

# The three Fs of sustainability in surgery: the facts, what is currently feasible and the future

What can we change now and what can we work towards to transition to sustainable surgery?

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**The facts**

The vast scientific evidence linking the rise of global surface temperatures with the accelerated accumulation of greenhouse gases into the atmosphere has put to bed scepticism around the existing climate emergency.<sup>1,2</sup> This temperature rise is not without cost. Worsening air pollution as well as increased frequency of heatwaves, floods and wildfires are some of the consequences that directly affect human health. Indirectly, health is affected by the damage to infrastructure and systems on which healthcare depends. Unfortunately, healthcare is a significant greenhouse gas contributor. The NHS contributes 5.4% of all UK greenhouse gas emissions.<sup>3</sup> Through the production, distribution and disposal of pharmaceuticals, medical equipment and devices, the global supply chain of healthcare is responsible for 71% of its carbon footprint.<sup>3</sup>

Surgical services (and operating theatres in particular) are a carbon hotspot for healthcare. An operating theatre's high energy demands, equipment procurement, anaesthetic gases and the generation of excess amount of waste are the main contributing factors.<sup>4</sup> In order to help put this into context, a systematic review of the carbon footprint of operating theatres identified a single (average) operation in the UK to be responsible for 173kg of CO<sub>2</sub>e (carbon dioxide equivalents).<sup>5</sup> This is equivalent to driving from London to Edinburgh or 450 miles in an average petrol car for every operation performed.

Heating, ventilation and air conditioning are to blame for operating theatres' high energy consumption.<sup>4</sup> Inhaled anaesthetic gases have varying global warming potential, with the use of certain gases such as desflurane behind the potential for anaesthetic gases to contribute as much as 63% of carbon emissions associated with an operation.<sup>4</sup> Although waste only accounts for 3% of healthcare's carbon footprint,<sup>3</sup> operating theatres are responsible for 70% of hospital waste.<sup>6</sup> This is especially exacerbated by our growing reliance on single-use plastic, which is contributing to landfill and worsening ocean pollution.<sup>7</sup> A shift away from single-use items in operating theatres will have a significant impact on healthcare's waste carbon footprint.

However, healthcare around the world has started recognising its contribution to the climate crisis. In 2020, the NHS in England became one of the few national healthcare organisations in the world to set a net zero carbon emissions target.<sup>8</sup> That has inspired 24 other national healthcare systems to follow suit.<sup>9</sup>

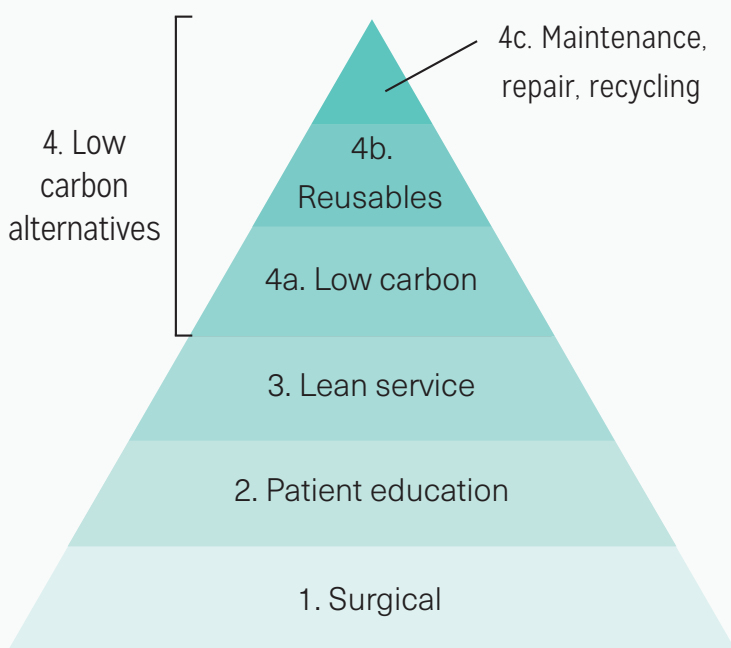
The four surgical royal colleges have declared a climate emergency and in 2019, the Royal College of Surgeons of England established its Sustainability in Surgery group, which has been tasked to make sustainable improvements in surgical practice, associated industries and the royal colleges.<sup>10</sup> The principles of sustainable surgery have been developed as a guide to diminish the environmental impact of clinical practice (Figure 1)<sup>11</sup> and the Intercollegiate Green Theatre Checklist<sup>12</sup> was published as peer reviewed guidance to facilitate sustainable change. Although these are small steps towards sustainable surgery at an organisational level, these actions are of limited value if they are not reflected in our everyday clinical practice. As the evidence base grows from the increasing research in sustainability, the decarbonisation of surgery will require tangible action from every practising clinician to ensure that the evidence is put into practice.

**What is currently feasible?**

In adherence to the stereotype that surgeons take pride in doing, here are some practical adjustments to your everyday practice that would evoke sustainable change.

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Figure 1 Principles of sustainable surgery<sup>11</sup>



*As well as the culture change among surgeons, basic training in, for example, carbon footprinting is required to allow effortless identification of greenwashing by the medical manufacturing industry*

*Travel:* Ten per cent of NHS carbon emissions originate from patient, staff and visitor travel.<sup>8</sup> Maximising the use of technology to facilitate virtual clinics can reduce travel emissions. Adopting and encouraging active travel, car sharing, and the use of public transportation by staff, patients and visitors has even more potential.

*Anaesthesia:* Use regional or local anaesthesia for procedures instead of general anaesthesia when appropriate. The gases used in general anaesthesia are responsible for its higher environmental impact.<sup>13</sup>

*Hand scrub:* Using waterless hand scrubs can save millions of litres of water every year. There is no difference in antiseptic effectiveness between alcohol-based waterless hand scrub, and traditional chlorhexidine and iodine-based hand scrub.<sup>14</sup> The National Institute for Health and Care Excellence (NICE) recommends the use of waterless hand scrub for subsequent cases after the first traditional hand scrub of the day.<sup>15</sup>

*Reusable textiles:* Use reusable surgical gowns, drapes and hats. They are associated with lower consumption of energy and water; they also generate less solid waste<sup>16</sup> while offering better protection.<sup>17</sup> There is no difference in the rate of surgical site infections associated with their use compared with their single-use counterparts.<sup>18,19</sup>

*Waste disposal:* Although minimising the amount of waste generated in operating theatres is a priority, appropriate

disposal of any waste generated is just as important. Less than 50% of recyclable waste generated from operating theatres, like equipment packaging, is recycled.<sup>20</sup> Appropriate waste segregation by separating clinical waste from non-clinical waste will minimise the high energy processes that go into clinical waste disposal.

*Operative equipment:* Review instrument trays for unused instruments regularly as this can lead to significant cost savings<sup>21</sup> and reduce unjustified energy waste. The use of reusable or hybrid versions of surgical instruments instead of single-use instruments reduces the carbon footprint associated with the operative procedure and is associated with cost savings in almost every circumstance.<sup>22-24</sup> Using sutures instead of skin clips also reduces your carbon footprint.<sup>12</sup>

*Clinical interventions:* Ensure antibiotic prophylaxis is guided by the evidence base. NICE advises against the routine use of antibiotic prophylaxis for clean non-prosthetic surgery.<sup>15</sup> The nitrous oxide in Entonox<sup>®</sup> used for acute pain relief has very high global warming potential. Opting to use alternatives such as Pentrox<sup>®</sup> with similar analgesic effect<sup>25</sup> and less global warming potential will be the sustainable choice.

*Surgical organisations and societies such as the Association of Surgeons of Great Britain and Ireland, and the Association of Surgeons in Training must be at the forefront of the transition to sustainable surgery*

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*Energy conservation:* Switching off air conditioning, heating and ventilation systems or turning them to standby when operating theatres are not in use can halve energy consumption in theatres.<sup>4</sup> The prudent use of ultraclean air ventilation to generate laminar flow is also advised. NICE recommends its use primarily for joint replacement surgery.<sup>26</sup>

### The future

Reducing the environmental impact of surgery requires further research and innovation as well as a unified alliance between non-clinical and clinical professionals, policymakers and industry. Embedding sustainability into all surgical research, medical education and quality improvement will be vital for this. The sustainability in quality improvement framework (SusQI), which has been developed by the Centre for Sustainable Healthcare, helps to embed sustainability into quality improvement. However, sustainability needs to be recognised formally as a quality improvement domain by the surgical royal colleges, as already done by the Royal College of Physicians.<sup>27</sup> This act will further empower surgical teams to embark on sustainable quality improvement projects and the integration of sustainability into the implementation of technological advances in surgery.

As well as the culture change among surgeons, basic training in, for example, carbon footprinting is required to allow effortless identification of greenwashing by the medical manufacturing industry. An example of such training is already available in short courses delivered by the Centre for Sustainable Healthcare.<sup>28</sup> Surgeons have an active role in choosing suppliers, and should leverage this purchasing power to accelerate the decarbonisation of the industry and its complex supply chain. The unethical labour and employment practices identified in the current globalised supply chain of surgical instruments<sup>29</sup> is yet another reason to hasten its redesign to one that embeds circular economy principles at its core.

Inspiration for sustainable surgical innovation should be sought by studying our surgical colleagues in low and middle income countries. The finite resources available to them have forced the frugal design of their clinical pathways and processes, leading to efficient low carbon services<sup>30</sup> with occasionally comparable patient outcomes.

Finally, surgical organisations and societies such as the Association of Surgeons of Great Britain and Ireland, and the Association of Surgeons in Training must be at the forefront of the transition to sustainable surgery. By taking a leading role in advocating, promoting and educating

in environmental sustainability in surgery, stakeholders (us surgeons, industry, policymakers) will be encouraged to adventurously think outside the box for sustainable solutions that will be the driving force of sustainability in surgery. As trainees, we are the future of surgery, and we therefore have the power to demand, drive and make changes to ensure that patients and the planet, our planet, have a long and healthy future.

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