# Environmentally sustainable emergency medicine

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## ABSTRACT

Emergency clinicians worldwide are demonstrating increasing concern about the effect of climate change on the health of the populations they serve. The movement for sustainable healthcare is being driven by the need to address the climate emergency. Globally, healthcare contributes significantly to carbon emissions, and the healthcare sector has an important role to play in contributing to decarbonisation of the global economy. In this article, we consider the implications for emergency medicine of climate change, and suggest ways to improve environmental sustainability within emergency departments. We identify examples of sustainable clinical practice, as well as outlining research proposals to address the knowledge gap that currently exists in the area of provision of environmentally sustainable emergency care.

## INTRODUCTION

Emergency clinicians are uniquely placed to recognise the front line impacts of climate change on their populations, and have started to mobilise to tackle the climate emergency. Emergency department (ED) staff work closely with the multiple other medical specialties, as well as community and prehospital services and are starting to practice environmentally sustainable healthcare. In 2019, the Royal College of Emergency Medicine (RCEM) in the UK publicly divested investments from fossil fuels, and made a formal declaration of a climate emergency, as well as establishing an environmental specialist interest group to examine ways of assessing and reducing the carbon footprint of EDs.[1] In the USA, the American College of Emergency Physicians has acknowledged the significant impact of climate change on human health, healthcare systems and public health infrastructure, and advocates for initiatives to reduce the carbon footprint of EDs.[2] In the midst of the unprecedented bushfires of late 2019, the Australasian College for Emergency Medicine issued a statement proclaiming climate change to be a medical and population health emergency.[3] However, there is a gap in the emergency medicine (EM) evidence base, as demonstrated by a recent literature search,[4] with regard to which strategies can be employed by EM to reduce the carbon footprint of the specialty, and to improve environmental sustainability.

In this article, we review the literature and outline sustainability initiatives which have been adopted across different healthcare settings. We consider how these could be applied to EM, in the context of environmentally sustainable treatment pathways. In addition, the websites of the NHS Sustainable Development Unit[5] and the Centre for Sustainable Healthcare[6 7] (CSH), an organisation based in Oxford UK, were reviewed to identify case studies of healthcare institutions adopting low carbon technologies which could be applied to an ED setting (table 1). We have also presented some research proposals specific to EM following discussions between members of RCEM's Environmental Specialist Interest Group. (table 2).

## GLOBAL PERSPECTIVE

Awareness of the health impacts of climate change among healthcare professionals is increasing internationally, and there is a growing body of literature documenting the provision of environmentally sustainable healthcare.[8–10] The movement for sustainable healthcare is being driven by the need to address the climate crisis, which has been described by The Lancet as the biggest global health threat of the 21st Century.[11] The Lancet Countdown Report of 2019 highlights how the life of a child born today will be profoundly affected by climate change and urges bold new approaches to policy making.[12] Globally, the healthcare sector is estimated to have been responsible for 4.6% of all greenhouse gas emissions in 2016,[12] but 7% of Australian[13] and 9.8%[14] of US emissions originate from healthcare. This underscores the vital role that the healthcare sector has to play in contributing to decarbonisation of the global economy, and the UK Committee on Climate Change has recommended that an economy wide approach is needed to tackle emissions.[15]

The National Health Service (NHS) in England is the first national healthcare system to declare a net zero carbon target, for emissions controlled directly by the NHS by 2040, and for emissions which are influenced by the NHS (covering a wider set of indirect emissions from purchased energy and transportation of goods and services, including the supply chain),[16] by 2045. Achievement of these targets will require changes throughout the NHS, including in EDs and will build on decarbonisation work between 2007 and 2017, which achieved an 18.5%[17] reduction in carbon emissions, along with financial savings of £1.85 billion from energy measures,[18] despite an 27.5% increase in clinical activity during this period,[17] demonstrating that improvements in environmental sustainability can be achieved while reducing costs and meeting clinical demands.

## SUSTAINABLE HEALTHCARE INITIATIVES

The CSH highlights four principles of sustainable healthcare: prevention of illness, patient

**Table 1** Highlights examples of projects demonstrating environmental sustainability in an NHS clinical setting

| Sustainable change | Example of implementation | Measurable benefit |
|---|---|---|
| Low energy lighting | Light Emitting Diode (LED) lighting upgrade. Maidstone and Tunbridge Wells NHS Trust. | Predicted reduction of 520 tonnes $CO_2$e per year, equivalent to 2 786 835 km by car and annual savings of £160 000.[5] |
| Turn off computers and reduce monitor brightness | Automatic Personal Computer(PC)shutdown system at night. NHS Oldham. | Estimated decrease of 800 tonnes $CO_2$e per year, equivalent to 4 287 438 km by car. Projected annual savings £41 000.[5] |
| Reduce paper use | Double sided printing, digital documentation. West Kent Primary Care Trust. | Ten tonnes of $CO_2$e, equivalent to 53 592 km by car and £10 000 saved per year.[7] |
| Appropriate waste segregation | Appropriate segregation of waste (avoiding unnecessary landfill and incineration). Queen Victoria NHS Foundation Trust. | Projected savings of 40 tonnes of $CO_2$e, equivalent to 2 14 372 km by car and £30 000 per year.[5] |
| Reduce unnecessary plastic glove use | 'Gloves Off' campaign. Addressing over use of non-sterile gloves through education. Great Ormond Street Hospital NHS Foundation Trust. | Reduced 21 tonnes of plastic going to clinical waste in 1 year.[39] |
| Reduce disposable cup use | Reducing single use plastic in catering. Sheffield Teaching Hospitals NHS Foundation Trust. | Reduced single plastic cup use by 66%.[5] |
| Reusable sharps bins | Reusable bins (avoiding incineration of the bin itself). University Hospitals Coventry and Warwickshire NHS Trust. | 92% reduction in $CO_2$e compared with single use sharp bins over a 10 year life cycle.[5] |
| Promote active transport among staff | Encouraging sustainable travel among staff. Central Manchester University Hospitals NHS Foundation Trust. | 25% reduction in air pollution impact of staff travel.[5] |
| Increased use of teleconferencing | Implementation of teleconferencing service. NHS Derbyshire Community Health Services NHS Trust. | 20 tonnes $CO_2$e, equivalent to 107 186 km by car and savings of £100 000.[5] |

NHS, National Health Service.

empowerment and self-care, lean service delivery and low carbon technologies.[19] This approach aims to maintain or increase clinical standards while also reducing carbon emissions. Sustainable healthcare considers not only what can be delivered to an individual today, but also the population in general and the patients of the future.[20] Development of sustainable treatment pathways is a key priority, and EM may be able to build on work done in other specialties.

Anaesthetic practice worldwide has seen a concerted move away from the use of the most environmentally harmful anaesthetic gases,[21] including nitrous oxide and desflurane, in favour of agents with a lower global warming potential (GWP) (a measure of how much warming a gas causes in relation to carbon dioxide, which has a GWP of 1, over a time period, ie, 100 years). Nitrous oxide and oxygen mixtures are commonly used in EDs and prehospital settings as rapid inhalational analgesia. Less environmentally harmful alternatives such as methoxyflurane($GWP_{100}$ of 4),[22] compare favourably against nitrous oxide ($GWP_{100}$ of 298),[23] and may be a more environmentally sustainable alternative. However, further research comparing the environmental impact of the whole life cycle of each gas, including production, distribution and disposal, is urgently needed. Potent greenhouse gases are also found in metered dose inhalers, commonly prescribed in EDs, in the form of hydrofluorocarbons. These gases are used as propellants, but could be replaced with dry powder inhalers (DPIs), which have a much lower carbon footprint, saving up to 422 kg $CO_2$e ($CO_2$e is a way of expressing each different greenhouse gas relative to the amount of $CO_2$ which would result in equivalent warming) per patient per year. This is equivalent to driving over 2253 km in a medium-sized petrol car.[24] Although DPIs will not be suitable for every patient, the rates of prescribing for DPIs are much lower in countries such as the UK (13%) than in Sweden (70%).[24] The lower carbon footprint of DPIs has now led to recommendations from the British Thoracic Society that they are preferentially prescribed if appropriate.[25]

**Table 2** Highlights some examples of research questions relevant to environmentally sustainable emergency medicine

| Research ideas | |
|---|---|
| Recycling of high-grade medical plastics: how infectious and hazardous is this waste? | Does tele-triage reduce unnecessary attendance at and travel to the ED? |
| Carbon footprint of methoxyflurane versus nitrous oxide: a life cycle analysis | How much do patients value environmentally sustainable emergency care? |
| What do emergency medicine trainees understand about the burden of climate change-related illness? | What is the environmental impact of unnecessary blood tests and prescribing in the ED? |
| How does the carbon impact of reusable personal protective equipment (PPE) compare to disposable PPE? | What is the travel-reduction and clinical impact of a virtual ED follow-up clinic? |
| Clinical procedure packs - how much is used in practice? | What is the carbon footprint of common ED presentations? |

ED, emergency department.

Nephrology practice has also undertaken many specialty-specific sustainability initiatives, including reducing water wastage from dialysis machines, as well as 'process' and 'model of care' innovations, such as improved telecommunications, ensuring autoconfiguration of IT and heating equipment to the most sustainable settings and inclusion of environmental criteria in procurement contracts. This approach has led to a marked culture change across the UK dialysis spectrum over the past 3–4 years period as well as a projected annual reduction of 11 000 tonnes of $CO_2$e.[26]

Improved telecommunications technology could also facilitate the introduction of telemedicine into EM. Innovations in telemedicine have been shown to result in 40-fold to 70-fold decreases in carbon emissions from health sector travel (for distances over a few kilometres), compared with transport by single-occupancy vehicle.[27] Telemedicine (including enhanced clinical triage) is likely to be increasingly incorporated into emergency care to ensure that patients are directed to the most appropriate services for their needs if a service can be provided closer to their location, or via a digital platform. The establishment of telemedicine clinics, as default referral pathways from an ED (rather than a face-to-face follow-up), may also help to reduce repeated attendances to the hospital.

Technological and digital tele-conferencing advances may also help to reduce the significant emissions generated by EM conferences and teaching, as a result of delegate travel and accommodation, single-use plastics and food waste. Such events should aim to be carbon neutral, and should evaluate whether or not the event requires in person attendance, or whether it can be conducted virtually.[28]

## EM SUSTAINABILITY INITIATIVES

Linstadt *et al*[29] have outlined a vision of a 'Climate Smart' EM combining low carbon and resilient healthcare strategies from an US perspective, including a call for improved segregation of ED waste (thus reducing emissions from incineration of inappropriately segregated clinical waste) as well as introduction of renewable energy and sustainable transport, yet acknowledge that there are currently few examples of 'climate smart' EDs.

'Climate smart' EM must factor in the high patient turnover environment of EM as well as ensure high clinical standards are maintained for patients while improving environmental sustainability. The international "Choosing Wisely" initiative[30] has made specific recommendations to help reduce low yield investigations in EM, including reducing low yield laboratory testing, due to the established carbon footprint of laboratory and diagnostic testing.[31]

EDs may also be able to reduce wastage from commonly performed procedures such as peripheral cannulation. In one ED setting, a 59% drop in the total number of intravenous cannulas used was achieved following an intervention to reduce unnecessary insertion. The projected annual reduction of $CO_2$e from this single intervention was 8403kg, equivalent to 45 034 km by car. The project also had potential to make savings of £27 830 per year.[6] However, the impact on patients of this intervention was not evaluated. As ED clinicians seek to develop 'climate smart' departments, evaluation of ED treatment pathways should be undertaken with the focus on patient care, alongside financial and environmental aspects.

Further examples of case studies applicable to EDs that have been undertaken in an NHS setting can be found in table 1.,[5–7] Although they are unpublished, they hold great value in demonstrating how NHS trusts are already taking steps towards sustainable improvement. To give context to some of the measurements used, we compare them to emissions in kilometres from a medium-sized petrol passenger vehicle using UK government conversion factors.[23]

Implementation of the above measures could reduce the carbon footprint of an ED, however, consideration should be given as to which areas of healthcare have the biggest carbon footprint. Worldwide, approximately 71% of the health sector's total greenhouse gas emissions originate from procurement of goods or services, with only 17% of emissions coming directly from healthcare facilities themselves.[32] Therefore, the changes which may have the most impact include those targeting the supply of goods and services, including procurement of pharmaceuticals, equipment and instruments, for instance, by ensuring sustainable procurement policies are used by EDs.

Looking forward, EM should attempt to expand the evidence base on which we can inform changes to practice. The accuracy of our carbon footprint calculations will improve from Life Cycle Analysis, a technique which captures the 'cradle to grave' of emissions of a resource or process used in the ED. Quantification of the carbon footprint of EM will be vital for making decisions about interventions and measuring improvement, however, this research takes time and funding. Meanwhile, we can also use quality improvement (QI) methodology to make changes in EDs starting today with the aim to improve environmental, social and economic outcomes (the 'triple bottom line)[33] in relation to patient outcomes. EM trainees often undertake QI projects during training and we would see rapid culture change if these projects incorporate sustainability into their objectives. EDs could also create clinical fellow roles that combine EM with sustainable clinical practice to pioneer new ways of working and disseminate good practice. The establishment of a sustainability agenda in an ED may also help with departmental cohesion and could encourage a broader sense of team working, as a recent survey of NHS staff in the UK found that 98% believe it is important for the health and care system to support the environment.[34]

As the climate crisis progresses, EM will need to adapt services to meet the needs of patients affected by the climate emergency, and to ensure the provision of routine care despite extreme weather events. Departments in some areas may face an increase in workload, as attendances often rise during adverse weather events such as heatwaves.[35] EDs may also need to adapt their physical infrastructure, for example to ensure sufficient cooling of the department during heatwaves, or to ensure resilience from flooding if the hospital is built on a flood plain, and climate change resiliency assessment models have been proposed and trialled in some areas.[36] The vehicles involved in transport to and from EDs, including ambulances idling outside EDs, also contribute to air pollution 'hotspots' around hospitals, the health burdens of which are well established; and examples are emerging of institutions employing successful strategies to deal with this.[37]

## CONCLUSION

In the context of the world-leading NHS England strategy to create a net zero NHS by 2040,[16] EDs have the opportunity to adopt examples from other specialties and contribute to the research and development of new sustainability initiatives. As we adapt towards 'climate-smart' practices, we can set the example for specialty staff that visit our departments regularly. The aim is to create a positive culture change that protects our environment and the health of our patients. The task of 'greening our EDs' cannot begin and end on the shop floor, but must also be facilitated by medical journals and funders who help to shape research agendas. Throughout the next decade and beyond, emergency clinicians worldwide have a critical role to play in responding to the climate emergency as it unfolds[38] and are in a powerful position to advocate for changes at local and national levels. Validated ways of measuring our environmental impact will enable us to optimise the provision of sustainable care for the patients of today, and for future generations of patients.

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