SUSTAINABILITY IN THE OPERATING THEATRE

Royal College of Surgeons of England
ADVANCING SURGICAL CARE

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A guide to good practice

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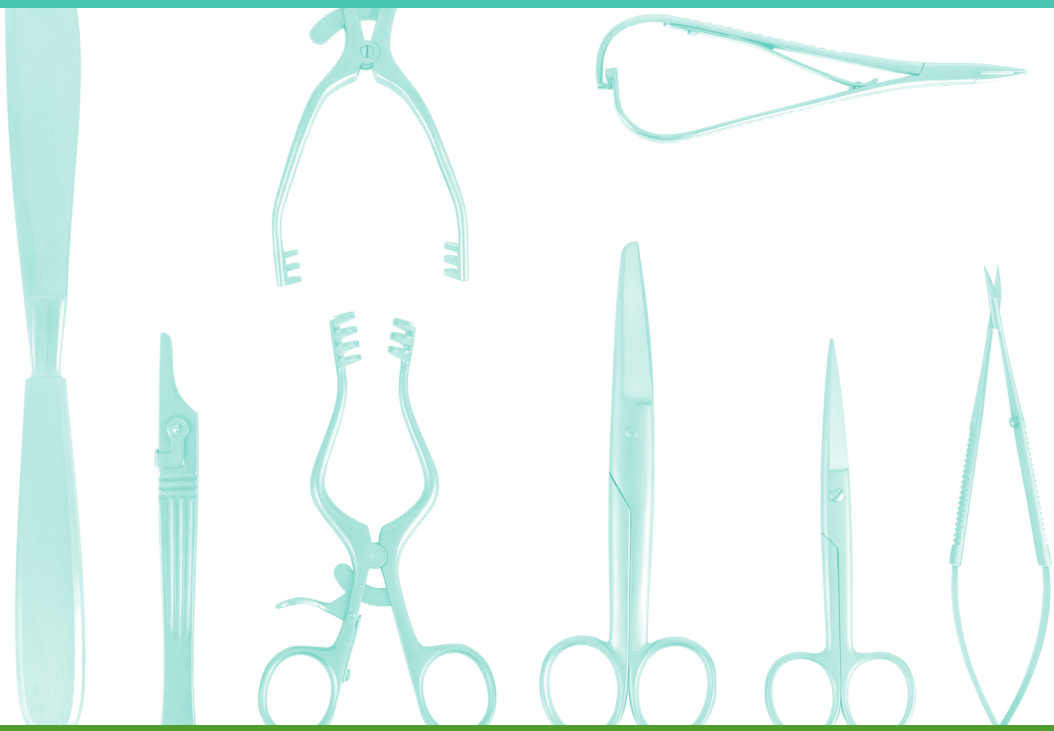

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1. Introduction

In 2009, the Lancet Climate Change Commission declared climate change as 'the biggest global health threat of the century'.[1] Climate change arises from the accumulation of 'greenhouse' gases, which trap heat in the atmosphere and results in rising temperatures. Human activity adds enormous amounts of these gases into the atmosphere, most commonly carbon dioxide (CO2), through electricity generation, transportation, power manufacturing, industry and agriculture. It is estimated that climate change will adversely affect most populations, but it will particularly exacerbate current health disparities for marginalised and low socioeconomic groups.

The healthcare sector, which is expected to help combat this health threat, is in fact one of the biggest contributors of greenhouse gas emissions, with the NHS accounting for 4.6% of the UK's total carbon footprint and approximately 25% of the public sector's footprint.[2,3] Operating theatres, in particular, have a disproportionate environmental impact because of their energy-intensive processes, consumption of resources, use of volatile anaesthetic agents and production of waste. They are estimated to be three to six times more energy intensive than clinical wards and tend to produce approximately 50–70% of the total hospital waste.[4,5]

The NHS, supported by the UK Health Alliance on Climate Change, has pledged to meet a 'net zero' carbon target by 2045 through its Greener NHS campaign.[6] Individual surgeons and surgical teams also have a responsibility to protect the current and future health of their patients. They are in a unique position to lead efforts to improve the environmental sustainability of the operating theatre, which in most cases also offers potential short and long-term cost savings.

This document makes practical recommendations for surgeons and members of the surgical team in the areas of solid waste reduction, green purchasing, water conservation, care pathways, cultural change and surgical leadership. The aim is to support improvements in surgical care through small, sustainable practices that maintain patient care and support environmental health.

2. Reducing solid waste

Most waste in the operating theatre comes from single-use surgical supplies and instruments, most commonly textiles (e.g. personal protective equipment (PPE), drapes and operating table sheets), sterile and non-sterile packaging, and various consumables and perioperative equipment including surgical scissors, plastic suction bottles, laparotomy pads, etc.[7,8] The advent of COVID-19 has exacerbated the problem through the vast amounts of PPE required throughout the pandemic.

Although not all waste can be eliminated, it is possible to reduce its volume and its impact on the environment significantly through a combination of initiatives.

REUSING PRODUCTS AND INSTRUMENTS

One of the causes of the increased volume of theatre waste is the shift from reusable to single-use products in recent decades, in an effort to address the infectious risk from bloodborne diseases, such as hepatitis B.[9] According to the World Health Organization, there is no clear evidence to support a difference between reusable or disposable materials in reducing the risk of surgical-site infections or wound contamination.[10,11]

Disposable equipment generates landfill waste, which releases methane gases into the atmosphere. In many cases, single-use products (which are often made of single-use plastic) can also increase costs unnecessarily, whereas non-disposable products allow the initial purchase cost to be spread over multiple uses.

Studies suggest that the use of non-disposable equipment, textiles and instruments is environmentally friendlier and results in a lower carbon footprint than their single-use equivalents, even after accounting for sterilisation and laundering, reducing the generation of waste and the energy burden associated with waste processing and transport.[12] The umbrella use of disposable materials and instruments should therefore be challenged.

Recommended solutions

- Opt for reusable textiles, including reusable PPE such as fluid-resistant gowns, eye visors and face shields, as well as reusable drapes, towels and table sheets. Linen or cotton are natural reusable alternatives for textile materials.
- Optimise the use of consumables through reusable surgical trays, paddings (e.g. reusable gel pads) suction receptacles and others. Waste from plastic suction bottles, for example, could also be reduced by reusing the containers and lining them with disposable liners.
- Reduce disposable instruments, such as surgical scissors, laparotomy pads and other laparoscopic instruments, and anaesthetic equipment where possible.
- Encourage local policies that consider the option of reusable materials and products as a default option.

- Consider reusable sterilisation packaging, and minimise secondary and tertiary packaging by making arrangements to return it by the next delivery truck of the specific company.[i]
- Reduce paper towel waste through using hand dryers or hand sanitisers for non-surgical handwashing.

CORRECT WASTE SEGREGATION

Waste generated in hospitals is split into clinical waste, which needs to be treated before disposal, and non-clinical waste, which can be disposed of in the same way as regular domestic waste. Guidance from the Department of Health requires hospital waste to be segregated into several granular categories based on the different treatment and disposal methods needed.[13] Broadly, this covers:

- Hazardous waste, which is infectious or chemical and requires incineration. This includes anatomical waste, chemically contaminated material, cytotoxic and cytostatic material, medicinally contaminated infectious waste and category A pathogens.
- Hazardous waste, which is infectious or chemical and needs to be treated before disposal but not necessarily through incineration (e.g. through autoclaving, microwaving, ultraviolet light or chemical decontamination). This includes waste derived from patients with known or suspected infectious diseases, such as wound dressings, gloves, gowns, and sharps contaminated with body fluids or medicines.
- Non-hazardous, non-infectious waste, which is comparable to domestic waste and can be recycled, repurposed or disposed of without treatment.

According to the World Health Organization, approximately 85% of hospital waste is non-hazardous,[14] but in the operating theatre the vast majority of non-hazardous waste is misclassified as infectious or hazardous,[15] resulting in substantial environmental impact and unnecessarily high costs through high-energy disposal processes. There is also general consensus that up to 80% of all theatre waste is generated before the patient arrives for surgery and is therefore not infectious unless it is mixed with other waste.[15]

Non-hazardous waste will typically end up in a landfill or recycled and, although landfill is not an ideal option, it is considered far better than incineration. Incineration is superior to other forms of treatment, as it can treat all types of waste (other than radioactive waste) and it significantly reduces weight and volume of waste transferred to a landfill.[16] However, clinical waste incinerators release toxic pollutants and heavy metals into the air, which means that incineration contributes significantly to pollution and contamination of the food chain from bioaccumulative and carcinogenic toxin emissions (such as dioxin emissions) and also mercury,[4] resulting in adverse impact on human development. This comes on top of emissions generated indirectly through the transport of waste to these treatment facilities.

Such incorrect sorting of waste is often caused by a lack of understanding of the nuances of waste segregation or fear of reprimand for incorrectly allocating waste as non-hazardous. This is compounded by the complex colour coding put forward by

i. Secondary packaging refers to the exterior packaging that groups packages together or further protects or labels the products. Tertiary packaging is used for bulk handling, storage, and distribution.

the Department of Health in its guidance (black bags for general waste, yellow bags for hazardous waste requiring incineration, red bags for anatomical waste requiring incineration, orange bags for infectious waste that needs to be treated but not necessarily incinerated, yellow/black striped tiger sacks for hygienic/sanitary waste, and several other categories for sharps and other materials). Other factors that contribute to incorrect waste segregation can be lack of leadership and lack of proper planning, but also convenience, for example when there are yellow, orange or red bags in and around the theatre allowing the sorting of infectious and/or hazardous waste but no black bags for general waste.

Recommended solutions

- Educate staff on waste segregation and treatment.
- Increase the number and availability of general waste bins, including using black/general waste bags in the operating theatre until the patient arrives.
- Use product coding to enable more accurate and efficient sorting of waste.
- Unused and unexpired supplies could also be donated to hospitals in developing countries that might benefit from them, taking into account ethical obligations and local infrastructure needs. Organisations such as MedShare, for example, are able to redistribute to countries around the world, equipment that would otherwise end up in landfill.

RECYCLING CLEAN PLASTIC, PAPER AND OTHER MATERIALS

Extending the lifetime of products through reuse and reprocessing generally has higher environmental value and is therefore preferable to recycling. Recycling involves significant energy consumption but is overall less resource intensive than producing new products, as it uses less energy on sourcing and processing new raw materials. As such, it is associated with lower carbon emissions and is better than incineration or throwing materials into landfill. The two approaches of reusing and recycling should be used in combination, as there are materials and equipment that cannot be reused.

Products made for medical applications must normally be developed from primary sources, which means that recycled equipment cannot be used for the same purpose.[17] For this reason, and because of the energy-intensive processes involved, it is important that there is participation by staff in the recycling process. Staff should participate from the point of generation to offset as much as possible the environmental impact from the collection and reprocessing of recycling materials, including emissions generated from collection trucks and sorting facilities, as well as side streams of waste associated with the recycling process.[16]

Recommended solutions

- Initiatives to enhance a hospital's recycling plans by extending and optimising the sorting of a higher diversity of recyclable materials.
- Recycle materials such as cardboard and paper, fluorescent light bulbs, aluminium, steel, glass (not broken), batteries, high-quality plastics, linen, surgical towels and other fabrics. Some of the most used and discarded plastic and recyclable materials in the operating theatre are polypropylene (PP), polyethylene (PE) and polyvinyl chloride (PVC), which are found in laminate bags, among other products. For those laminate bags consisting of a PP layer and a paper layer, it is easy to separate the two for recycling.[16]
- Ensure that there are easily accessible recycling bins across most areas of the hospital.

3. Environmentally preferable purchasing

Hospitals have substantial purchasing power. It is estimated that the NHS generates two thirds of its carbon footprint during the production of the goods it procures.[18] Thus, NHS trusts have the responsibility to influence suppliers to ensure that the products and services they procure are produced in an environmentally sustainable and ethical way. The NHS Supply Chain has issued a supplier code of conduct, which states:

We expect our suppliers to strive to support NHS Supply Chain's climate protection goals through the products and services they deliver (e.g. by providing relevant data on climate protection). In this regard, we also expect our suppliers to take climate protection appropriately into account in their own operations, for example by setting climate protection goals for themselves and achieving them.[19]

This makes environmentally preferable purchasing an important consideration in the contract between vendors and hospitals. Environmentally preferable purchasing is understood as the 'purchasing of products and services whose environmental impacts have been considered and found to be less damaging to the environment and human health when compared to competing products and services'.[20]

Recommended solutions

- Support environmentally preferable purchasing by working with managers of surgical units and purchasing teams to incorporate environmental sustainability into purchasing decisions. Organisations such as Practice Greenhealth and Healthcare Without Harm have guidance with detailed advice on the purchasing process and policy templates for selecting greener products that can be adapted to the needs of each hospital.[21,22]
- Adopt policies that support purchasing consumables such as computers, office equipment or food from local suppliers to reduce greenhouse gas emissions associated with transport and to support the local economy.
- Aim to purchase energy-efficient office equipment (see for example the office energy efficiency guides from the Carbon Trust).[23]

4. Water conservation

Surgery uses vast amounts of water every day and yet it is an undervalued and mindlessly wasted resource. The traditional preoperative hand wash is estimated to use approximately 18.5 litres of water per scrub, per staff member.[24] Waterless hand scrubs have been found to have the same antiseptic efficacies,[25] and over the course of a year millions of litres of water could be saved by using alcohol-based agents. Challenging the use of excess water and reducing water consumption has environmental benefits by decreasing the energy required to treat and deliver water, and can also help mitigate hospitals' operating costs, including reducing the need to wash and process towels.[26]

Recommended solutions

- Make conscious efforts to conserve water.
- Use alcohol-based waterless scrub agents prior to surgery.
- Install intermittent flowing water systems where staff can use their feet to push a knob to release running water.[16]
- Upgrade shower heads, faucets and toilets to low-flow fixtures.
- Avoid bottled water where there are safe alternatives.

5. Care pathways and travel

VIRTUAL CONSULTATIONS AND STAFF TRAVEL

In most cases, the operative process begins and ends with a visit to an outpatient clinic. Travel to and from hospitals by patients and staff contributes up to 18% of the total healthcare carbon emissions.[5,27] Conversely, virtual appointments by phone or video conferencing with suitable patients can be a potent carbon reduction factor. For example, patients with low-risk conditions, patients who do not need physical, internal or close visual examination, patients with follow-up appointments or chronic conditions who already know the surgeon with whom they will be communicating are generally suitable to have remote consultations, if they are able to use and communicate through remote technology. The Royal College of Surgeons of England has published guidance on how to carry out consultations with surgical patients, setting out criteria for selecting suitable patients for remote appointments and standards around the consent process, data protection and technical requirements.[28]

Staff travel can also be reduced where appropriate through remote meetings, as above, or it can be optimised through incentives for using public transport, car-sharing or low-carbon transport options such as walking, cycling and electric cars.

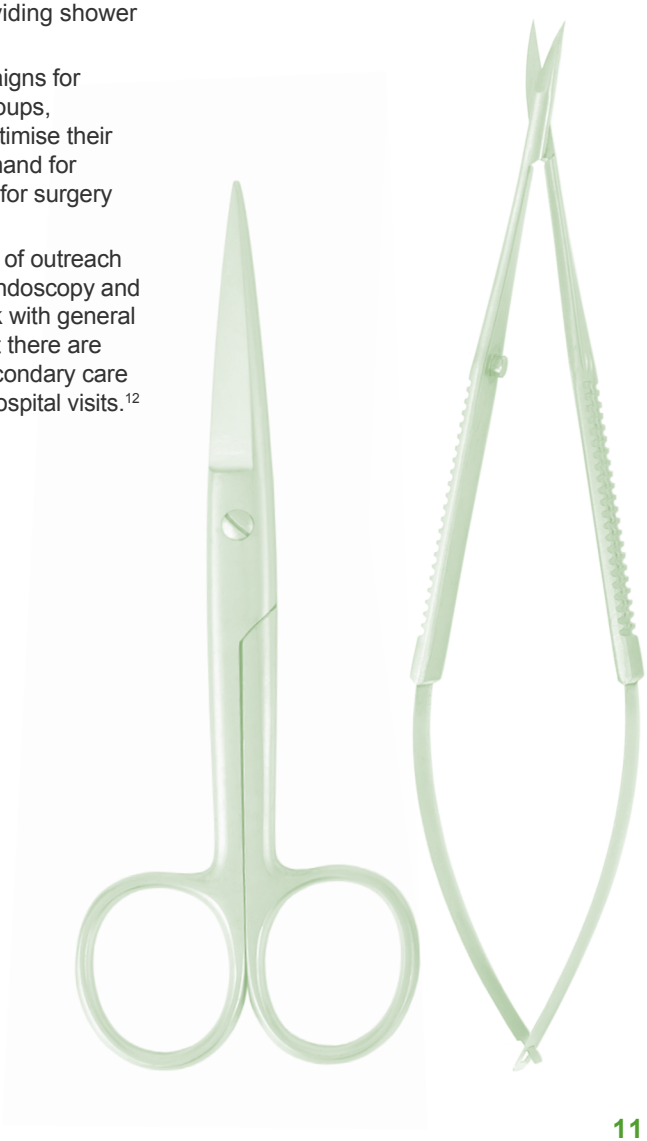
SERVICE CONFIGURATION

More emphasis should be placed on disease prevention to reduce avoidable hospital admissions and the need for resource-intensive invasive operations.[12] If an operation is required, encouraging healthy behaviours, such as exercise and smoking cessation, can help to maximise fitness for surgery and reduce length of stay in hospital.

Moving care closer to home through more outreach clinics for minor surgery, endoscopy or daycase surgery and through extended primary care services for patients who do not need to go to hospital and can be managed by a general practitioner or a primary care nurse in the community, are all further measures that can support healthcare provision that is more environmentally sustainable, cost effective and increases patient satisfaction.

Recommended solutions

- Develop policies and criteria to allow the regular and systematic review of patients' need to travel or have remote consultations.[27]
- Establish incentives for staff to use low-carbon travel options, such as reimbursement and parking provision schemes for car sharing, provision of accessible and secure cycle storage, encouraging walking, providing shower and changing facilities.
- Consider education campaigns for specific surgical patient groups, empowering patients to optimise their health and reduce the demand for surgery or improve fitness for surgery if a surgery is required.[12]
- Consider the development of outreach clinics for minor surgery, endoscopy and daycase surgery, and work with general practitioners to ensure that there are appropriate referrals to secondary care that reduce unnecessary hospital visits.[12]



6. Leadership and cultural change

Environmental concerns and sustainable initiatives are rarely at the forefront of surgeons' and managers' minds. Where there is willingness to undertake such initiatives, this does not always translate to implementation. Some of the primary barriers are limited data, lack of strategic planning and leadership, insufficient staff engagement and misconceptions around infection risk of reusable equipment, waste sorting, perceived cost or perceived workload.[5] Strong leadership is essential to create lasting change and an environmentally mindful culture.

RECOMMENDED SOLUTIONS

Research, data and quality improvement initiatives

- Most of the available literature captures high-level trends and advice. More detailed research is needed to get granular data and understand the specific environmental impact of individual surgical procedures, instruments and materials. Surgeons should take the lead in investigating best practices around environmental initiatives and undertake quality improvement projects on sustainability, for example by examining the environmental impact of healthcare activities and technologies, auditing waste streams of processes or equipment, developing devices or processes that minimise adverse environmental effects while maintaining safe and high-quality care.
- Equally, employers need to put policies in place that support such initiatives and provide clinicians with the time and resources they need to carry out these projects and find areas of practice where there is scope to reduce both the surgical carbon footprint and excess cost.

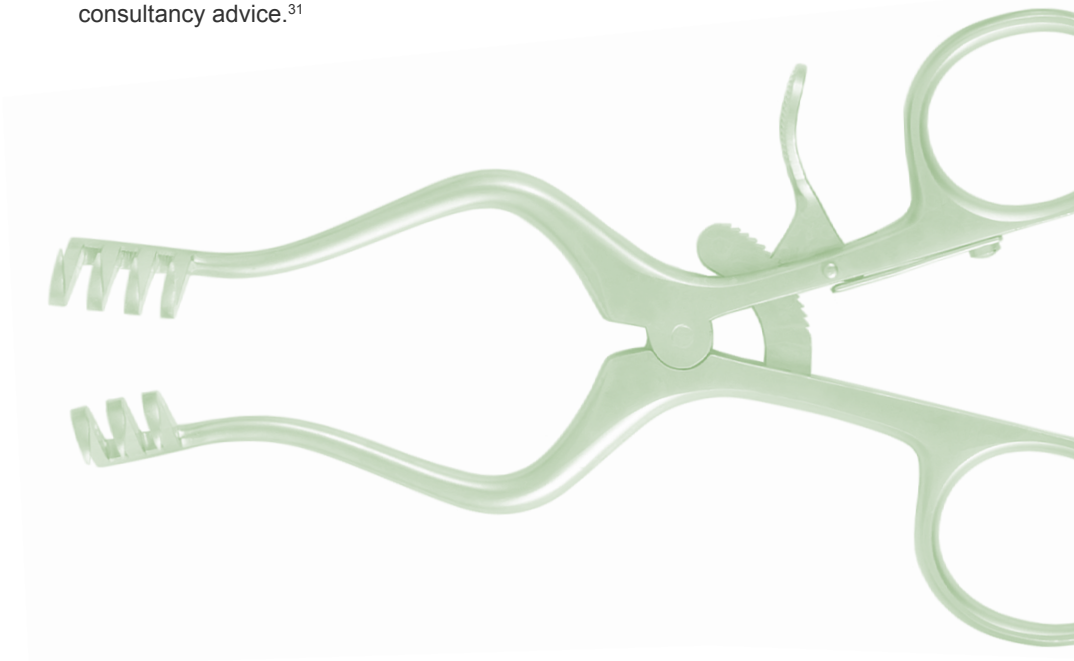
Staff engagement and championing

- Successful change requires continuing involvement and the support of surgeons and all members of the surgical and perioperative teams, including anaesthetists, nurses and surgical care practitioners. Clear communication and progress reports can ensure that clinicians understand and support the benefits of any proposed changes and are clear on the actions that need to be taken.[4]
- Surgeons have an active role in decision making in the operating theatre and they are often involved in choosing supplies. They can therefore lead by example and serve as champions of environmentally preferable purchasing and other sustainable practices with colleagues and stakeholders. Initiatives such as the Green Surgery Challenge from the Centre for Sustainable Healthcare can serve as a wider network for members of the surgical team to collaborate with and find support from peers in other institutions.[29]
- Peer-to-peer communication can be an effective way to engage staff in green initiatives and to secure universal commitment for driving culture change.

Peer-to-peer communication means that there is a representative from each specialty/interest group on the green operating theatre team. When decisions and messages need to be communicated, each representative delivers the message directly to their peers, rather than it being imposed by other groups.[30]

Education

- Education is crucial for the lasting success of sustainable initiatives, as it can clarify misconceptions about the benefits of specific green choices and reduce the use of unsustainable practices and products. For example, hospitals could arrange basic online training on waste segregation and disposal as part of mandatory annual training.
- The Centre for Sustainable Healthcare provides a range of resources that can be used both for educational purposes as well for strategic planning including templates, case studies and tailored consultancy advice.[31]
- Organisations such as Practice Green Health have made available a wealth of information and educational material, including a guide for clinicians on the purchasing process, the Greening the Operating Room initiative, which supports hospitals make cost savings and efficiency improvements,[21] and the Centre for Sustainable Healthcare, which fosters peer leadership and peer-to-peer learning for members of the surgical team.[31]
- Healthcare without Harm is a useful resource for environmentally preferable purchasing, with information and template policies aimed at limiting mercury entering the hospital, avoiding carcinogenic plastics, choosing environmentally friendlier cleaning supplies, and others.[22]



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