

# HOT TOPIC

## IS TIVA GREENER?

### SUMMARY OF KEY POINTS:

- The climate emergency is a health emergency. Where multiple safe options exist we can choose the most sustainable option.
- Total intravenous anaesthesia (TIVA) has been shown to have a lower carbon footprint than volatile anaesthesia, however there are concerns regarding biotoxicity of propofol.
- To reduce the carbon footprint of volatile anaesthesia it is best to avoid desflurane and nitrous oxide and use low flows (<1L). Emerging volatile capture technology is likely to significantly reduce the carbon footprint of volatile anaesthesia.
- The largest carbon hotspot of operating theatres is anaesthetic gases. There are many other additional actions you can take to make your operating theatres and patient pathways greener.

### REVIEW OF EVIDENCE

#### Why should paediatric anaesthetists be concerned about climate change?

The evidence is clear. Climate change is occurring, and it is caused by human activity, with 8 of the last 10 years being the hottest on record.

The climate emergency is a health emergency. The children we treat will be most vulnerable to the effects of intense weather events, heatwaves, air pollution and a rise in infectious diseases. We have an opportunity to modify this through our actions in healthcare.

Healthcare is responsible for over 4% of the UK carbon footprint. Taking action to reduce harmful carbon emissions will save lives and improve health now and for future generations. The NHS has set out an ambition to reach 'net-zero' for the emissions we control directly (the NHS Carbon Footprint) by 2040 and for the emissions we can influence (our NHS Carbon Footprint Plus), by 2045<sup>1</sup>.

#### So what can we do?

Anaesthetic gases are responsible for 2% of the NHS carbon footprint. As anaesthetists, this is an area we have direct influence over, so it makes sense to start here. Volatile agents are greenhouse gases and each has a different global warming potential (GWP): sevoflurane, isoflurane and desflurane having 130, 510 and 2540 times the GWP of carbon dioxide over a 100-year time horizon (GWP100), respectively<sup>2</sup>. Desflurane lasts in the atmosphere for 14 years, even at low flows. This will have a cumulative effect over a whole career. Consider 'ditching the Des' as many anaesthetic departments have done.

Nitrous oxide (N<sub>2</sub>O) is a much used drug amongst paediatric anaesthetists for its smooth induction benefits and odourless nature. However, it is a greenhouse gas (with a GWP 265 times that of CO<sub>2</sub>), an ozone depleter and it persists for 114 years in the atmosphere. Using N<sub>2</sub>O alongside a sevoflurane anaesthetic will greatly increase the carbon footprint of that anaesthetic, even more so than isoflurane due to the higher gas flows required<sup>2-3</sup> at induction.

Reducing wastage of N<sub>2</sub>O is a key priority for the NHS. The nitrous oxide project<sup>4</sup> found that sites studied were losing, on average, 95% of the nitrous oxide through leaking manifolds, cylinder expiry or theft. In some sites this amounted to millions of litres of nitrous escaping. By auditing clinical use against the amount of gas ordered, it is possible to work out how much potential waste you could eliminate. The good news is it's not all up to you - multi-disciplinary gas committees have been created across the UK and can work together to reduce carbon footprint and make economic gains, so why not make some enquiries and start the nitrous oxide project in your hospital? Here is a handy [toolkit](#) to help you get started.

Utilising low flow anaesthesia (<1L) in an oxygen/air mixture is an effective way to reduce the carbon footprint of an anaesthetic<sup>2-3,5</sup>. Gas inductions involve high flows, therefore an intravenous induction (where safe and appropriate to do so) is less carbon-intensive. Where gas inductions do take place, consider using a circle system rather than T-piece where possible, to minimise flows. Focus groups held with children have demonstrated that many would alter their choice of



induction based on the carbon footprint of their healthcare, such as choosing an intravenous induction over an inhaled induction<sup>6</sup>.

Emerging technologies for volatile capture and cracking of N<sub>2</sub>O are likely to significantly reduce the carbon associated with volatile anaesthesia<sup>2</sup>. A number of UK sites are currently trialling this technology. In terms of N<sub>2</sub>O it makes sense to eliminate waste alongside these measures.

### **Is TIVA better for the environment than volatile anaesthesia?**

A number of studies have utilised cradle-to-grave life cycle analysis (LCAs) to determine which method is better for the environment. These take into account all drugs and equipment involved. TIVA has been shown to have the lowest carbon footprint with the most carbon attributed to the energy required to power the TIVA pumps<sup>3</sup>. However, there are concerns regarding biotoxicity of propofol (1% is excreted unchanged by patients). More research is required to investigate the effects of this on the biosphere<sup>2</sup>. It is of vital importance that propofol is incinerated and not disposed of into the sink for these reasons.

While TIVA has the lowest carbon footprint currently, as we see the uptake of volatile capture technology the carbon footprint could reduce to similar levels to a sevoflurane anaesthetic in the absence of nitrous oxide.

### **What else can we do beyond anaesthetic gases?**

While 42% of the carbon footprint of theatres is made up of anaesthetic gases<sup>7</sup> there are a few other things you can consider to make your practice more environmentally friendly.

- Medicines account for 25% of the NHS carbon footprint<sup>1</sup> with IV medicines generally having a higher carbon footprint due to sterilisation, packaging and transport emissions. Consider, where you might be able to use oral medicines instead of intravenous medicines, such as using pre-operative oral paracetamol.
- Re-usable equipment often has a lower carbon footprint than single use equipment so where safe to do so, consider using reusable laryngoscopes, surgical hats or surgical instruments - could you get your surgeons involved?
- Energy accounts for a large proportion of the operating theatre's carbon footprint. Consider measures such as turning off scavenging systems overnight, motion-sensored lighting and conductive patient warming in favour of energy-hungry convective methods.
- Care pathways have an inherent carbon footprint. Consider if these can be streamlined such as promoting day surgery, minimising pre-operative hospital visits and utilising virtual or telephone consultations where safe to do so.
- In every quality improvement project, there is an opportunity to assess the 'triple bottom line' which incorporates social, environmental and financial impact. There are many resources to help you explore this further<sup>8-9</sup>.

### **Who can help with this?**

You are certainly not alone. The NHS has 1.4 million staff and almost 9 in 10 want to improve environmental sustainability. Here are a few things you can do:

- Every hospital must now have a Green Plan setting out how to reach the NHS net-zero ambitions. Consider meeting your local sustainability lead or net zero committee to see where you can help as a clinician.
- Talk to your colleagues about how to make your department more sustainable - involve the whole multidisciplinary team.
- Join a network - there are many green anaesthesia networks popping up all over the country allowing sharing of lessons and solidarity amongst environmentally conscious anaesthetists.
- Consider talking to your patients, they might want to be involved in decisions that will affect their lives in the long term.

### **Conclusion**

*The climate crisis is a child rights crisis (RCPCH).*

The decisions we make today will affect young people for the rest of their lives. It is vital that we consider the best course of action, one that is safe and does minimal damage to the environment in the process. As anaesthetists we work across many areas in the hospital, in large teams, handling drugs and equipment. We have a huge opportunity to influence the environmental outcomes of our treatment and improve the lives of our patients for many years to come.

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# Theatre Carbon Emissions

42%

Anaesthetic Gases

29.2%

In-patient Bed Days

23%

Surgical Procedure

5.5%

Patient Travel

Surgical Procedure

58% Energy

32%

Consumables

5%  
Equipment

5%  
Staff travel

0.01% Waste  
0.01% Water