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***“How can dermatological surgery become
more environmentally friendly?”***

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Introduction

The activities of the health and social care sector have a substantial environmental impact, accounting for 6.3% of England's total carbon footprint¹. Within the hospital setting, surgical procedures make a comparatively large contribution to the health sectors ecological impact, being three to six times more energy intensive than other hospital-based procedures². All healthcare professionals should be concerned with developing more environmentally friendly practices, it being written in the NHS's constitution to ensure the most 'sustainable use of finite resources'³. However, dermatologists should be particularly alert to this need given the potential dermatological health consequences of air pollution and climate change⁴. Such consequences include changes in the geographical distribution of infectious cutaneous diseases⁵, exacerbations of chronic conditions such as atopic dermatitis⁶ and increased incidence of melanoma as behavioural changes in response to warmer temperatures increases population exposure to UV⁷. Engendering environmental sustainability should thus be the concern of all dermatologists wishing to take a preventative approach to their practice. This essay will consider a range of behavioural, procedural and structural interventions that could contribute to minimising the environmental impact of surgical dermatology. Reductions in waste, greenhouse gas emissions, air pollution and water consumption will act as indicators of reduced environmental impact.

What is the environmental impact of dermatological surgery?

Through identifying the most environmentally intensive aspects of dermatological surgery, targeted interventions can be developed. With research in this area very limited, this essay will draw on research analysing environmental interventions from

other procedure-based specialties and consider how this information may be applied to surgical dermatology. The use of anaesthetic gases, energy-intensive medical equipment, high throughput of single-use devices (SUDs) and over-supply of medical instruments have been identified as areas of significant environmental impact in surgery⁸. Dermatological surgery primarily uses local anaesthesia and relies upon low energy-intensive equipment; as such, high consumption and oversupply of medical instruments and SUDs are likely to be 'environmental hotspots' ripe for intervention. The five Rs (reduce, reuse, recycle, rethink and research⁹) offers a framework for classifying environmental interventions.

Reducing

Waste

Medical equipment is the second largest contributor to the NHS's carbon footprint¹. Minimising the use of materials in dermatological procedures thus has potential to yield significant environmental gains. The over-supply of materials in surgery, or 'overage', is a common source of waste, as opened but unused materials are discarded¹⁰. One simple measure to prevent overage is to record the quantity and type of unused materials at the end of each procedure. Surgical staff can then use this information to guide and adjust future practice⁹. Improving communication between surgeons and staff regarding surgical set up should also help to reduce waste, given that staff over anticipating surgeons' needs is a common cause of overage¹¹. Another strategy for waste reduction¹¹ is to adopt a 'just-in-time' model¹², whereby only essential materials are supplied ready and open, with additional equipment remaining readily available but unopened.

Overage also arises from the inclusion of excess instruments and materials within pre-packaged theatre kits^{12,13}. To prevent such surplus, surgeons can work directly with suppliers to reformulate pre-packaged kits to include only essential materials needed for a specific procedure. Dermatological surgeons from Nottingham have described how engagement with manufacturers enabled them to reduce Mohs surgical kits to essential items only whilst also eliminating the inclusion of unnecessary plastic components¹⁴. The use of leaner theatre kits can deliver significant environmental benefits; the introduction of 21 specially designed pre-prepared packs in Royal Liverpool and Broadgreen University Hospitals facilitated a 90% reduction in packaging waste across all its theatres¹⁵. What's more, this approach can deliver both environmental and cost-efficiencies, as has been described in the field of hand and plastic surgery^{16,17}.

Water

Dermatological surgery is likely to be less water-intensive than more invasive surgical specialties for which full surgical scrubbing is required. Nevertheless, dermatological surgeons can further reduce their water consumption by only disinfecting their hands with soap and water at the start of surgical sessions and then using alcohol-gel for disinfection between cases. These savings can be significant; switching from soap to alcohol-gel based disinfection across theatres in one American hospital is estimated to have decreased annual water consumption by 2.7 million litres¹⁸. Such changes to handwashing practice can reduce water consumption whilst maintaining infection control¹⁹ and is also a practice currently endorsed by NICE²⁰.

Energy

Multiple interventions can be considered for reducing energy use in dermatological surgery. These include appropriate temperature regulation²¹, turning off electrosurgical equipment when not in use and, for rooms dedicated to Mohs surgery, turning off ventilators overnight²². Such seemingly simple measures can have a big impact. An initiative implemented at Barts Trust, 'Operation TLC' (Turn off equipment, Lights out, Control temperatures), reduced annual carbon emissions by 2200 tonnes and energy costs by £500,000²³.

Reuse

Where reducing is not possible, the waste hierarchy endorses reusing materials²⁴. The reprocessing of single-use devices has been suggested as a strategy for greening surgical procedures²⁵. Although reprocessed SUDs are already used in dermatological practice, some concerns have been raised about the quality of reprocessed instruments. One study of dermatological surgeons across two large hospitals in Scotland found 33% of reprocessed SUDs were deemed inadequate, with instrumental bluntness cited as the most common problem²⁶. Before increased use of reprocessed SUDs can be recommended as an environmental intervention, greater consensus on the quality of instruments must be established to ensure patient care is not compromised.

However, any type of equipment can be considered for reuse – including the bins themselves. The use of recyclable 'bio-bins' for non-sharp materials²⁷ and the implementation of reusable sharps bins have both delivered environmental benefits, with the latter's carbon footprint being just 8% that of single-use bins²⁸.

More creative measures for repurposing surgical waste can also be valuable. These may range from using surgical packs as keyboard covers²⁹ to using suture packaging as a digital splint or sterile ruler in planning skin repairs³⁰. Whilst such acts of repurposing seem small, the sharing of such practices may facilitate widespread change.

Recycle

Estimates of the proportion of surgical waste suitable for recycling varies between 17-25%⁹. However, effective recycling depends upon proper segregation of hazardous, clinical and domestic waste. It is estimated that 90% of domestic waste in Australian theatres is misclassified as clinical or hazardous⁹. Assuming similar findings in the UK, this poor segregation is problematic as it reduces the volume of waste recycled and increases the volume of waste sent for incineration. With one bag of incinerated clinical waste producing the same volume of carbon dioxide as driving a Ford Fiesta 50 miles³¹, improving waste segregation is paramount. The best means of disseminating information about appropriate waste segregation will depend on the local context but may range from educational posters to formal staff training. Dermatological surgeons can act as environmental stewards by raising awareness amongst their team and paying greater attention to waste management during procedures. For example, making domestic waste bins more readily available during surgical set-up and segregating waste prior to the patient's arrival can reduce the volume of clinical waste produced⁸.

Rethink

Rethinking involves consideration of how current patient care is delivered and how this can be restructured to provide more sustainable services. Given that patient and visitor travel accounts for more than 50% of air pollution produced by the health and social care sector¹, delivering more services via teledermatology provides an important opportunity for reducing vehicle numbers on the roads. In place of in-person clinics, post-procedural follow-up could be provided via online platforms that allow patients to communicate with medical professionals in a virtual environment. Such platforms could also deliver education on surgical after-care, having the added benefit of reducing demand for paper booklets³². Some studies suggest virtual follow-up services may also increase patient satisfaction³², however, these benefits may be countered if an inability to access such services results in inequality of care.

Research

Until further research is undertaken to quantify the ecological footprint of dermatological procedures, the impact of any environmental interventions implemented will be difficult to measure. This evidence gap is problematic as it inhibits selecting interventions in such a way as to ensure the most cost-effective use of resources. Quality improvement (QI) projects for monitoring compliance with environmental interventions should be encouraged and, to motivate staff participation, given a similar level of value as more clinically-focused QI projects.

Conclusion

A wide-range of interventions may be employed to establish more environmentally friendly practices in surgical dermatology. Many of these interventions involve small-

scale procedural or behavioural changes that can be readily adopted by individuals or departments at little cost. Other interventions, such as teledermatology, will require more significant financial investment and planning. Lack of evidence precludes recommending certain interventions as the most environmentally impactful or economically efficient. Instead, interventions may be selected according to the feasibility and priorities of the local context, alongside consideration of possible negative impacts on patient care. The predicted health consequences of climate change and air pollution should motivate dermatologists to act as leaders in the creation of a sustainable NHS. Small changes in practice applied at a large-scale can facilitate significant reductions in environmental impact.

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