



SUSQI PROJECT REPORT

Reducing the CO₂e of Orthopaedic Surgery

Start date of Project: 20th May 2024

Date of Report: 16th August 2024

Team Members:

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Background:

Climate change caused by humans is affecting weather and climate extremes across the globe. Greenhouse gas emissions through human activities have contributed significantly to the risk of irreversible climate change, resulting in negative effects on human health. The slowing down of climate change can be achieved with a sustained reduction in greenhouse gas emissions (IPCC: Summary for Policymakers, 2023). Health systems are accountable for 4.4% of global emissions, with surgical practice being one of the largest areas of resource use with an estimated 5.7 million tonnes CO₂e per year (Green Surgery Report, 2024). Some of the greatest areas for improvement in reducing carbon emissions in the NHS have been shown to be in the supply chain, estates and medical devices (NHS England, 2022). These are the areas that will be focused on in this QI project with the aim of reducing the carbon emissions of orthopaedic arthroplasty surgery. We have chosen this speciality due to the abundance of single use consumables. A study found the carbon footprint of knee arthroplasty to be 85 kgCO₂e which was significantly higher compared with other common operations such as hernia repair and laparoscopic cholecystectomy (Rizan et al., 2023). The opportunity to drive change on a larger scale is also present, as a result of a new elective arthroplasty centre currently being built at our trust. In the 2023-2024 financial year, we performed 991 arthroplasty procedures at RHCH and this figure stands to significantly increase in the future. We plan to identify several areas for change as outlined below, which we feel well placed to achieve as a multi-disciplinary team spanning anaesthetics and recovery.

Specific aims:

We aim to implement the low carbon alternative principle of sustainable healthcare to introduce several changes within our arthroplasty theatres to promote sustainable value, considering and evaluating the 'triple bottom line' of environmental, financial and patient outcomes.

A summary of impacts across the 6 projects is detailed in table 1, with links to more detailed reports in the project summary column.



Project summary	Financial impact (£)	Environmental impact (kgCO2e)	Social impact	Clinical impact
Switch from ethyl chloride spray to The CoolStick® (Theophany Ltd, Dorset, UK)	10,621.56	6,240.91	Feedback still being collected at time of writing.	CoolStick® was non-inferior to ethyl chloride in assessing level of sensory block and therefore had no negative impact on patient anaesthetic experience (Grassby et al., 2023).
Switch from a reusable positioning device with single use foam inserts to a reusable pad alternative for hip arthroplasty	11,106.80	166.68	Pads received positively by surgeons and anaesthetic staff responsible for preparing the positioning equipment. Due to the reusable nature, the pads do not need changing after each case, reducing labour time for practitioners	No change in patient outcome or experience.
Reduce the use of intravenous paracetamol in favour of oral administration	855.80	440.43	75% respondents said they would be somewhat likely or very likely to adopt oral paracetamol in their clinical practice.	Potential for reducing need to administer additional drugs to manage hypotension and preventing inadvertent harm to patients
Reduce waste by removing unnecessary items from spinal anaesthesia packs used in lower-limb surgery.	11,180.50	544.62	Anecdotal reports of staff frustration over wasted materials were alleviated, though formal feedback is pending.	No change in patient outcome or experience.
Reduce energy consumption by switching off Heating, Ventilation, and Air Conditioning (HVAC) systems and Anaesthetic Gas Scavenging Systems (AGSS) when theatres are unoccupied (Not yet implemented)	34,203	58,658	Delays in implementation meant no staff feedback was collected yet, but automatic switching aims to ease staff burden and improve engagement in energy-saving practices.	No change in patient outcome or experience.
Switching from a fully disposable battery-powered pulse lavage device to an alternative (Ecopulse) (Not yet implemented)	Annual cost of £7,601.04 (Excluded from total as not being implemented at present).	2,789.64 (Excluded from total as not being implemented at present).	Noise reduction from the Ecopulse will improve working environment for staff in theatre.	No change in patient outcome or experience.
Total	£67,967.66	66,050.64		



Discussion:

Our aim for this project was to implement a 'green surgery' within the 2 orthopaedic theatres and to achieve this we wanted to implement as many carbon reducing initiatives as possible. The limited time frame of this project was one of our barriers to completing all our projects. It became evident that to enable change to happen in a complex environment like the operating theatres it can involve many stakeholders. It is important that these stakeholders are engaged early on in the project as some of the processes of engagement can be lengthy.

Financial implication became a barrier for one of the projects causing it to not be completed regardless of the significant carbon savings the project projected. We hope that with promotion and exposure of the wider sustainability agenda, we can highlight and utilise the savings from other projects in order to allow for investment in those projects that need it.

Patient and staff safety remains of paramount importance, and we must address the potential exposure to risk when implementing new processes. We have addressed issues and concerns around infection control and exposure to anaesthetic gases through developing processes to mitigate risk and seeking advice from specialist practitioners. Seeking approval from divisional governance has also helped us to consider any potential areas for harm so that we could mitigate these.

Whilst we began our project looking at lower limb arthroplasty surgery specifically, it was clear that many of our initiatives were applicable to other surgical specialities. Where this is the case, for example spinal packs and coolsticks that are used in urology, obstetrics and gynaecology we have projected our savings across trust. Similarly, we considered the switch off for one of our hospital sites with the intention to roll this out across trust. Across all specialties, our combined projects have the potential to generate a carbon saving of 66,050.5 kgCO₂e per year or 195,069 miles driven and £60,367.04. This is taking into account the negative cost implication of the pulse lavage. If we consider the impact our initiatives have had on arthroplasty surgery alone, the carbon footprint of a knee replacement is estimated to be 85kgCO₂e (Rizan et al., 2023). Assuming the carbon footprint of a hip replacement is similar to that of a knee replacement, this is 84,235kgCO₂e per year in our hospital which performs 991 procedures per year. Rizan et al's (2023) paper did not include anaesthetic associated emissions or HVAC and AGSS systems so it is difficult to directly compare our results, but theoretically our projects stand to save 21.17 kgCO₂e per arthroplasty procedure and 20,976.20 kgCO₂e per year in our trust. In the UK, over 60,000 hip and knee arthroplasties are performed per year (NHS Digital, 2021), and so the opportunity for carbon savings across the NHS are significant.

Going forward, we aim to ensure that these initiatives become embedded into daily practice, through review and audit of our processes. The aspects of our project that are yet to be implemented will be prioritised, and data collection ongoing to measure the impacts across the triple bottom line and improve sustainable value in our department.

Conclusions:

We aimed to look at a number of small changes to our arthroplasty theatres to generate significant impact on the sustainable value of our department. In reality, whilst some aspects of the project were simple and have been successful in achieving our aims, some required greater investment than we anticipated



and considerable work to ventilation systems which needed more time than we had expected initially. The key elements that contributed to the success of our projects were developing good relationships with key stakeholders. This was essential when things were not going to plan and we needed advice on the next steps.

This project highlighted to us that even when problems or barriers occurred during the implementation stage or the results were not as expected there was still key learning and knowledge to gain. Not all projects will achieve the triple bottom line but the QI practice that is involved in the process of completing a project provides good learning and experience.

To ensure lasting change, we plan to continue to engage with our department, providing updates on projects at clinical governance and also present our findings at relevant events across the trust. We will also continue to seek opportunities to align with national recommendations as outlined in the green surgery report (2023) and work towards a net zero NHS.

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