

Improving the environmental sustainability of paediatric care

Rosie Spooner ^{1,2}, Alessandra Glover Williams,³ Claire Roome⁴

¹Centre for Sustainable Healthcare, Oxford, UK
²Paediatrics, Gloucestershire Hospitals NHS Foundation Trust, Cheltenham, UK
³Paediatrics and Neonates, Bristol Royal Hospital for Children, Bristol, UK
⁴Paediatrics, Wexham Park Hospital Children's Services, Slough, UK

Correspondence to

Dr Rosie Spooner, Centre for Sustainable Healthcare, Oxford, Oxfordshire, UK; rosanna.spooner@nhs.net

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ABSTRACT

Accelerated global warming is directly related to greenhouse gas (GHG) emissions. In order to achieve international and national set targets on reducing GHG emissions, paediatricians should aim to decrease GHG emissions associated with paediatric care, when this is not in conflict with patient outcomes. In this article, we review literature on practical ways to encourage environmentally sustainable paediatric care and identify areas where more evidence is required. Finally, we introduce readers to the principles of sustainable healthcare which may be used to help guide further efforts to reduce the environmental impact of paediatric care.

and lack of knowledge about how climate change affects paediatrics and child health.⁵

The health effects of climate change are particularly pertinent to our specialty. Children are uniquely vulnerable to the direct and indirect consequences of climate change.⁶ These include physical and psychological sequelae of weather disasters, increased heat stress, decreased air quality, altered disease patterns for some climate-sensitive infections, and food, water and nutrient insecurity in vulnerable regions.⁶ It is children and young people who suffer most from the consequences of the decisions that are made today. Additionally, the worst effects of climate change are already impacting the parts of the world least responsible for greenhouse gas (GHG) emissions.⁶ Unabated climate change is set to become an amplifier of existing inequalities of childhood health outcomes and further hamper efforts to meet the United Nations Sustainable Development Goals.⁷

The ambitious, but necessary, targets set out by the Intergovernmental Panel on Climate Change require radical changes to every sector of our society.⁸ At a policy level, paediatricians can demand system-wide actions to address causes of climate change, a role that the RCPCH has taken on in earnest. In October 2020, RCPCH declared a climate emergency, divested from fossil fuels and set up a working group to help further understand how best to promote sustainable practice.⁹

However, there is a sparsity of published literature describing how we encourage environmental sustainability in paediatric care. Some non-speciality-specific literature on the principles of sustainable healthcare exist to help guide paediatricians aiming to promote low carbon clinical practices.^{10–12} We aimed to review published articles, particularly those in paediatrics, which improved the environmental sustainability of delivering clinical care. In March 2021, we searched

A GLOBAL PUBLIC HEALTH CRISIS

The intersecting biodiversity and climate crises have created a global public health crisis.^{1 2} Public awareness of this has increased in recent years perhaps because of an increasing global prevalence of extreme weather events but also, in part, due to activism of young environmentalists such as Greta Thunberg. In 2021, a large international survey found the majority of health professionals are concerned about the public health consequences of anthropogenic climate change, with 93% of participants concerned about the health impacts for future generations.³ An increasing number of paediatricians are engaging in activism to campaign for actions to reduce the causes of climate change⁴ and have started to mitigate their 'carbon footprint' both at an individual and, more challengingly, at a systems level. However, despite high levels of commitment to the issue, many healthcare professionals remain unsure where to direct their efforts in their professional role. The recent 2021 Royal College of Paediatrics and Child Health (RCPCH) members survey indicated that the three key barriers to making change to their practice to be more sustainable are lack of time, lack of funding for projects/changes



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Ovid Medline, Google, Google Scholar, Biomed Central, PubMed as well as the Greener NHS, RCPCH central and Centre for Sustainable Healthcare (CSH) websites for articles that included terms 'Paediatrics' or 'NICU' or 'PICU' and 'Sustainability' or 'Carbon footprint' in the article title or abstract and appeared to be relevant to the research topic. Papers must have been published, or if 'grey literature', produced after the year 2000, in English. Letters, newspaper articles, opinion pieces and non-academic documents were excluded. [Table 1](#) displays our findings.

WHAT CAN WE DO TO HELP?

There is a small body of published projects which improve environmental sustainability within paediatrics and neonatology, including suggestions on appropriate waste management,¹³ promotion of active forms of transport,¹⁴ changing to re-usable products¹⁵ and changes in clinical and prescribing practice,^{16–20} as displayed in [table 1](#). The initiatives are wide ranging and broadly grouped in the fourth column by the 'sustainable healthcare principle' that they primarily adopt.²¹ The principles of sustainable healthcare: prevention of illness, patient empowerment, lean-service delivery and low carbon technologies, were set out by the Centre for Sustainable Healthcare (CSH) in 2010 with the aim of maintaining or increasing clinical standards while minimising GHG emissions. [Figure 1](#) illustrates how these principles contribute to reductions in GHG emissions using a driver diagram.²¹

The principles of sustainable healthcare form an extension of best quality of care and relate to those of the NHS Constitution, putting patients and patient safety at the centre of the care that we provide. Much of the 'Getting It Right First Time' work, practised extensively throughout the NHS, improves the 'carbon footprint' of that care, through reducing variation and practice of lean pathways, see [box 1](#) for further information.²²

However, it is not routine for paediatricians to report on the environmental benefits of QI projects. Including environmental sustainability in reporting of QI initiatives could increase motivation among healthcare professionals to act on environmental issues in their professional settings and allow comparison between projects, supporting decisions on where we can act to make the highest impact.²³ Regan *et al* found their QI changes were more easily accepted and embedded by encouraging an awareness of both the financial and environmental costs involved.²⁴

HOW CAN WE MAKE CHANGES?

One of the most challenging aspects for health professionals is knowing where to direct their efforts in making changes. The NHS is a complex organisation with significant authority over procurement, infrastructure, travel, waste and energy. As clinicians we can feel detached from these complex systems which

makes appreciating their carbon impact difficult to grasp, and the ability to envisage change even more overwhelming.

One area that has been highlighted by the Greener NHS England as having a high environment in the delivery of clinical care is that of hydrofluorocarbon (HFC) released in the use of metered dose inhalers (MDIs).²⁵ HFCs which are liquefied, compressed gases are used as a driving force and an energy source for atomisation of drugs in MDIs.²⁶ Current estimates, based on national prescribing data for adults and paediatric care, suggest MDIs contribute approximately 3.9% of the carbon footprint of the National Health Service (NHS).²⁵ An issue for paediatricians who want to address this issue is the need for MDIs in the majority of our patient group as the alternative dry powder inhalers cannot be used with a spacer. Additionally, there are real concerns that stigmatising the use of MDIs may discourage children from using a life saving medication, which could inadvertently worsen their asthma control and therefore counter-productively increase the carbon footprint of their care.

However, the QI project carried out by Roome focusing on MDIs showed that by using the principles of sustainable healthcare, leaner pathways, patient empowerment and low carbon alternatives, significant reductions in GHG emissions in providing care can be achieved, see QIP [box 2](#) for details.¹⁶ Focusing on the respiratory pathway as a whole, as has begun in adult care, helps us to see how we can simultaneously deliver high quality, patient-centred, paediatric respiratory care and reduce its environmental impact.²⁷

WHERE TO CONCENTRATE OUR EFFORTS?

We suggest that the first step to making the sustainability process less daunting is to become familiar with the scope of NHS carbon footprint and carbon hotspots as set out in the NHS Net Zero plan.²⁵ Carbon hotspots within the NHS have been highlighted by Greener NHS and knowledge of them helps us to develop a targeted approach to high carbon areas.²⁵ By becoming more carbon literate, we can begin to recognise which activities in our day-to-day practice have a high carbon footprint and then focus on these areas. For example, many health professionals concerned about healthcare's carbon footprint focus on correct segregation of clinical waste.²⁸ Training staff to put waste into the correct bin avoids both financial and environmental costs of waste management but it only contributes less than 0.2% of the NHS carbon footprint,²⁵ while we tend to focus on recycling, reducing waste is the most impactful approach. To further education in this area, the Carbon Literacy Project is developing a Carbon Literacy Toolkit specifically for healthcare professionals which should be available soon.²⁹

Table 1 Published projects in paediatric care that have documented a carbon saving or reduced the environmental impact of care

Article	Description	Financial saving	Environmental saving	Sustainable healthcare principles (see figure 1)
Sustainable approach to reducing unnecessary combined biochemistry tests on a paediatric cardiology ward. ²⁴	QIP to reduce unnecessary lab requests (bone profile and liver function tests) when bloods were clinically required daily for renal function and plasma electrolyte monitoring purposes only. Double outcome of financial and carbon saving emphasised to encourage embedding and sustainability.	£11 338 saving over 32 months	13.4 tonnes CO ₂ e/ annum	Leaner pathway
Gloves Off Campaign GOSH. Greener NHS Case Study, 2019. ³²	Infection control nurse-led initiative to reduce non-sterile glove usage. Education package rolled out, multiple communication formats and project updates.	£90 000 a year	Estimated 21 tonnes less plastic going to clinical waste in a year	Leaner pathway Prevention
Minimising environmental impact of metered dose inhalers (MDIs) on a paediatric unit. ¹⁶	Quality improvement project in a district general hospital working with the local Clinical commissioning group to switch from a brand of salbutamol MDI with a high carbon footprint to a comparable brand of salbutamol MDI with a low carbon footprint additionally promoted correct inhaler technique and implemented safer inhaler disposal and recycling.	Cost neutral	363 tonnes CO ₂ e/ annum from salbutamol to Salamol switch 44 tonnes CO ₂ e/ annum from correct disposal	Low carbon alternative Prevention Patient empowerment
Reusable sharps containers at University Hospitals Coventry & Warwickshire NHS Trust. ¹³	Trust-wide conversion to using reusable sharps bins. Sharps bins were previously disposed of after each use. Reusable sharps bins have a 10-year lifespan, are washed and reused repeatedly during this time and have been found to reduce sharps injuries.	£20 000 per annum before measuring potential impact of reduction in sharps injuries	92% reduction in CO ₂ e compared with single use sharp bins over a 10-year life cycle. Total amount of CO ₂ saving not stated.	Low carbon alternative Prevention
Boosting healthy and sustainable travel in Manchester. ¹⁴	Trust-wide sustainability project to improve staff sustainability. Services included: bicycle maintenance services monthly, improved cyclist amenities, personal travel advice for staff, a shuttle service between sites, updated travel information, two public bus route stops on the main sites and car clubs. 40% of staff have used more sustainable methods since 2013.	Not calculated	Estimated a 25% reduction in air pollution impact of staff travel	Low carbon alternative
The replacement of polystyrene cups with a sustainable alternative. ¹⁵	Eco-QIP introduced Neonatal intensive care unit charity-funded bamboo cups for £8 each to replace single-use polystyrene cups that were being bought at a rate of 96 000 a year. Plan do study act methodology used.	NICU saved £4464 per year, the charity received £637.50 from sales	Reduced level of plastic pollution	Low carbon alternative Prevention Patient empowerment.
Keeping Sick Children Out of Hospital' - The Ambulatory Care Experience (ACE) service. ¹⁷	Comprehensive, regional service redesign QIP to reduce paediatric admissions and move secondary care into the community using Band 6 paediatric nurses and good communication with the inpatient team.	Not calculated	Not calculated	Prevention Leaner pathway Optimising resource use Patient empowerment
Screening for early onset neonatal sepsis: NICE guidance-based practice vs projected application of the Kaiser Permanente sepsis risk calculator in the UK population. ¹⁸	Regional adoption of new early onset neonatal sepsis (EONS) risk calculator tool with its clinical management guideline. Resultant 74% reduction of infants screened for EONS saving unnecessary resource use, antibiotic exposure and familial distress. Three infants with positive blood cultures (50% of all positive cultures) missed by both current NICE guidance and new calculator.	Not calculated	Not calculated	Leaner pathway

Continued

Table 1 Continued

Article	Description	Financial saving	Environmental saving	Sustainable healthcare principles (see figure 1)
Making paediatric theatres greener. ¹⁹	QIP to change the paediatric anaesthetic practises away from using high-carbon footprint nitrous and desflurane to using total intravenous anaesthesia (TIVA) or sevoflurane as a lower footprint alternative. Significant practice changes seen.	Not calculated	Achieved a reduction in desflurane and N2O use for maintenance of anaesthesia to <5% cases	Low carbon alternative
The KidzMed project: teaching children to swallow tablet medication. ²⁰	QIP to train staff and embed a system of converting eligible children (5–15 years of age) to tablet medication from liquid. Liquid medications have short expiry dates, require refrigeration, are difficult to obtain from local pharmacies, can cause dental decay, many are unpalatable, unlicensed and costly (eg, nitrofurantoin cost £9 tablets vs £447 liquid per month). A series of changes were made including training, making kit available, publicity and developing team protocols.	£46 588 per year	Not calculated	Optimising resource use Patient empowerment

For reference: Average UK citizens annual CO₂e emissions estimated at 12.7 tonnes.³⁸
NICU, neonatal intensive care unit.

WHO TO INVOLVE?

Change is notoriously challenging to manage, especially in an organisation which is under-resourced; however, we all share a common goal: to improve patient outcomes. However, despite our common goal, different staff groups may engage with different messaging regarding the environmental impact of clinical care. Building narratives that resonate with a diverse range of stakeholders and also relate to staff’s everyday concerns is a critical factor in the success of QIPs.³⁰ Although not specific to the healthcare setting, work carried out by the charity Climate Outreach gives some evidenced-based, strategic understanding of how to communicate about environmental concerns to others.³¹

Engagement of clinical staff was key to the success of the ‘Gloves off Campaign’ at Great Ormond Street Hospital, which focused on reducing non-sterile glove use. Reducing glove use runs counter to the accepted norm that prevention of healthcare acquired infections requires mass deployment of single-use devices.³² Therefore, key to this project’s success was involvement of infection control staff who initiated and led the project, see QIP box 3. If other hospitals are also going to reduce unnecessary use of single-use items, then engagement with infection control is key.

At a hospital management level, an increasing number of Trusts employ Sustainability Officers, and although non-clinical, clinicians may find them a

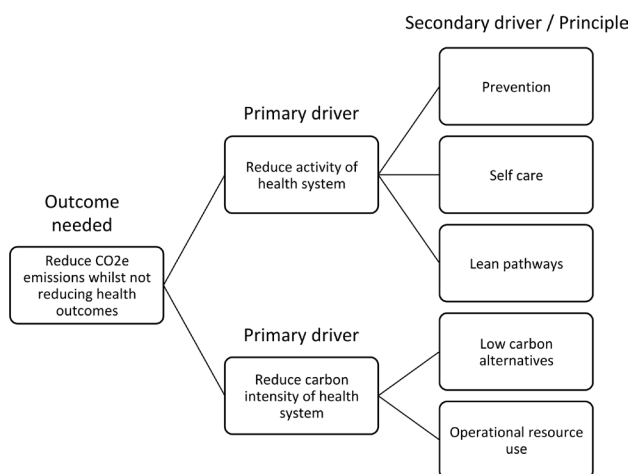


Figure 1 Principles of sustainable healthcare. Reprinted with permission from Mortimer F, Isherwood J, Wilkinson A, *et al.* The sustainable physician. *Clinical Medicine* 2010;10:110–1.²³

Box 1 QIP Idea 1. Reducing unnecessary combined biochemistry tests

Procurement accounts for approximately 60% of the NHS carbon footprint and QIP encouraging a leaner approach to care can have financial and environmental benefit.²⁴ The first step in conducting a QIP at reducing wasteful processes is to establish the current patterns of behaviour and understand what drives them. Regan *et al* found that after studying the current system they were able to reduce unnecessary combined biochemistry investigations by highlighting the environmental costs involved through educational sessions and behavioural ‘nudges’ such as rationalising electronic combined blood test ordering profiles.²⁴ The RCP guide, ‘Less Waste, More Health’ offers simple changes to achieve leaner use of medical supplies³⁹ as well as the GIRFT guide to pathology services.
NHS, National Health Service.

Box 2 QIP Idea 2: Reducing the environmental impact of metered dose inhalers (MDI's)

Children do not have the inspiratory flow required to use dry powered inhalers but it is still possible to do a QIP to reduce the environmental burden of inhalers.¹⁶ This could include promoting correct inhaler technique, implementing safer inhaler disposal and recycling, educating patients and staff about how much medication their inhaler contains as well as using less puffs of a preventer where possible by moving to higher dose per puff for some inhaler types. Patients and families may find it easier to use fewer puffs per day as it reduces administration time.

useful contact to support low carbon clinical changes. NHS England now required all organisations to have a Board-level lead responsible for helping achieve Net Zero and the broader Greener NHS England agenda.²⁵ Paediatricians may find engaging those at a board level useful to ensure alignment of their clinical goals with the hospital's wider strategy.

LOOKING BEYOND CLINICAL PRACTICE CHANGES

Engaging clinicians forms one part of the changes required to enable us to reach the Greener NHS England's Net Zero goal.²⁵ We also require strong leadership, transformative policies and the health sector industry to support us to enable us to make informed decisions about the policies and practical changes we advocate. Together these changes could form a virtuous cycle for climate action in the delivery of healthcare, as proposed in [figure 2](#). Reducing the emissions from the health services supply chain is vital, because although we can adopt leaner pathways, healthcare delivery will always require many complex products and up to 90% of product emissions are generated during manufacture.³³ Introducing a product weighting for sustainability for the procurement process is part of ambitions

Box 3 QIP Idea 3: Reducing single use plastics

Healthcare professionals can play a critical role in tackling plastic consumption and waste within our own institutions. The 2018 Great Ormond Street 'Gloves Off' QIP was very successful in reducing unnecessary use of non-sterile gloves.³² The first step in their project was to work collaboratively to develop an educational awareness programme for staff. As a team they developed a communication strategy including a frequently asked questions sheet, webpages, screensavers, posters, presentations and a hand hygiene event. Personal protective equipment use has dramatically increased since the COVID-19 pandemic and Healthcare without Harm have produced a guide to help identifying opportunities to reduce the use of single use plastic products including areas where reusable products may substitute single use plastics.⁴⁰

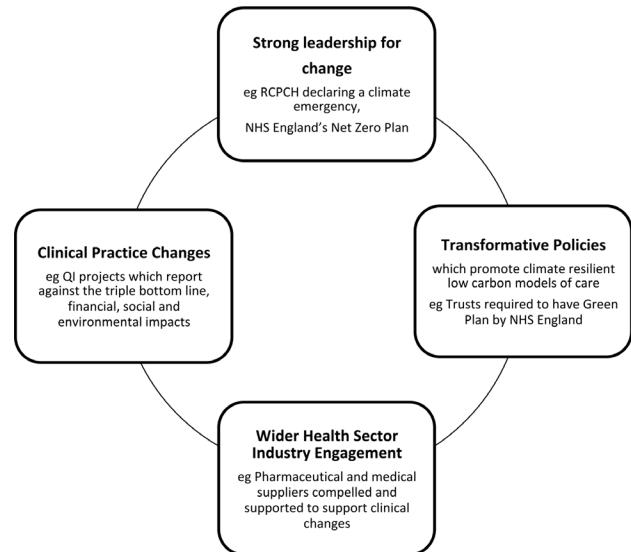


Figure 2 Virtuous cycle for climate action as proposed by the authors. NHS, National Health Service; RCPCH, Royal College of Paediatrics and Child Health.

of the Green NHS plan and forms an essential part of reducing the NHS carbon footprint.³⁴

Specialities such as Anaesthesia and Surgery have funded Sustainability Fellowships to help provide specialty-specific information on how to minimise environmental impact while maintaining or enhancing safety and quality of care. These fellows have helped produce frameworks and guidelines for departments or individuals to follow, successfully published research on their work and have been recognised for their achievement with national awards, QIP [box 4](#) has details of published reports of this is paediatric anaesthesia.^{35–37}

Funding a Paediatric Sustainability Fellowship could help provide further knowledge for busy paediatricians on activities they could incorporate into their clinical

Box 4 QIP Idea 4: Greening paediatric theatres

Anaesthesia as a speciality contributes up to 2% of the NHS carbon footprint.^{25 41} Groome *et al* showed that they were able to change the culture around the choice of use of anaesthetic gases by highlighting the different environmental footprints of the gases used, encouraging low carbon alternatives.¹⁹ Their first step was to audit current practice, achieved either through reviewing purchase records or by using ventilator logs, alongside a survey to understand different viewpoints of team members. This baseline information on gases used can be converted into metric that are more easily understood by staff, ie, miles travelled in a car and used as an engagement tool to raise awareness. Prompts could include coloured cards placed on anaesthetic machines with facts about the impact linked to everyday activities and QR codes on machines directing clinicians to website resources for more information.⁴²

NHS, National Health Service.

practice. It is not the expectation that paediatricians become experts in sustainability but with expert input they may be encouraged able to incorporate principles of sustainable healthcare into their everyday practice.

CONCLUSION

We are entering an era where all sectors of society are being required to rapidly reduce GHG emissions but as shown there remain many questions on how best to do this in clinical practice. Despite these questions, paediatricians should be encouraged to decrease GHG emissions associated with paediatric care, when this is not in conflict with patient outcomes and there are examples of this already taking place in the healthcare sector, such as reusable sharps containers, reducing healthcare-related travel and leaner clinical pathways, often providing both financial and environmental benefits. Paediatricians have a pivotal role to play as powerful advocates of the wider sectorial changes needed to mitigate climate change and as specialty we can become an example of how best to practise environmentally sustainable clinical care.

Twitter Rosie Spooner @spooner_rosie and Alessandra Glover Williams @alessglover

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ORCID iD

Rosie Spooner <http://orcid.org/0000-0002-9594-552X>

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