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Editorial

An evidence-based approach towards sustainable anaesthesia

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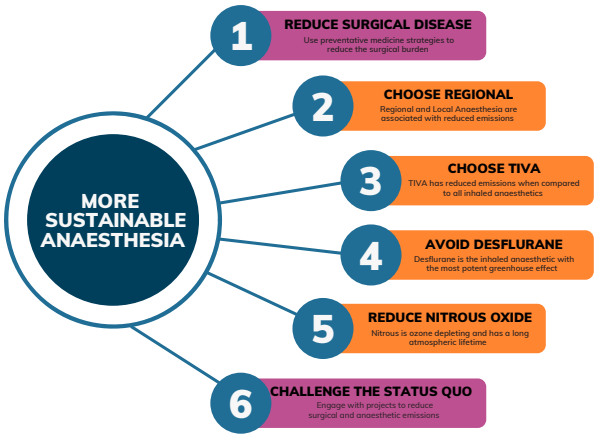
Introduction

Health and social care currently account for between 4-5% of UK annual emissions[1]. Recognising this, the NHS has set a net zero goal for direct emissions by 2040, alongside an 80% reduction goal before 2032[2]. Net zero here refers to a balance between residual emissions and carbon offsets. To this end, trusts are exploring measures to reduce their direct emissions through changes in practice, renewable electricity generation, and energy efficiency improvements. The NHS will then offset any remaining emissions after 2040. Surgery and anaesthesia together account for 8% of the carbon footprint associated with acute trusts at present, with nearly half of this due to the use of anaesthetic vapours and gases, predominantly nitrous oxide and desflurane[3]. The NHS net zero panel expect 2% of its total emissions reduction will be achieved through changes to the delivery of anaesthesia[4]. This raises the question: what changes can be made to anaesthetic practise to achieve this goal?

Evidence-based approach towards sustainable anaesthesia

Strong evidence exists for how surgeons and anaesthetists can reduce their environmental impact in their day-to-day practice[5]. As such, we need to consider ourselves not only as participants in the drive towards net zero, but as role models using available evidence to provide the best patient care using the least carbon intensive means. For that reason, we show four low- or no-cost interventions below, which evidence shows can have a significant mitigation impact. However, to truly be part of a climate conscious movement, we need to look at the bigger picture, go beyond the individual patient and make changes at a population level. We need to be advocates for patient and planetary health, as well as educators of current and future health care providers. To expand upon this, we propose two ways for anaesthetic practitioners to make their mark, which are equally relevant to surgeons. This is intended to create a robust approach for sustainable anaesthesia which can be adapted as best practice evolves.



1. Reduce the need for surgery all together

Avoiding the need for surgery altogether is the most effective mitigation strategy. Globally, the climate crisis is inextricably linked with inequity, with those worst affected being the most deprived. The same association is found when looking at preventable surgical disease, for example: a) Obesity, which disproportionally affects deprived groups, is linked with an increase in gall-stone associated disease, hip replacements, and bariatric procedures[6]; b) Abdominal aortic aneurysms are detected more frequently in the most deprived[7]; c) Patients from more deprived areas have lower rates of admission for elective care, despite having a higher burden of disease, while being more likely to present for emergency care, suggesting potentially missed preventative care opportunities[7]. Health inequality in the UK has widened markedly in recent years which has a knock-on effect on the surgical disease burden[8]. The NHS Long Term Plan highlighted a need for greater investment in prevention and reduction of widespread health inequalities which, if successful, would include a reduction in need for surgical intervention. While anaesthetists tend to get involved only at the point of surgery being planned, we need to engage proactively and innovatively. As patient advocates, we should seek to better understand our local populations, and engage with the wider multi-disciplinary team, including primary care, to identify opportunities for better reach of, and care provision to, underserved populations.

2. If surgery is needed: Use local or regional rather than general anaesthesia

There are benefits for both the patient and the theatre team of preferentially using local or regional anaesthesia. Surgery under local anaesthesia is low resource, avoids pre-operative fasting, and may enable higher theatre turnover. Surgery under regional anaesthesia also generally uses fewer resources than general anaesthesia and can lead to shorter hospital stays[5], without increasing adverse outcomes[6]. Enabling a shift towards increased

use of regional techniques requires a multi-disciplinary approach, including an anaesthetic workforce confident in administering regional anaesthesia, availability of adequate equipment, early identification of suitable surgical cases by pre-operative nurses and surgeons, and discussion with patients.

3. If general anaesthesia is needed: Use intravenous rather than gaseous agents

Greenhouse gas emissions (GHG) calculated across the life cycle of inhaled anaesthetic agents are several orders of magnitude higher than that of propofol, the key component of total intravenous anaesthesia (TIVA)[9]. This data includes the manufacture and disposal of equipment used in the administration of TIVA. Unlike in some European countries, inhaled anaesthetic agents remain the default in the UK. However, many arguments exist in favour of a shift towards TIVA; reduced environmental impact, significant reduction in risk of post-operative nausea and vomiting, and financial benefit. This transition can be supported by early and recurrent training in TIVA throughout anaesthetic training and into consultancy, while raising awareness about the environmental impact of inhaled agents.

4. If gaseous agents cannot be avoided: Avoid desflurane

Among the 4 key anaesthetic vapours desflurane has the largest environmental impact when measured over the short term. Most studies comparing the environmental impact of different anaesthetics use the Global Warming Potential (GWP)[9]. This is a multiplication factor assigned to pollutants which compares their environmental impact to that of CO_2. More precisely, if a pollutant has a GWP_{100} of 1 then the 100-year-integrated impact of a one tonne emission of this pollutant is the same as that of a one tonne emission of CO_2. Desflurane (GWP_{100} = 2540) is 20 times more environmentally damaging than sevoflurane (GWP_{100} = 130) and has one third of the potency clinically (three times as much is required for the same anaesthetic effect)[10]. Therefore, for a given operation using desflurane is approximately 60 times more polluting than sevoflurane when using similar flow rates. As sevoflurane is a safe clinical equivalent to desflurane[11], the NHS initially advocated for a reduction in desflurane use and announced targets to reduce desflurane in UK trusts. With encouragement from the NHS net zero panel desflurane use declined to 9.5% of volatile gas use nationwide by October 2021[12]. These data have enabled NHS Scotland and NHS England to decommission desflurane from Spring 2023 and early 2024, respectively.

5. If nitrous oxide cannot be avoided: Audit nitrous oxide use and reduce waste

Nitrous oxide (N2O, GWP_{100} = 265) is used in theatre as a carrier for inhaled anaesthetic agents[10]. Although the GWP of nitrous oxide is lower than other anaesthetic gases, it is destructive to the ozone layer and has a longer atmospheric lifetime[13]. In comparison to oxygen alone as a carrier of inhaled anaesthesia, use of nitrous oxide significantly increases the emissions associated with anaesthetic administration[14]. Nitrous oxide contributes more than half the environmental footprint of anaesthesia, and evidence suggests that upwards of 90% of nitrous oxide emissions are due to pipeline leaks, manifold waste, and ineffective stock management, rather than clinical use[15]. For these reasons, NHS England and NHS Improvement recommend regular reviews of piped nitrous oxide and suggest the leanest possible nitrous oxide supply should be introduced. The nationwide Nitrous Oxide Project have produced a simple waste reduction strategy, which enables a concise review of clinical use, product supply, and cylinder turnover[16]. If implemented, the review could reveal that usage is far less than what is procured and enable the individual trust to cap the manifold and instead use nitrous oxide from cylinders in theatres.

6. Advocate and educate: Make "sustainable anaesthesia" the norm

The information available to anaesthetists and surgeons concerning the climate impact of their clinical practice is increasing rapidly. The concept of completely net zero surgery has been explored and the rapid increase in published research on the topic demonstrates a growing interest in sustainable perioperative care[17]. Importantly, this enables us to quantify the environmental footprint of our current practice and allows us to identify hotspots for change. Importing this knowledge into a quality improvement methodology to drive change will help solidify the interventions, quantify the impact locally, and identify potential obstacles in sustaining the change. The sustainability in quality improvement framework, developed by the Centre for Sustainable Healthcare, is a powerful way to approach quality improvement and enables all interventions to be viewed through the lens of "the triple bottom-line": social, financial, and environmental impact[18]. Besides providing the data to go through QI cycles, the framework also provides a strong base for advocacy and the awareness that our practice may have multiple effects that reach beyond the individual patient-provider interaction.

Are we making progress towards sustainable anaesthesia and surgery in the NHS?

In short, yes, but there is work to do. The NHS has shown willingness to change to safeguard the health of the planet and big strides have been made over the last few years. However, as surgery, and therefore anaesthetic use, is projected to increase globally over the next decade, questions about the environmental impact of our practice are timely. We have a responsibility to minimise our climate impact to allow the necessary and long overdue expansion of high-quality healthcare across the globe. We must recognise that UK emissions attributable to health and social care far outweigh what is compatible with our net zero goal, and that mitigation and changes in practice are part of the NHS's future.

While national leadership from the Greener NHS and NHS net zero panel is crucial, Trusts need to set their own population specific targets to become net zero by 2040. As highlighted above, there is a significant volume of evidence around sustainable surgery and anaesthesia which can be used to make progress in 'Greener Surgery and Anaesthesia'. To make true and lasting change, we must work together to push at theatre, hospital, Trust, and national levels, to affect patient-centred care centred around principles of sustainability and health equity.

Conflicts of interest

None.

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