions but also provides economic advantages.[18]

The use of total intravenous anaesthesia (TIVA) and regional anaesthetic technique has a minimal impact on direct emissions. Hence, this technique is deemed most environmentally friendly.[19] However, TIVA requires disposable plastic syringes, intravenous (IV) tubing, and often target-controlled infusion pumps, which consume a small amount of electricity. These disposables and process EEG monitoring add modest cost as well as environmental burden in the form of plastic waste. According to an audit from a Dutch hospital, waste and related costs associated with the use of TIVA are high, at 43 kg per week, of which 14 litres are medication. The costs exceed €350,000 per year.[20] It is important to note that propofol disposal must be done appropriately, as it is known to be toxic to aquatic populations. Improper disposal can lead to harmful effects on the environment.[21]

Finally, using either volatile or TIVA, monitoring the depth of anaesthesia (DoA) plays an important role in reducing emissions and minimising the impact on the environment. Accurate assessment of DoA should be tailored to individuals and, at the same time, prevent awareness and overdose of anaesthetic agents.[22] In a review assessing the cost-effectiveness of using DoA, it has been shown that DoA is associated with reduced anaesthetic requirements, shorter anaesthetic recovery time, and lower costs.[23] We recommend monitoring the DoA to reduce volatile consumption.

Scope 2: Indirect emissions from the energy used

A systematic deactivation of operational systems outside designated working hours can help reduce energy use. This is especially important for heating, ventilation, and air conditioning (HVAC) equipment, anaesthetic gas scavenging mechanisms, and anaesthetic delivery machines.[24] Drinhaus *et al.* demonstrated

that anaesthesia workstations utilise high consumption of energy during standby mode. Switching off anaesthesia workstations overnight has a potential cost reduction of between €5,000 and €11,600 per year.[24] Other than that, using energy-saving technologies such as LED lighting, motion-activated lighting systems, and cordless medical instruments will make surgical areas much less polluting and leave less of an impact on the environment overall.[25] Concurrently, the provision of comprehensive training to personnel regarding energy conservation protocols is anticipated to foster enhanced sustainability initiatives across healthcare institutions. A strategic transition towards renewable energy sources, exemplified by photovoltaic (solar panel) systems, holds the potential to significantly diminish carbon emissions and lessen dependence on fossil fuels.[26] Moreover, proactive measures to prevent energy dissipation, such as the insulation of windows to preclude heat loss and the strategic incorporation of large windows to maximise natural illumination, are imperative. Implementing wider windows with appropriate glazing and a daylight-linked dimming lighting control strategy in an Italian hospital led to a 17% reduction in primary energy demand.[27]

Scope 3: Indirect emissions from the supply chain

Indirect emissions from the supply chain, often categorised as Scope 3 emissions, arise from activities that are not directly controlled by a healthcare organisation but are essential to its operations—such as the production, transportation, and disposal of products.[28] It is essential to note that medical waste accounts for 4% of total plastic waste, and prior to the COVID-19 pandemic, plastics comprised 23% of the total waste in the NHS.[29] Reducing the number of items used can minimise unnecessary consumption of resources and energy throughout the supply chain. This can be achieved by limiting the use of single-use items, preparing medications only when required, and ensuring that medication ampoules are used in their entirety whenever possible.[30] The usage of single-use items in operating rooms and intensive care units (ICUs) is sometimes necessary to ensure safety and hygiene. However, many single-use items have now been replaced with reusable equivalents to reduce waste generation.

Evidence supports the environmental benefits of this approach: for example, an Australian study found that single-use disposable plastic laryngoscope handles generate 16–18 times more life cycle CO_2 emissions compared to reusable steel handles.[31] This significant difference highlights the potential of reusables to reduce environmental impact in healthcare settings, provided that infection control and patient safety are not compromised.

Recycling ensures that materials are reprocessed rather than discarded. Recycling should be promoted by ensuring the segregation of waste streams in operating theatres and ICUs. Collaboration between hospital administration and local authorities can strengthen recycling infrastructure and maintain regulatory compliance. This process requires ongoing commitment. As demonstrated by Evliya *et al.*, targeted training initially increased the amount of recyclable waste per surgery from 1.30 kg to 1.80 kg ($p = 0.01$) in the first month. While there was a decrease in medical waste per surgery from 4.92 kg to 4.14 kg, this change was not statistically significant ($p = 0.09$). Importantly, by the second month post-training, waste levels began to revert to baseline (recyclable: 1.79 kg; medical: 5.07 kg per surgery), indicating that the positive effects of a single training session may diminish without continued reinforcement. [32]

Promoting sustainability in anaesthesiology settings requires rethinking procurement strategies to prioritise suppliers with strong environmental commitments and redesigning supply kits to eliminate non-essential items, reducing waste at the source. Additionally, establishing robust internal protocols for the timely maintenance and repair of equipment can extend the lifespan of valuable assets and minimise the need for premature replacement. Ensuring that supplier agreements include comprehensive post-sale support and guaranteed availability of spare parts further supports the efficient repair and ongoing functionality of equipment, fostering a more resource-efficient and environmentally responsible approach to healthcare operations. [33]

To carry out the research programme, anaesthetic departments should undertake local waste and resource audits, as well as life cycle assessments of items and practices, to identify environmental hotspots. These findings should then be published and disseminated throughout the department, hospital, and community to inform sustainable practice changes, such as implementing the 6Rs of sustainability (Reduce, Recycle, Reuse, Refuse, Rethink, and Research), purchasing more eco-friendly products, and advocating for policy changes to reduce the environmental footprint of healthcare. [30]

Integrating sustainability into anaesthesia training and ongoing education is crucial to foster lasting change in clinical practice. Increasing staff awareness about the environmental impact of their clinical choices empowers them to advocate for and adopt greener practices. However, without ongoing reinforcement, the positive effects of a single training session may fade over time. This is evidenced by Elviya *et al.*, who found that 40% of doctors lacked sufficient knowledge prior to training, and those most supportive of further education were often the least informed ($p = 0.02$), illustrating significant gaps in previous education. [32] In Malaysia, the proportion of anaesthesiologists with adequate knowledge of sustainability is high, but most of

the respondents did not receive adequate education and training on this subject, indicating substantial room for improvement. Addressing these educational gaps through comprehensive and continuous training is vital to ensure the widespread adoption of sustainable practices among Malaysian anaesthesiologists.

Wellbeing and self-care of anaesthesia care providers

Climate change poses increasing risks not only to patients but also to the healthcare workforce. It disproportionately affects individuals whose work is physically or cognitively demanding and undertaken in constrained environments. Anaesthesia providers, operating in thermally variable hospital settings and often in prolonged use of personal protective equipment (PPE), face increased vulnerability. Beyond environmental hazards, the climate-related psychological stressors place anaesthesia providers at increased risk of fatigue, dehydration, mental distress, and reduced clinical performance. Our toolkit focused on the health impacts of climate change relevant to anaesthesia providers from physiological, psychological, and occupational perspectives. The toolkit also outlined personal and institutional strategies to mitigate health and psychological risks, thus creating climate-resilient healthcare systems that protect the well-being of both providers and patients.

From the physiological perspective, exposure to elevated temperatures compromises human thermoregulation, leading to heat stress and, in severe cases, heat-related disorders such as exhaustion, heat syncope, and stroke. Anaesthesia providers are particularly susceptible due to prolonged periods in PPE and indoor environments with poor ventilation or limited cooling infrastructure. During prolonged shifts, especially in warm operating theatres or high-humidity regions, anaesthesia providers may experience significant fluid loss due to sweating, compounded by reduced opportunities to hydrate during procedures. Dehydration impairs cognitive function, concentration, and decision-making, which are critical components in anaesthetic care. In addition, prolonged dehydration may lead to diseases such as chronic kidney disease. The widespread use of PPE, particularly since the COVID-19 pandemic, has exacerbated heat burden among providers. Insulating gowns limit sweat evaporation, increasing thermal discomfort and cardiovascular strain. Climate-related wildfires, haze events, and increased urban heat contribute to poor air quality, raising the burden of respiratory illness. Anaesthesia providers with pre-existing respiratory conditions are particularly vulnerable. Moreover, indoor air pollution from outdated ventilation systems in some facilities may exacerbate symptoms such as wheezing and fatigue. Finally, vector-borne diseases such as dengue, malaria, and zoonoses are expanding geographically due to climate warming. Anaesthesia providers may be increasingly involved in

managing perioperative and critical care for patients with complex febrile illnesses, raising occupational exposure risks.[34]

From the psychological and occupational perspectives, climate change has multiple negative implications for anaesthesia providers. Heat exposure may lead to increased mental fatigue, irritability, and reduced job satisfaction. Climate-induced disasters, such as floods and pandemics, may lead to higher rates of anxiety, burnout, and post-traumatic stress disorder among anaesthesia providers. There is also evidence that increasing heat and humidity have profound adverse effects on worker productivity.[34] Lastly, eco-anxiety, defined as the psychological distress associated with awareness of climate change, has been shown to have significant implications for overall well-being and health among the general population. A meta-analysis conducted by Gago *et al.* revealed a moderate negative correlation between the level of climate anxiety and psychological well-being.[35] Eco-anxiety has also been linked with feelings of apathy or paralysis.[36]

Strengthening workforce resilience is therefore a key component of sustainable healthcare. This can be achieved by integrating climate-related health risks education into staff wellness programmes, closely monitoring and identifying high-heat areas within the hospital—such as wards, on-call rooms, and older facilities with limited climate control—and promoting regular hydration and adequate rest. Staff should be encouraged to consume 150–250 ml of fluids every 20–30 minutes in hot or humid conditions, while peer support systems, such as "buddy checks", can help detect early signs of heat strain, especially among junior and auxiliary staff. Additionally, ensuring equitable access to designated cooling zones, such as air-conditioned rooms or shaded areas, further supports the health and safety of all staff members.

It is also important to implement measures to improve mental health and psychological well-being in achieving heat resilience. Knowledge on climate-related stressors such as heat fatigue, post-traumatic stress disorder, and eco-anxiety should be imparted through wellbeing initiatives. In addition, anaesthesia providers serving in the frontline of climate-related events such as floods and heat emergencies should be provided with psychological first aid, peer support, and structured debriefing.

Finally, healthcare institutions should take responsibility for heat protection and staff well-being. Strategies that can be taken include implementation of indoor climate control standards for operating theatres, routine staff health alerts for high-heat and poor air quality days, creation of "green rest rooms" with cooling, hydration and rest facilities, and incorporation of heat and air quality surveillance into occupational health protocols. Healthcare infrastructure should integrate

passive cooling (*e.g.*, reflective roof materials, tree shading) and renewable energy-powered air conditioning. Building design should prioritise natural ventilation and insulation to reduce heat gain. These changes align with both occupational health objectives and broader emissions reductions.

In conclusion, sustainable anaesthetic practice is fundamental to the future of safe and effective healthcare. The *CoA-MSA Consensus Statement on Green Anaesthesia* provides practical guidance to reduce emissions across the perioperative process while maintaining patient safety and clinical standards. Meaningful progress requires education, leadership, and shared commitment from clinicians and institutions. By integrating environmental responsibility into everyday practice, anaesthesiologists can contribute to a low carbon and climate resilient healthcare system that protects both patients and the planet.

Declarations

Competing interests
IIS and SMF are Editors of the Malaysian Journal of Anaesthesiology. They have not been involved in any part of the publication process prior to manuscript acceptance. Peer review for this journal is conducted in a double-blind manner. The remaining authors declare no competing interests.

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College of Anaesthesiologists, AMM

Malaysian Society of Anaesthesiologists

CoA-MSA CONSENSUS STATEMENT ON GREEN ANAESTHESIA

– A STARTER TOOLKIT

For the College of Anaesthesiologists (CoA) and Malaysian Society of Anaesthesiologists (MSA)
Climate-Conscious, Evidence-Based, Health-Centred Anaesthetic Practice

INTRODUCTION

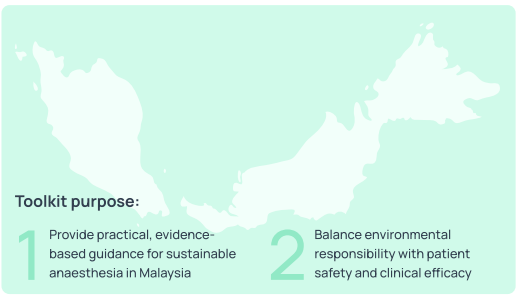
Climate change is the greatest global health threat of the 21st century, and healthcare significantly contributes to environmental degradation.

Anaesthesia has a disproportionately high environmental impact due to:


Energy-intensive operating theatres


Volatile anaesthetic agents with high global warming potentials (GWPs)


Single-use consumables



Toolkit purpose:

1. Provide practical, evidence-based guidance for sustainable anaesthesia in Malaysia
2. Balance environmental responsibility with patient safety and clinical efficacy

ROLE OF ANAESTHESIOLOGIST

Anaesthesiologists are central figures in perioperative care and uniquely placed to champion sustainability.

Can influence **Scope 1** (direct emissions), **Scope 2** (energy-related emissions), **Scope 3** (supply chain emissions), and **improve wellbeing and self-care of anaesthesia providers** through daily clinical decisions.

The World Federation of Societies of Anaesthesiologists has underscored this responsibility through **three core directives:**

1. Ensuring patient safety while implementing green practices
2. Fostering global unity across income settings
3. Advocating for healthcare-wide mandates to curb contributions to global warming.

OBJECTIVES OF THE TOOLKIT

Awareness:
Highlight anaesthesia's environmental impact in Malaysia.

Actionable Guidance:
Offer practical, locally relevant carbon-reduction strategies.

Support Initiatives:
Help departments align with national climate goals.

Foster Collaboration:
Promote teamwork among anaesthesiologists, surgeons, nurses, and administrators.

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CoA-MSA CONSENSUS STATEMENT ON GREEN ANAESTHESIA
– A STARTER TOOLKIT

For the College of Anaesthesiologists (CoA) and Malaysian Society of Anaesthesiologists (MSA)
Climate-Conscious, Evidence-Based, Health-Centred Anaesthetic Practice

KEY RECOMMENDATIONS & STRATEGIES

Scope 1: Direct Emission

Practice Low-flow anaesthesia
(≤1 L/min)

Lower flow reduces volatile agent consumption, costs, and emissions.[1,2] It is safe with modern CO_2 absorbers and reduces unnecessary environmental release.

1

Limit use of Desflurane
(specific cases only)

Global Warming Potential (GWP) data: Desflurane (2540), long atmospheric lifetime. We recommend the use of Desflurane only for specific indications. Examples include but not limited to the patients with morbid obesity, elderly patients, patients undergoing long surgeries and neuro-surgeries.[3-6]

2

Limit use of Nitrous Oxide(N_2O)
(labour analgesia only)

N_2O: Ozone depleter [7,8], small volume but high impact

3

Total Intravenous Anaesthesia (TIVA) / Regional Anaesthesia preferred

TIVA/Propofol: Life cycle assessment shows lower footprint, —even accounting for the manufacturing and disposal of syringes and IV sets.[9-11]

4

Use Depth of Anaesthesia (DoA) monitoring

DoA monitoring reduces agent use, and may lead to reduction of Green House Gas (GHG) emissions. [11]

5

Use leak-free closed-circuit with scavenging

Leak prevention essential for occupational safety. A leak-free anaesthesia machine is essential for the effective practice of low-flow anaesthesia.[12-14]

6

Scope 2: Indirect Emission From The Energy Used

Minimise energy consumption

Power off out of hours

Heat, Ventilation and Air-Conditioning (HVAC) Systems:
Ensure systems are powered down when not in use.

Anaesthetic Gas Scavenging System (AGSS):
Switch off when theatres are not in use or volatile anaesthetics are not being utilized.

Anaesthesia Machines:
Power down post-procedure, which can save approximately 50 kWh per day per machine.

Ventilators/ ICU Monitors:
Activate eco-mode during standby, which reduces energy consumption by 30%.

Utilise centralised monitoring to minimise the need for redundant devices:
- Introduce 'shutdown' and 'power on' checklists.
- Install occupancy sensors and automate 'set-back' modes HVAC systems.

Use cordless electrical equipment with rechargeable batteries

Implement energy-saving measures

Examples included but not limited to:
- Use of LED lightbulbs
- Install motion-activated lights.

Optimise temperature and humidity

- Maintain operating theatre (OT) temperature: 18-22°C with hypothermia prevention; Burns Unit: 24-30°C.
- Keep OT doors closed to reduce temperature loss. Maintain OT relative humidity between 30% and 60% for patient comfort and infection control.

1

Transition towards sustainable energy generation

Shifting to renewables significantly decreases life-cycle emissions of all hospital operations.

- Encourage solar, rooftop systems
- Sustainability planning with engineers

2

Prevention of energy loss

- Encourage window/ natural light sources to reduce electrical lighting.
- Optimisation of insulation/heat transfer for new facilities/major renovations of hospital facilities.

3

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Scope 3: Indirect Emission from the Supply Chain

Application of 6R, EM concepts[13–16,17]

Reduce

- Minimise non-essential single-use items.
- Prepare medications only when needed to reduce waste.
- Use medication ampoules fully whenever possible.
- Shorten ICU and hospital stays to lessen resource use and environmental impact.

Reuse

Where appropriate, substitute single-use items with reusable alternatives, provided they meet all relevant safety and hygiene standards.

Recycle

- Segregate waste streams in operating theatres and ICUs.
- Collaborate with hospital administration and local authorities to improve recycling infrastructure and ensure compliance.

Rethink

- Prioritise procurement from suppliers with strong environmental commitments.
- Redesign supply kits to eliminate non-essential.

Repair

- Implement internal protocols for timely equipment maintenance and repair.
- Ensure supplier agreements include full post-sale support and guaranteed spare parts.

Research

- Conduct and support local audits and life cycle assessments of anaesthesia-related products and practices.
- Publish and share findings.

Education[16] & Culture Change

- Integrate sustainability into anaesthesia training and continuing education programs.
- Raise awareness among staff about the environmental impact of clinical choices and empower them to advocate for greener practices.
- Celebrate and share successes (e.g., Green Anaesthesia Day) to foster a culture of environmental responsibility.

Monitor and Audit

- Regularly track supply use, waste generation, and recycling rates in the OT and ICU.
- Benchmark against national and international standards and set measurable sustainability targets.
- Use audit data to drive continuous improvement and inform procurement and clinical practice changes.

Encourage sustainable waste management[18-21]

Optimise use of waste containers[22]

- Segregate waste into designated, color-coded waste collection containers.
- Dedicated rubbish containers.

Reduce leftover and unutilised disposable medical items

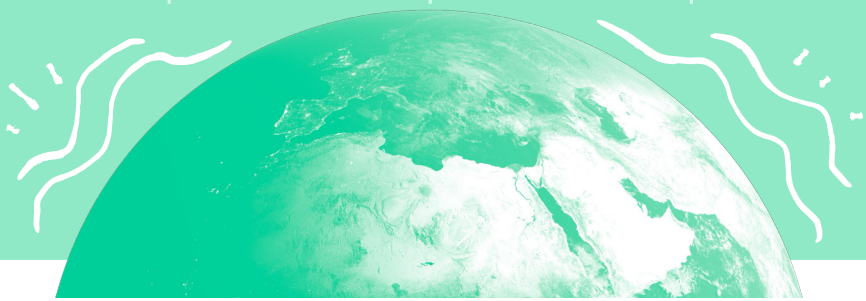
- Minimise partially used disposables.
- Limit unnecessary openings of single-use items.
- Optimise consumable supply usage.
- Prevent wastage of unopened medical disposables.

Ensure safe pharmaceutical waste disposal[23-26]

- Dedicated pharmaceutical disposal.
- Medication residue management.
- Safe handling of unused medication.

Promote paperless practices

- Minimize paper usage.
- Implement paperless documentation.
- Promote digital record-keeping.
- Decrease reliance on printed materials.



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KEY RECOMMENDATIONS & STRATEGIES

Wellbeing & Self-care of Anaesthesia Care Provider

Create awareness of physical health risks due to heat

Anaesthesia providers are vulnerable to extreme weather, heat, air pollution, and resource strain.[27,28] Strengthening workforce resilience is essential to sustainable healthcare. This can be done by:

Integrate climate-related health risks into staff wellness programmes.

Monitor and identify high-heat areas in the hospital. Examples include but not limited to wards, on-call rooms, and older facilities with limited climate control.

Promote hydration and rest

- Encourage regular hydration. Aim for 150–250 mL fluid intake every 20–30 minutes in hot or humid environments.
- Implement peer support systems ('buddy checks') to identify early signs of heat strain, particularly among junior and auxiliary staff.
- Use designated cooling zones (e.g. air-conditioned rooms, shaded areas) equitably across all staff groups.

Empower mental health and heat resilience[27,28]

- Address climate-related stressors such as heat fatigue, haze, and disaster response within staff wellbeing programmes.
- Provide basic psychological first aid training for frontline staff and team leaders following climate-related events (e.g. floods, heat emergencies).
- Enable peer support and debriefing to help staff cope with climate-induced stress, including resource strain and community displacement.

Address occupational & systemic challenges[28]

- Advocate for system-level upgrades to create safer, greener, and more resilient workplaces.
- Encourage cardiovascular fitness and regular aerobic exercise to enhance physiological heat tolerance.

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