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Sustainability in healthcare is not just about plastic packaging and recycling, says **Kevin Robinson**. When maintaining normothermia in surgical patients, it is important to find the right balance of different modalities across the patient warming workflow to improve patient outcomes and achieve sustainability goals for the healthcare provider.

In 2010, Sir Dave Brailsford was appointed as General Manager and Performance Director of Great Britain's professional cycling team, Team Sky. He was an advocate of the concept referred to as the "aggregation of marginal gains", a theory that the amalgamation of refining everything by just 1% would amount to a much greater affect in improvement. That strategy proved to be successful, as Team Sky went on to win the Tour de France four times, and the British cycling team won 70% of the gold medals at the 2012 Olympic Games.

In recent years, most of us have become very aware of climate change. In the UK alone we have experienced +40˚C temperatures, severe flooding, destructive storms, droughts, forest fires and coastal erosion. The last four decades have all been warmer than any previous decade since 1850, with the last being the warmest on record.[1]

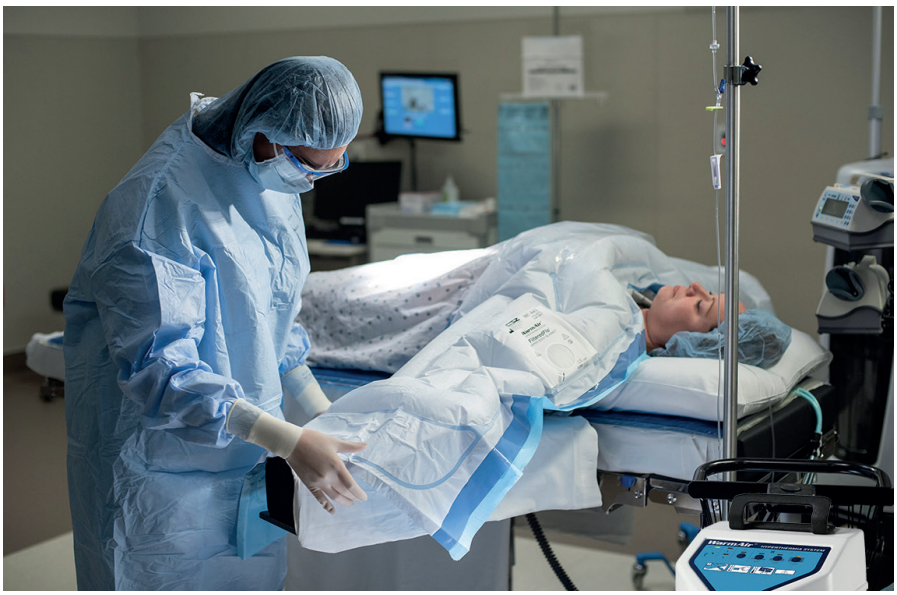
The primary cause is greenhouse gas emissions trapping the sun's heat and causing the earth's surface temperature to increase. Since the start of the industrial revolution in the 1800s, it has risen by approximately 1.2˚C, with human behaviour being the main driver for this.

Most recognise the main cause of greenhouse gases is through the burning of fossil fuels and the main contributors being energy, industry, transport, buildings, and agriculture. However, many may be surprised to realise the contribution the healthcare sector has on greenhouse gas emissions. Approximately 5% of global greenhouse gas emissions are generated by healthcare,[2] compared to 2.5% from aviation,[3] with one of the carbon hotspots being the perioperative and intensive care areas.

The main components that contribute to the carbon footprint are:[3]

- Anaesthetic agents and gases
- Energy consumption used for OR maintenance (HVAC, lighting)
- Water
- Pharmaceuticals
- Complex supply chains
- Waste management

The biggest contributors are anaesthetic gases, energy usage and products used in surgery.[3] Operating departments are the most energy intensive areas of a hospital using 3-6 times more energy than clinical wards, and accounting for 10% of the NHS carbon footprint.[3]



While most energy consumption is due to heating, ventilation, and air-conditioning, 1.5-8.4% results from plug-loads and lighting.[3] In a case study from Swansea Bay hospital, it was estimated they would reduce CO_2e by 144.8 tonnes and save around £26,000 a year by simply switching off non-essential equipment during non-planned surgery hours.[3]

Operating departments have high product use and consumption and produce about 20% of total hospital waste.[4] In England single-use products account for 68% of the carbon footprint of products used in the five most common operations.[3] One study estimated that a typical operation in the US, Canada and UK produced between 146-232kg of CO_2e, which is equal to driving 400-650 miles in an average petrol car.[3] The same study estimated that a large UK hospital generates over 5,000 tonnes of CO_2e per year, which is equal to driving round the globe 580 times.[3]

Over the last 30 years, to reduce the risk of infection, there has been an increase in single-use devices, which was exacerbated during the COVID-19 pandemic. Blood pressure cuffs, pulse oximetry probes, laryngoscopes, some complex instruments, and surgical drapes are now single use, despite WHO finding no evidence of different infection rates for single use *versus* reusable drapes.[3] They also say that approximately 85% of hospital waste is non-hazardous.[5]

While reuse is not appropriate for all devices, switching where appropriate will reduce carbon footprint by 38-56%, as the energy burden associated with waste processing and transport is greater than laundering and sterilisation.[3,5]

The Glasgow Declaration for Sustainability within Anaesthesiology and Intensive Care is the road map to environmental sustainability within the fields of anaesthesiology, and is based on the European Green Deal, which

aims to achieve climate neutrality by 2050 and reduce greenhouse emissions by 55% by 2030.[4] It focuses on the key areas where the greatest environmental gains may be made:

- **Medication Use**: discourage the use of anaesthetic gases and agents such as nitrous oxide and desflurane for anaesthetics with lower global warming potential.
- **Energy Use**: the setting of HVAC systems to 6 air changes when ORs are not in use, maintaining temperature to 18-23˚C. Reduce energy from lighting through energy efficient lighting. Use automatic lighting and water sensors.
- **Circularity in Processes and Waste:** where applicable, consider purchasing reusable or reprocessed equipment, avoid single-use items that do not provide a clear benefit in patient care, and reduce waste generated and landfill.

But for all these initiatives to work and to make healthcare more sustainable, it needs to be adopted across the wider community, in different disciplines and by all healthcare stakeholders and organisations. One area where small sustainable changes in practice can be made, that will maintain patient care, support environmental health, and improve surgical outcomes, is patient warming.

Patient warming to reduce the incidence of perioperative hypothermia has been used for decades. Since the first convective warming system was introduced in the mid 1980s, single-use forced-air warming blankets have been used routinely in most hospitals. In April 2008, NICE published CG65,[6] *The Management of Inadvertent Perioperative Hypothermia in Adults*, and recommended warming patients with a forced-air warming device from induction of anaesthesia. This was later updated in December 2016, with the recommendations that all patients should be warmed before induction of anaesthesia (prewarmed), and to consider the use of a resistive warming system if forced air was unsuitable.[7]

The objective of prewarming is to reduce the impact of redistribution temperature drop following induction of anaesthesia, by increasing the patient's peripheral temperature and reducing its gradient with the core. Prewarming has been shown to maintain perioperative normothermia and significantly reduce the incidence of intraoperative and postoperative hypothermia.[8,9,10] In contrast, when initiating active warming after induction of anaesthesia, and only once the patient has been prepped and draped, more than 50% of patients still experience perioperative hypothermia.[11]

Prewarming the patient for as little as 10 minutes before induction of anaesthesia has shown to be effective,[12] and can be carried out in the anaesthetic room or operating theatre, while the patient is being prepared for anaesthesia. Simply putting the warming device on the patient as soon as they arrive in the anaesthetic room can help to reduce the incidence of perioperative hypothermia and therefore reduce the risk this can cause the patient.

While forced-air warming has been shown to be effective at maintaining normothermia and preventing the incidence of perioperative hypothermia, resistive conductive warming has been shown to provide equivalence.[13,14] No single system will be suitable for all surgical procedures and patients, but having the ▶

availability of both forced-air and resistive conductive warming will enable clinicians to meet patient normothermia goals, while simultaneously contributing to reducing the carbon footprint of the healthcare facility.

Resistive conductive systems are reusable and, like the operating table mattress, they will require wiping down between patient use, but with no additional waste. They also consume very little energy compared to forced-air warmers. For example, the ASTOPAD System by Gentherm, at its peak, consumes around 160W of energy compared to 1500W from a forced-air warmer. This means that it will take the ASTOPAD more than nine hours of continual use to consume the same amount of energy that a forced-air warmer uses in one hour. Low energy consumption also allows the system to operate on battery power, maintaining blanket temperature for up to two hours.[15]

The European Society of Anaesthesiology and Intensive Care consensus document on sustainability unanimously recommended, with a 97% agreement, the use of conductive fabric warming systems as they are more energy efficient compared to forced-air.[16]

Resistive conductive systems produce much less waste, consume significantly less energy, require no periodic filter change, which itself produces additional waste and, when used correctly, will maintain normothermia and reduce the incidence of perioperative hypothermia.

Climate change is a global problem and no one person or solution will provide a resolution. But if each of us can make just a 1% improvement in our practices, the aggregation may prove to be truly significant. **CSJ**

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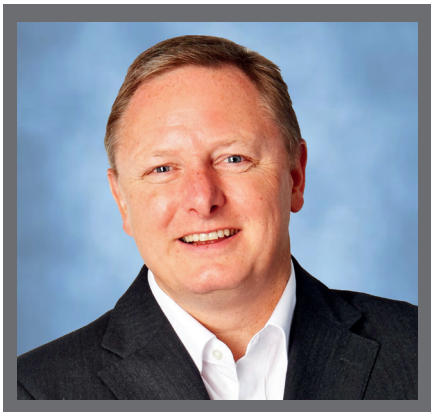

About the author

Kevin Robinson is currently Clinical and Technical Services Manager EMEA at Gentherm Medical. Kevin is a qualified Operating Department Practitioner with over 10 years' experience working at hospitals in London, UK and has over 20 years' industry experience specialising in active patient thermal management.