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GREEN TEAM COMPETITION

CENTRE FOR SUSTAINABLE HEALTHCARE

2022 IMPACT REPORT
GLOUCESTERSHIRE

NHS
Gloucestershire Managed Services

NHS
Gloucestershire Hospitals
NHS Foundation Trust

GLOUCESTERSHIRE
GREEN TEAM COMPETITION

POTENTIAL ANNUAL SAVING FROM PROJECTS COMBINED

£85,081

113,891 kg CO2e

CARBON SAVINGS EQUIVALENT TO..

The same amount as 4,556 mature trees absorb on average per year

328,027 miles in an average car

1,624 return trips between GRH and Kings Cross, London

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INTRODUCTION

Climate change is having far reaching consequences for planetary health, including within the United Kingdom, and is accepted as one of the greatest threats to the health of global populations[1]. In addition to climate change, the integrity of our environment, on which we depend, is threatened by pollution (air, plastic and chemical pollution), water scarcity, soil degradation, deforestation, and loss of biodiversity.

Whilst healthcare systems have a key part to play in maintaining health in the face of the threat of climate change, the delivery of healthcare is also undermining the health of our populations, by contributing to the problem. If healthcare were a country, it would be the 5th largest carbon emitter in the world[2].

However, climate change can also be viewed as 'the greatest global health opportunity'[3]. The NHS was the first health service globally to commit to net zero carbon. In the delivering a net zero NHS report[5], strategies to achieve this target are laid out. While National and international government action will be required, e.g., to decarbonise electricity, transport and supply chains, net zero will not be possible without front line NHS staff.

Clinicians have intimate knowledge of a vast range of medications, resources and equipment used for their daily practice to provide best, evidence-based care for their patients. Non-clinical teams are too essential to ensure that resources and patient care pathways are effective. The combined knowledge and understanding across of all aspects of care is vital when making the carefully nuanced decisions on how to maintain or improve clinical care whilst reducing environmental, social and financial cost.

The Green Team Competition is a clinical leadership and engagement programme for NHS Trusts wishing to improve their sustainability practice. Rachel McLean, Green Ward Programme Manager with the Centre for Sustainable Healthcare (CSH), has worked directly with six teams across Gloucestershire to develop, run and measure projects that add sustainable value within their service, by considering the 'triple bottom line' of reduced environmental harm, reduced financial waste, and adding social value.

Running the competition in an organisation also builds a community of clinical staff who are empowered, enthused, and equipped to further improve their services for the future, guided by the concepts of the triple bottom line and sustainable healthcare.

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COMPETITION ENTRIES

1. **STREAMLINING ENTERAL FEEDING EQUIPMENT,** HOME ENTERAL FEEDING TEAM.

TEAM MEMBERS:

Sarah Williams, Home Enteral Feeding Team Manager (job share) and Dietitian Training Lead

Laura-Marie Baldwin, Advance Home Enteral Feeding Team Dietitian and Adult Team Lead

Background:

Gloucestershire Home Enteral Feeding Team (HEFT) provide dietetic and nursing care to approximately 500 patients who are enterally fed (fed via a medically inserted tube into their gastrointestinal tract). The practice of enteral feeding uses a lot of different equipment, including multiple plastic devices which, depending on an individual’s needs, vary between patients. Many of these products are single use, and some patients may require multiple single use items within one day, generating a lot of plastic waste. Enterally fed patients in Gloucestershire have been raising concerns with clinicians of the HEFT about the amount of waste generated by their enteral feeding. These included concerns over cardboard waste, plastic waste- generated by both the feed bottles and the giving sets (the plastic tubing from the bottle of feed to the feeding tube) and fuel emissions produced by their supply deliveries. The HEFT clinicians took on board these concerns and were keen to seek alternative options to improve the patients’ experience.

The contracted supplier of the enteral feeding products, NUTRICIA, has recently procured a re-useable plastic bottle reservoir (Sterifeed bottle) as an alternative to a single use reservoir (Flo-care bottle) which is currently in use by many of our patients. Recent research undertaken by Nutricia has also shown their giving sets, previously advised to be single use only, are safe to be re-used within a 24 hours period with no contamination concerns (Nutricia, 2021). Applying these changes would lead to a reduction in the amount of single-use plastic bottles and a reduction in the number of giving sets needed by some HEF patients. The HEFT therefore launched a pilot project to trial the use of the re-useable Sterifeed bottles and trial the extended life of the giving set.

Specific Aims:

1. To evaluate the environmental, financial, social and clinical impacts of
   a. Replacing the use of single use Flo-care feed bottles with reusable Sterifeed bottles for appropriate patients in the Neurologiocal Centre
   b. Extending the life of giving sets from single use to 24 hour use for appropriate patients in the Neurological Centre.
2. Raise the awareness on the impact of health care on the environment amongst staff at the Neurological Centre, HEFT staff, enterally fed patients and their relatives.

Methods:

The pilot project was conducted in a local Neurological Centre where the HEFT care for 32 patients. Eligible patients were identified using the below criteria:

- Reusable bottles: Any patient using the single use Flo-care containers
- Giving sets: Patients who are using >1 giving set per 24-hour period

Patient equipment orders were changed with the supplier and the next delivery was amended to include the new bottles and reduced number of giving sets. While the bottles are reusable, they require a single-use adapter which cannot be cleaned and re-used. The change was not implemented immediately to give the staff chance to use up the remaining old stock to avoid unnecessary waste.

Two training sessions for staff were provided at the Neurological Centre to education staff to announcing the change to re-usable products, demonstrating how they are used and also how re-usable equipment should be safely cleaned between uses**.** Presentation slides and pictorial guides were used. We also used these sessions to raise awareness of the impact of health care on the environment.

The centre was chosen as a pilot site as there are several patients who are eligible to change to the new products. The sample of patients at the centre is representative of the wider population of enterally fed patients within Gloucestershire allowing for the impact of the change to be extrapolated to the entire HEF population and the carbon emissions saving estimated. The Neurological Centre is ideal for gathering feedback from service users before and after the launch of reusable enteral feeding products and it is also an ideal venue for training of multiple staff members over 2 pre-arranged training sessions.

Measurement:

Patient outcomes:

Based on research from Nutricia (Nutricia 2021), the changes being implemented will not compromise patient care and safety. Extensive testing on the safety of extending the life of the giving sets has been completed and extending the useable life will reduce the amount of set needed in a 24hour period for some patients.

The swap to the re-useable Sterifeed bottles will not alter the standards of patient care however currently there is not a 1000ml Sterifeed bottle available, therefore patients who receive 1000ml Flo-care containers will instead receive 2 500ml Sterifeed bottles. This is not anticipated to alter the patient care and there are plans to launch a 1000ml Sterifeed bottle in the future.

Environmental sustainability:

CO2e was calculated for each individual item using a bottom up (process based) methodology. Individual materials were weighed and appropriate carbon emissions factors allocated to each material from the UK Government GHG conversion factor database, and the greenhouse gas emissions associated with transport from production to our service site estimated. Emissions associated with waste disposal were obtained from Rizan et al 2021.

CO2e for each item was applied to our patient data to identify actual savings from changes implemented at the Neurological Centre.

The reduction in CO2e was then used to extrapolate to all patients under the HEFT who are receiving single use bottles to ascertain the overall impact of changing to re-useable containers throughout the patient population.

Economic sustainability:
Price comparison of the single use containers compared to the re-useable containers will be conducted, however, as these are both contracted items the overall cost will remain unchanged.

Social sustainability:
We aim to improve patient and staff experience by reducing the amount of plastic waste generated in enteral feeding practice without compromising patient safety or care. This will be measured by qualitative feedback from staff at the Neurological Centre.
A short questionnaire for staff members was conducted before and after the training session to understand staff's awareness and concerns surrounding health care impact on the environment and enteral feeding practices.

Following implementation of the new equipment, a second questionnaire was conducted and qualitative remarks from the staff were gathered by the Dietitian.

The subsequent impact of the project will reduce the volume of products being made and shipped, therefore reducing the quantity of raw materials consumed and fuel emissions of shipping. This will be an additional consideration and something which this project is unable to calculate.

Results:

Patient outcomes:
Results following the implementation of the Sterifeed bottles show that:

- 100% of staff reported the bottles were easy to use
- 100% staff reported that the set-up of the equipment (each element: universal bottle adapter, giving set, stand and pump) was "fairly easy".
- 100% of staff agree the Sterifeed were easy to clean. Staff commented that the wide bottle opening made cleaning particularly easy.
- Staff reported on average cleaning the Steribottle took 0-5mins and overall there was no-difference in the set-up time compared to the Flo-cares. Staff did highlight that the initial set-up of the Steribottle takes longer, but this was balanced out by the Steribottles being easy to access as they are able to be kept in the patient's room (as opposed to the Flo-care containers being in the stock room).
- Staff reported that there was no change in the convenience of using the Sterifeed over the flo-care containers and no change in patient care.

Environmental sustainability:
Caseload screening showed there were 4 patients eligible for a switch to reusable bottles, and 2 patients eligible for extended use of giving sets.

The tables below show the individual products carbon production emissions and the carbon emission savings which can be made by switching to the Sterifeed bottles and extending the useable life of the giving sets the Neurological Centre.

An estimation of the overall carbon saving to the whole HEF patient cohort using Flo-care containers was extrapolated by using recent total monthly usage data of the Flo-care containers and also by assessing monthly usage of giving sets for each individual enterally fed patient. One-hundred-and-one patients were found to be eligible for changing from Flo-care containers and 77 patients for reducing the number of giving sets used each year. From this, we calculated the annual usage.

Table 1: Carbon emissions data prior to changing to re-usable equipment:

	Carbon emissions per item (kgCO2e)	Number of items used per year at the Neurological centre	Total carbon emissions/year (kgCO2e) at the Neurological Centre	Number of items used per year for the entire HEF patient population	Total carbon emissions/year (kgCO2e) for the entire HEF patient population
500ml Flo-care	0.20	1,008.00	205.8	80,508	16,102
1000ml Flo-care	0.27	1,008	270.7	6,264	1,691
Giving set	0.18	1,344	245.8	74,208	13,357
TOTAL			**722.3**		**31,150**

Table 2: Carbon emissions data after changing to re-usable equipment:

	Carbon emissions per item (kgCO2e)	Number of items used per year at the Neurological centre	Total carbon emissions/year (kgCO2e) at the Neurological Centre	Number of items used per year for the entire HEF patient population	Total carbon emissions/year (kgCO2e) for the entire HEF patient population
Giving set	0.18	672	120.96	27,381	4,929
500ml Sterifeed *	0.17	108	18.36	2,832	481
Universal Adapter	0.03	1344	40.32	33,936	1,018
TOTAL			**179.64**		**6,428**

*Carbon emissions associated with cleaning the reusable bottles has not been included, so may be slightly underestimated.

The carbon foot printing has demonstrated a saving of 417.82 kgCO2e by changing from disposable 500ml and 1000ml containers to 500ml reusable containers at the Neurological centre. If this data were to be extrapolated out to all 101 patients currently using Flo-care containers, this would result in a further saving of 16,293.08kgCO2e per year.

By implementing the new giving set guidance of one item per 24 hour period, a saving of 124.84 kgCO2e per year could be predicted at the Neurology centre. A total saving of 8,428.8kgCO2e per year would be made throughout the entire HEF patient population on an annual basis.

The carbon savings in total are **24,722 kgCO2e** per year, equivalent to driving 71,204 miles, which is equivalent to driving from Lands end to John O'Groats 107.5 times, or driving around the UK coastline 9.2 times.

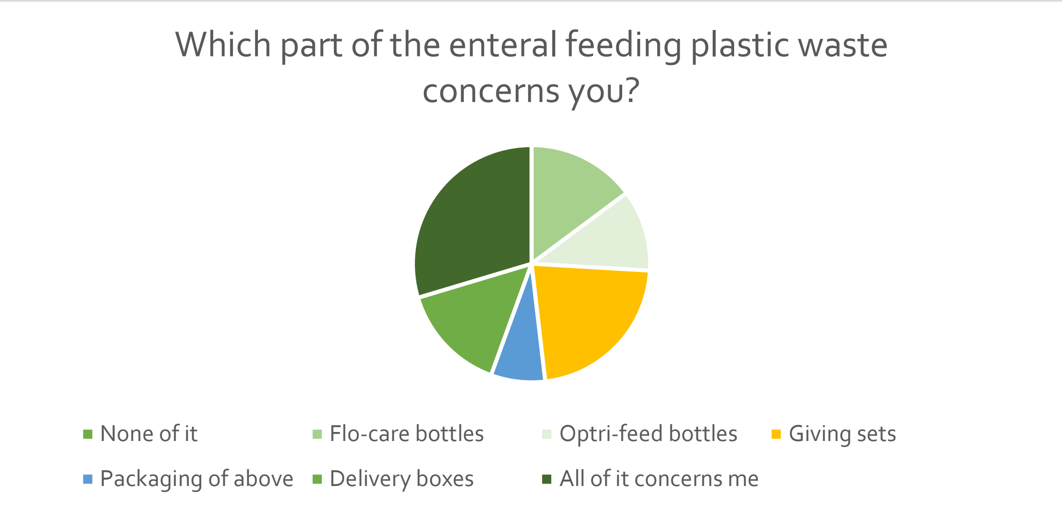
Economic sustainability:

The cost of the disposable and re-usable containers are the same. The financial impact for these products is therefore neutral. However, by swapping patients to the reusable products and adding a daily universal adapter in order for the product to fit the giving sets, there is an additional cost of £368.65 per year to the healthcare commissioners for Home Enteral Feeding services.

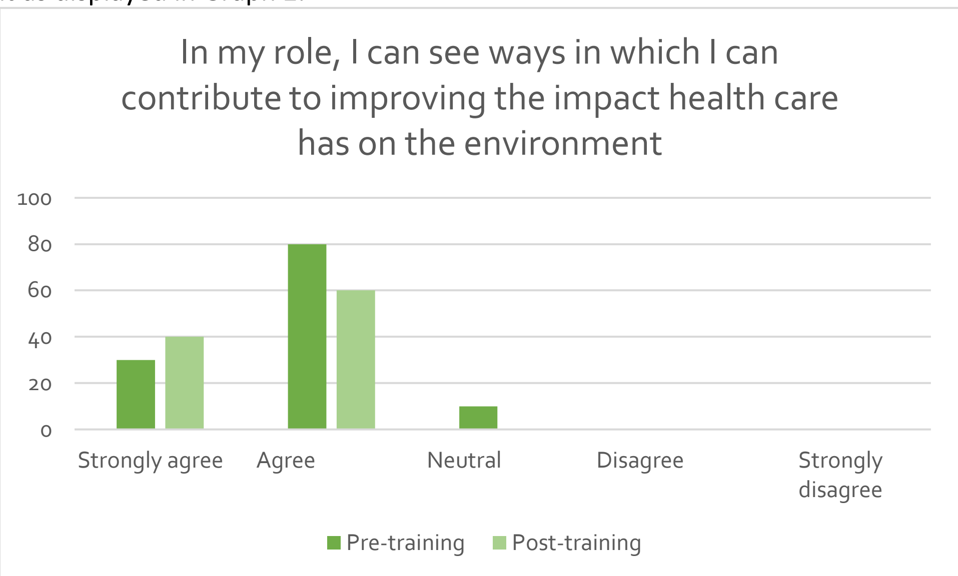
There may be benefit to supplier and further up in the supply chain as less products are being made, less products are being transported and overall, less products are needing to be recycled. However, this will also result in less product being purchased therefore the financial impact here may also be neutral. This was unable impact was unable to be evaluated within the scope of this project.

Social sustainability:
Of the 10 staff members surveyed at the Neurological Centre prior to the training 80% of them reported concerns on the impact of health care on the environment. Following the training this rose to 100% of the staff members strongly agreeing or agreeing that they had concerns on the impact of health care on the environment. 90% of staff reported that the information received changed their thoughts on the impact of health care on the environment.

When asked about products specifically relating to enteral feeding, 90% of those surveyed were concerned by the amount of plastic waste generated. The breakdown of the items which concerned them is displayed in Graph 1.



When asked if they could see ways in which they could contribute to improving the impact health care has on the environment in their role, before the training 30% strongly agreed, 80% agreed and 10% were neither agreed or disagreed. Following the training this rose to 40% strongly agreed and 60% agreed that they can see ways in which their role can contribute to improving the impact of health care has on the environment as displayed in Graph 2.



Comments on why the plastic waste generated by enteral feeding practices concern staff are displayed below:

As it can be recycled and it is not done enough
Plastics are single use i.e. syringes, giving sets, bottles and packaging.
Because it is all put in normal bins. There is no specific place to recycle it. Mainly because it can go into the Ocean.
We go through a lot of the (enteral feeding plastics) and they are usually thrown away in clinical waste.
Because most of it is one time only.

This project has demonstrated that similarly to our patients, staff members caring for enterally fed patients at the Neurological Centre are also concerned about the amount of plastic waste generate through enteral feeding practices. The majority of staff report that although they have these concerns and they recycle at home, they do not recycle the plastic waste generated from enteral feeding at the Neurological Centre. It is understood that there is limited space available for recycling facilities at the Centre, but it is hoped the results of this survey can demonstrate the need for this to be reviewed and for alternative options to be sought.

Since switching to the containers staff feel that the change has had a very positive impact on the environment, as previously they were very upset about the amount of waste generated through enteral feeding practice. staff commented that they wish the products had been available to them earlier.

Discussion:

The impact of this project has been seen in several different areas. When our patients began to raise their concerns over the amount of plastic generated in the practice of enteral feeding, we knew we needed to consider making changes to reduce the environmental impact. When Nutricia made available the new re-usable Sterifeed bottles we were keen to trial them with our patients. This coincided with new data on the usable life of the giving sets. This provided a good opportunity for HEFT to change their practice around these two products and respond to our patients concerns.

The project has had a positive effecting in raising the awareness of the impact health care has on the environment. It is hoped that this effect will have a sustained effect and staff may continue other sustainability projects at the centre in their job roles. As the majority of staff surveyed recycled in their personal lives too this demonstrated that they are conscious of the environment at home.

Announcing the change to re-usable products, demonstrating how they are used and also how re-usable equipment should be safely cleaned between uses was undertaken during 2 pre-arranged training sessions at the Neurological centre using presentation slides and pictorial guides. A challenge of this arrangement is that not all staff (including night shift staff) could attend the sessions and we have therefore relied on the trained staff training the staff that could not attend. To help upskill the members of staff who could not attend the training sessions, we made our presentation slides and pictorial guides available to all staff at the Neurological centre. A further challenge that was not foreseen was that the Neurological centre had an overstock of the disposable containers. This caused a delay in staff swapping from disposable to re-usable products and a time lapse between the training sessions and swapping to reusable equipment occurred.

Although the overall impact of this project has been positive, there have been some challenges identified. The Sterifeed bottles need a universal bolus adapter to connect them to the giving sets. These are single use items, therefore a new adapter is needed for each bottle, it cannot be cleaned and re-used. So although the bottle can be, the adapter must be discarded after every use. To make the whole process of using the Sterifeeds then most sustainable practice, this product re-useability needs to be reviewed. As a result of this project, we have raised this with Nutricia and hope that this something they can look into.

The limitation that the Sterifeed bottle must be hung on a different frame to the bottles of feed. This is taking up additional space on the patient's bed side table. A possible solution to this could be a flexible hook on the base of the Sterifeed bottle (as per Flocare container design) so that it is compatible with the current hanging frame.

Another comment raised following the implementation was the lack of a 1000ml Sterifeed bottle, which there is in the Flo-care range. One patient was needed a two 500ml Sterifeed bottles in place of one 1000ml Flo-care containers. In practice, at the neurological centre this wasn't a problem because the patient has 1:1 staff member 24hrs per day. However, in a patient's own home this may impact routine, and, as a result may need their feeding regimen altered.

A further consideration for using the Sterifeed is their cleaning. To ensure the feeding system remains as clean and safe as possible, the bottles should be washed thoroughly after every use, preferably as soon as the feed has finished. For more mobile patients in our cohort, this may not be convenient if they are out and about in the community. Therefore, for these patients, the Sterifeeds may not always be suitable.

Conclusions:

The total reduction in the carbon footprint resulting from a change to reusable enteral feeding equipment amounts to 24,722 kgCO2e. This information from the study can be used when negotiating changes to patients enteral feeding supplies and to let service users know of the positive impact the change will have on the environment. The changes are planned to be carried out by the HEF team throughout 2023. The HEF team members are keen to make changes to their practice that would have a positive impact on the environment. We intend to present the pilot results from the Neurological centre to the HEF team and share the training resources we have developed in order for them to be used with enterally fed patients across Gloucestershire. Swapping to re-usable enteral feeding equipment will be discussed with each eligible HEF patient during their scheduled enteral feed reviews which are undertaken as home visits.

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2. SCOPING FOR CHANGE – ADOPTING GREENER PRACTICE IN ENDOSCOPY IN GLOUCESTERSHIRE, ENDOSCOPY TEAM

TEAM MEMBERS:
- Dr Luke Materacki, Consultant gastroenterologist
- Lucy Breach, Endoscopy sister

Background:

Global warming has cataclysmic implications for current and future generations globally. The NHS, one of the largest contributors to carbon emissions in the UK, has set an ambitious target to be carbon net zero by 2040.[1] Endoscopy is the third largest contributor to carbon emissions within the NHS due to a throughput of several million patients annually with the second largest amount of waste generated per clinical procedure.[2]

There is growing enthusiasm nationally for more sustainable practice in endoscopy. The Joint Advisory Group (JAG) on GI endoscopy recently recommended that endoscopy services should aspire to develop a green endoscopy working group and initiate at least one environmental initiative.[3] Furthermore, the British Society of Gastroenterology (BSG), JAG and Centre for Sustainable Health (CSH) recently published a joint consensus on practical measures for environmental sustainability in endoscopy.[2]

More than 9,000 endoscopic procedures are conducted across four endoscopy units in Gloucestershire annually offering huge opportunity for carbon savings. Prior to the Green Teams competition, Gloucestershire did not have a dedicated green endoscopy working group.

Specific Aims:

1. To establish a multi-professional green endoscopy working group in Gloucestershire
2. To make at least one change to improve sustainability in endoscopy in Cheltenham General Hospital and measure its environmental (CO2e), financial and social impact.

Methods:

A detailed process mapping exercise was initially conducted to outline the existing patient pathway in endoscopy and identify areas for change. Three broad aspects of the patient pathway were considered: pre-endoscopy, during the endoscopic procedure and post-endoscopy. A long list of potential changes were considered before a final shortlist was created and presented at the Cheltenham endoscopy governance meeting for discussion within the wider department. This helped to improve buy-in within the department and following this meeting many interested staff were invited to join the endoscopy 'green team.' Although several changes were agreed, we focus on three changes for the purpose of this report.

1. Pre-endoscopy: We aimed to reduce paper use/postage by offering patients the choice of an electronic copy of their pre-procedure booklet provided via email. The endoscopy bookings/administrative team were instrumental in driving this change, which once agreed was implemented immediately on 03/10/2022. The uptake of electronic leaflets compared with paper was recorded contemporaneously from 03/10/22 to 28/10/22. A 'green champion' in the bookings/administrative team was identified and this has helped to improve buy-in and bring together the wider endoscopy team. We have also contacted the leaflet printing company to negotiate ordering future leaflets printed on recycled paper without inflating cost. Prototype leaflets are awaited. This process also exposed some deficiencies in the patient-facing endoscopy website which we plan to revamp to enhance the electronic information available to patients, including accessibility to leaflets.

2. During endoscopic procedures: We utilise a large number of single use disposables and aimed to reduce

a) Use of single use disposable shorts, worn by patients for lower GI endoscopy (colonoscopy and flexible sigmoidoscopy). Instead of the single use shorts, we offered patients a washable patient gown to wear first-line during their lower GI endoscopy. Staff responsible for product ordering, the shorts and inkopad manufacturers and the Gloucestershire managed services team regarding the gowns were contacted. Additional patient gowns were ordered from the hospital stock for endoscopy and there was regular engagement with senior endoscopy nurses in the department and endoscopy staff at departmental meetings to reinforce the change.

b) Prophylactic inkopad use: previously an inkopad would be placed prophylactically either beneath the mouth or anus to catch any potential fluid loss. We targeted reduction of this 'just in case' practice, agreeing responsive practice such that an inkopad would be used if requested by the endoscopist or if high risk of fluid loss was anticipated. Endoscopy staff were encouraged not to use inkopads prophylactically for gastroscopy, flexible sigmoidoscopy and colonoscopy. Instead inkopads were used if deemed necessary by the endoscopy staff during a procedure (e.g. if high risk of or active fluid leakage).

Once the change in practice had been implemented, staff were asked to keep a tally of procedures where shorts or inkopads were used.

3. Post procedure: Patients are offered a hot or cold drink using a single use cup. We aimed to reduce single use cup use by encouraging patients to bring in their own water bottle or reusable coffee cup. Patients were asked to do this by the endoscopy bookings/administrative team when they were given information about their appointment, and we had planned to reinforce this by adapting patient leaflets. It was not possible to adapt leaflets to encourage patients to bring in their own reusable cups or water bottles during the study period. Furthermore, data collection regarding the number of cups used each day proved difficult, in part due to several different staff recording numbers of cups used on different days with different systems for recording. Furthermore, the financial, environmental and social impact was felt to be less than the other interventions and so this was not prioritised during the competition and instead represents a medium-term goal. Therefore, we have not calculated savings for cups. Interestingly some staff felt it was unfair to ask patients to bring their own reusable cup or water bottle, feeling it may increase the stress and anxiety associated with the procedure.

Measurement:

The baseline number of endoscopic procedures performed across each of the four endoscopy units in Gloucestershire is recorded monthly. At baseline, all patients would have received a paper leaflet about their procedure, a prophylactic inkopad during flexible-sigmoidoscopy, colonoscopy or gastroscopy and a pair of single use shorts during flexible sigmoidoscopy or colonoscopy. All patients were offered a drink post-procedure which we assumed would utilise one single use cup. .

Patient outcomes:

Patient outcomes were not formally assessed however we obtained feedback from staff of their perception of the impact of changes on patient care

Datix reports were monitored for any comment related to the interventions made.

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Environmental sustainability:

1. Pre-endoscopy leaflets: The environmental impact was estimated by calculating the carbon emissions factor per leaflet. We have calculated the paper and envelope using weights, and postage by cost. We have also included travel as the leaflets are printed by a local supplier 5.8km from the hospital. We have not taken into account the printing itself.

2a.

Single use shorts. The environmental impact was determined by weighting the material the shorts (ICE database) and first layer of packaging were made of, and applying emissions factors to each material. We also included transport (BEIS) from the manufacturer to supplier to the hospital. Waste disposal (assuming shorts are incinerated, and packaging is recycled) was calculated using emissions factors from Rizan et al (2020).

Reusable gowns: It was challenging obtaining accurate data regarding carbon emissions factors for the hospital gowns as the linen department were unable to provide detail regarding the lifespan or washing cost/process involved with each reusable gown. As a result a previously determined carbon emissions factor from another Trust was used. This factor assumes that the gown weighs 0.2 kg, is made of Polypropylene, gets transported to an external facility to be washed and dried, can be used 100 times and will be disposed of by waste to energy at the end of its life.

The difference was multiplied by the number of procedures performed over the study period. procurement of medical equipment with additional benefit in terms of reduced waste incineration. Assumptions were made in terms of transport methods and point of distribution.

2b. **Inkopads:** The carbon emissions factor per inkopad was determined by weighting the material and applying emissions factors to each material. Packaging was not included. The inkopads are manufactured in Sweden although the exact distribution location is unknown. Direct distribution from Stockholm, Sweden to Gloucester Royal Hospital by lorry has been assumed. Savings were extrapolated based on the number of inkopads saved (a tally chart was recorded of usage during the study period).

Economic sustainability:

Financial data was obtained from the staff responsible for procurement. There were no investment costs.

1. Pre-endoscopy leaflets: The printing and postage cost per leaflet was used to calculate the financial saving of electronic leaflet use. the environmental cost of ink and staples was not included. The distribution cost in terms of mileage to/from post sorting office to final destination was also not included

2a. Single use shorts and gowns: It was difficult to determine the financial impact of switching from routine use of shorts to gowns since information from the linen team was difficult to obtain (e.g. the lifespan of a reusable gown).

2b. Inkopads: The financial cost per inkopad was taken from Trust finance team and was used to estimate the savings in reduction of use.

Social sustainability:

Staff attitudes towards sustainability and the changes made in endoscopy were assessed using an electronic questionnaire. Some staff concerns about patients' dignity when gown is used was raised and so patient feedback regarding their dignity during the procedure was sought from patient feedback questionnaires. Patient experience in general was assessed in the post-procedure questionnaire.

Results:

Patient outcomes:
Use of gowns and reducing inkopad use was welcomed by a number of endoscopists as having some procedural benefit as the single use shorts and inkopads were sometimes noted to gather on the colonoscope which may lead to fabric catching and needing to be ripped during the procedure, impairing insertion. This may lead to more efficient procedures.

The choice of leaflet format has made patient care more patient-centered, timely and efficient. Standards of care have continued to be maintained, evidenced by consistent patient feedback and no Datix reported related to the changes during the study period. Arguably some aspects of care are safer as patients are more likely to receive their leaflet pre-procedure in a format and language suitable for them.

Economic and Environmental sustainability:
The below results were collected from data obtained on our 25 day monitoring period.

1. electronic leaflet
49% of patients opted for an electronic leaflet (n=402). At this percentage uptake, the total number of paper leaflets posted each year would reduce from 16,971 to 8,655 with savings of £1,497 and 1,701 kgCO2e.

2a: replacing disposable shorts with reusable gowns
A small proportion (<5%) of patients who had undergone a procedure before requested they use the shorts again. Switching from single use shorts to reusable gown use during the study period was therefore estimated in 95% of patients undergoing colonoscopy and flexible-sigmoidoscope. On this basis 8,548 less single use shorts would be used annually leading to financial saving of £7,180.

The CO2e for one pair of shorts is 0.2834 kgCO2e. The carbon emissions saving from reduced shorts manufacture and orange waste incineration is 2,423 kgCO2e annually, again an over-estimate for the reasons outlined. The carbon footprint of one reusable gown is 0.06284 kgCO2. The carbon footprint of 8,548 reusable gowns would be 537.16 kgCO2e. This is a saving of 1,886kg CO2e.

This figure does represent an over-estimate as the cost of purchasing replacement gowns during the year and laundry cost/disposal cost for expired gowns is unclear. It is unknown whether the endoscopy budget would be responsible for this or whether these costs would be included in an existing hospital contract.

2b: Inkopads:
We are continuing to measure the number of inkopads saved from reduction in prophylactic use. From clinical experience we estimate inkopad use at 10% for OGD or flexible sigmoidoscopy and conservatively, 50% in colonoscopy. Based on this estimate, 12,735 fewer inkopads would be used each year with savings of £891 and 3,032 kgCO2e annually from reduced inkopad manufacture and incineration in orange waste bags.

Total savings: Overall the potential savings across all four endoscopy units if these three interventions were made would be £9,568 annually with carbon emissions savings of **6,619 kgCO2e** annually, equivalent to 19,063.9 miles driven in an average car.

Social sustainability:

The Green Teams Competition has provided a platform to establish a multi-disciplinary green endoscopy working group in Gloucestershire consisting of staff from the endoscopy bookings team, endoscopists, trainees, endoscopy nurses and healthcare assistants. Staff have felt involved which has helped to create buy-in for the interventions. Endoscopy staff attitudes regarding green endoscopy and the interventions made were assessed during an electronic survey of staff attitudes (n=16). 100% of staff were supportive of greener practice in endoscopy and accepted everyone had a responsibility for adapting their way of working to reduce carbon emissions.

1. electronic leaflet: 94% of staff either somewhat or strongly agreed with switching leaflets from paper to electronic format although concerns were raised that the electronic format may be less appropriate in some patient cohorts, hence choice should be maintained as a choice.

This change has benefits of enhancing patient choice and offering instantaneous distribution, particularly beneficial for patients undergoing an endoscopic procedure at short notice when a paper copy may not arrive via post in time, particularly during a climate of postal industrial action. Electronic leaflets arguably improved the reliability of leaflet provision and also offered a format which could be easily translated to other languages using an online translator.

Estimating 30 seconds time saved for the endoscopy bookings staff per leaflet, this would generate roughly 69 hours of time for additional activity annually. This time may mean more patients can be contacted during their working day, or there be extra opportunity to take breaks and improve wellbeing.

2. Replacing shorts with gowns: Switching from single use shorts to reusable gowns was more contentious with 50% disagreeing with the change, siting loss of patient dignity as a concern. This has been discussed at departmental meetings and felt to be unfounded, perhaps created in part by the marketing of shorts as 'dignity' shorts. We are aware that other services such as gynaecology and urology procedures do not use shorts. Crucially, patients have not highlighted a concern with dignity in post-procedure feedback surveys or recorded via Datix. This will be fed back to staff during departmental meetings to address concerns.

3. **Inkopads**: Ceasing the prophylactic use of inkopads was supported by 81% of endoscopy staff. Some additional staff education was needed during the study period as some staff misunderstood the intervention instead thinking inkopad use had been completely condemned. Patient feedback and Datix should continue to be monitored to ensure no issues are highlighted with the interventions made

Conclusions:

The interventions have reduced the carbon intensity of each endoscopy procedure with additional benefits financially and more importantly by improving choice and widening information accessibility during the patient journey.

The Green teams' competition has been incredibly useful in nurturing a culture of greener practice in endoscopy in Gloucestershire and empowering the team to make positive change. Creating a working group of staff involved in each part of the patient pathway is important to create enthusiasm and maintain momentum of change. It can be frustrating when information or data is not forthcoming but important to realise that everyone is incredibly busy in the organisation but despite this most people have a willingness to help, although sometimes on differing time scales.

The inception of the green endoscopy working group should help to create lasting change and I plan to hold quarterly meetings to discuss ideas and new interventions to make our endoscopy practice greener. Posters have been added to staff noticeboards encouraging ideas for greener practice and discussion about green endoscopy should form a part of endoscopy governance meetings. I have also promoted the Green Teams Competition to the endoscopy lead for the BSG, suggesting this could be a national competition for endoscopy units with ideas showcased at the national BSG meeting and achievements recognised. I plan to develop our results into an abstract so they can be presented at the annual BSG meeting, allowing our interventions to be showcased to other endoscopy units nationally.

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3. https://www.thejag.org.uk/green-endoscopy - accessed 03/01/2023

3A. **REDUCING CARBON (CO2E) WASTE FROM PULSE LAVAGE SYSTEMS USED IN JOINT REPLACEMENT SURGERY**, ORTHOPAEDIC THEATRES

TEAM MEMBERS:

- Matthew Chan, ST8 Trauma & Orthopaedics Registrar, matthew.chan1@nhs.net
- Amanda Neale, Principal Operating Department Practitioner, amanda.neale1@nhs.net

Background:

Pule lavage is used widely in orthopaedic surgery. It plays an important role in modern cementing techniques for total joint arthroplasty by ensuring a clean cancellous bone bed to allow cement inter-digitation[1, 2, 3]. Additionally, it also plays a role in providing high volume washout of soft tissues during wound irrigation[4]. A variety of different disposable pulsatile lavage system are available commercially. These differ mostly in the source of power (battery/AC), plastic/carbon and cost.

We perform over 1000 joint replacements per year whilst nationally it is estimated that 215,000 - 440,000 total hip and knee replacements will be performed by 2035[5]. Consequently, thousands of disposable pulsatile lavage systems are used and discarded per year resulting in significant environmental and economic implications. The current system used at our trust is the Pulsvac Plus supplied by Zimmer-Biomet® (Warsaw, US). This is a single use, disposable, battery-operated system (8xAA) and is like most of the pulsatile lavage systems used across the UK. We propose the use of a novel pulsatile lavage system called the Ecopulse (De Soutter Medical Ltd.®, Aylesbury, UK).

De Soutter have provided a certificate of carbon neutrality making the Ecopulse the only commercially available carbon neutral pulsatile lavage system on the market. The main difference between these systems is that the Ecopulse is powered via the power tool handpiece already in use on joint replacement sets. This removes the battery waste and reduces the size and weight of the product, resulting in less raw materials required. This leads the potential for significant environmental and cost savings.

Specific Aims:

1) Evaluate and compare the carbon footprint of the Ecopulse compared to the Pulsvac Plus
2) Evaluate and compare the cost of Ecopulse compared to Pulsvac Plus
3) Clinical evaluation of Ecopulse by surgeons

Methods:

Project timeframe

Organisation of the project began in August 2022 and data collection started between October 2022 and December 2022.

Baseline data

Our local National Joint Registry (NJR) report for 2018-2019 (last pre-COVID year) was used to provide an estimate on our annual knee and hip replacements. The NJR is used by our trust to collect data on all of the total joint replacements performed across the UK. This figure was then used to estimate the annual carbon footprint and cost of each product.

Clinical implementation and analysis

The Ecopulse was trialled using a product evaluation form provided by De Soutter. This trial period was done over a two-week period between 5/9/22 – 23/9/22. The product was used by orthopaedic surgeons and their teams across this period and then an evaluation form was completed. The evaluation form is shown in the appendix. The products were provided by De Soutter free of charge and no funding was required.

Measurement:

Patient / clinical outcomes:

Surgeon product evaluation form shown in the appendix. This was completed by surgical teams following the use of the Ecopulse.

Environmental sustainability:

The total raw materials of the product, their weights and packaging were provided by the manufacturers. We also weighed the products and packaging individually to confirm this data. Using carbon emission factors provided by UK Government GHG conversion factor report[6] the carbon footprint of each product was calculated. For transportation, carbon emissions were calculated by estimating total miles from distribution centre to our trust and then using the carbon emissions factors from the UK Government GHG conversion factor report[6]. A total carbon footprint for each product was then created by combining these figures. We then projected the total carbon footprint annually. The Ecopulse comes with a carbon neutral certificate with a formal carbon footprinting analysis carried out by Carbon Fooprint Ltd. This is a very detailed report which we could not replicate as well when assessing the other models. We felt repeating the carbon footprinting using our simplified method would verify the results and allow us to get a more accurate comparison to the other products available. Table 1 shows the factors used in the carbon footprint analysis.

Table 1: Factors used for carbon footprint calculation	***Pulse Lavage system***		
Main components of instrument	*Ecopulse®*	*Pulsvac® (Battery)*	*Pulsvac® (AC)*
Hard plastic main body	✓	✓	✓
Batteries	×	✓	×
Tubing	✓	✓	✓
Inner Packaging	✓	✓	✓
Outer packaging	✓	✓	✓
Transport			
Distance from distribution centre to Hospital	✓	✓	✓

Economic sustainability:

Costings were provided by our procurement department. Unfortunately, due to Non-Disclosure Agreement exact figures were not available. Cost savings were calculated annually by estimating the procurement of 2,500 pulsatile lavage kits per year. This saving was based on using one pulse lavage system per operation and on 100% replacement of the current Pulsvac model.

Social sustainability:

Details of this were taken from the comments provided by the evaluation forms

Results:

Patient / clinical outcomes:

The Ecopulse favoured well in the clinical trial period and was acceptable for most surgeons. Some of the advantages that were highlighted were that it was much quieter than the Pulsvac and hence made communication and training easier. One of the disadvantages is that once attached to the power tool it was heavier than the Pulsvac. In addition, with the power tool in use mechanical brushes could not be used simultaneously to clear the femoral canal of debris. Neither of these problems will negatively impact patient care but it does mean that not all surgeons will be able to use the Ecopulse and so a supply of the Pulsvac option will be required.

Environmental sustainability:

Item	KgCO2e / use	Uses per year	KgCO2e / year
Ecopulse (De Soutter, Aylesbury, UK)	1.69	1,800	3,045
Pulsvac Plus Battery (Zimmer-Biomet, Warsaw, US)	4.32		7,783 389.15 260.65
Pulsvac Plus AC (Zimmer-Biomet, Warsaw, US)	2.90		5,213

The estimated annual carbon emissions of each device are shown in the table 1. The overall footprint of the Ecopulse was significantly smaller than that of the Pulsvac, reflecting a 2.6x carbon emissions saving compared to the battery powered Pulsvac. In addition, the carbon neutral Ecopulse means it offsets their carbon emissions providing even better savings in comparison to the existing Pulsvac

We currently use the Pulsvac **Plus Battery** for 100% cases. Assuming, 95% of cases are eligible to switch to the Ecopulse we project a saving of **4,501.1 kgCO2e.** This is equivalent to driving 12,9634 miles driven in an average car. In addition, switching from the battery to the AC powered option for the remaining 5% of cases will save a further **128.5 kgCO2e** giving a total saving estimate of **4,629.6 kgCO2e** (13,334 miles driven).

The main environmental benefits arise due to the difference in the power source. Using the power tool provided on the existing joint replacement sets means that no electronics, batteries, or motors are required in the Ecopulse. This significantly reduces the weight and the raw materials used leading to much less carbon emissions. Additionally, it is likely that the manufacturing process for the Ecopulse is also more efficient due to the lack of motors and simplicity of the design. However, in this project we have been unable to quantify this cost. Zimmer-Biomet do offer an AC powered version of their pulse lavage which has the benefit of not using batteries. This option has less carbon emissions then the battery-operated version but is still inferior to the Ecopulse.

The Ecopulse is primarily compatible with De Soutter power tools. The p31 series is also compatible with Stryker® power tools. Adaptors exsist to use the Ecopulse system with Linvatec®/Hall®, Aesculap® and Synthes® power tools. Although this encompasses most of surgical power tools on the market it may not be possible to use the Ecopulse in all trusts due to compatibility issues with existing systems. When it is not possible to use the Ecopulse, we strongly advocate the use of the AC powered pulse lavage systems.

Economic sustainability:

Based on a projected procurement of 2,500 pulse lavage kits per year and 95% use the Ecopulse saved an estimated £6,175 per year. Likely the cost saving comes from requiring less raw materials and a simpler manufacturing process.

Social sustainability:
De Soutter estimates that using the Ecopulse will provide a 2.5x increase in storage space. This will help create valuable space in operating theatres stores. This is demonstrated in the comparison between Figure 1 and 2. This improved storage space allows for more room for other important orthopaedic instruments and will allow us to keep more sets on site and reduce our loan kit requirements. This will have both economic and environmental benefits. Additionally, it makes it easier to move around in what is normally quite a tight storage making it easier for theatre staff.

During an operation there can be significant amount of noise, and this can sometimes make working in this environment difficult for staff. As the Ecopulse is quieter it should improve the working environment for the staff during the operation.

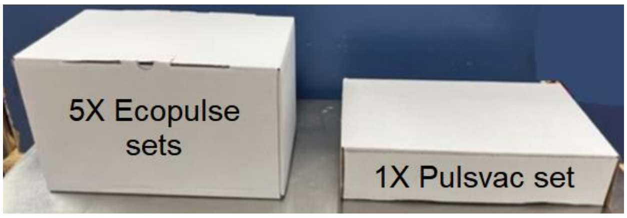

Figure 1. Packaging:
Ecopulse box (Left) containing 5 ecopulse sets, Pulsvac box (right) containing 1 pulsvac

Figure 2. Device:
Pulsvac Plus (Left), Ecopulse (Right)

Discussion:

Our project has shown that there is significant environmental and economic savings that can be made by using the Ecopulse compared to more commonly used battery powered pulse lavage systems such as the Pulsvac Plus.

The potential savings at our trust alone are significant, however it is important to project and consider the potential benefits nationally. Using data from Culliford et al. it is projected that in 2024 around 180,000 knee and hip replacements will be performed in the UK. Using our estimations, we predict that this would generate 778 Tonnes CO2e if battery operated pulselavage systems like the Pulsvac are used. By using the Ecopulse this figure will reduce to 304 Tonnes CO2e saving 450 Tonnes CO2e over a year. This is equivalent to nearly 1.3 million miles driven by the average passenger car.

Introducing new products into a surgical department is not always an easy process. Starting discussion early with all members of the surgical team can help identify potential stumbling blocks as early as possible. By calculating the carbon factors, it has helped put the environmental impact into perspective. This has certainly helped raise awareness on the issue and has helped gain support.

I have had excellent senior mentorship during this process, and this has helped guide me through the process and identified who are the key stakeholders that needed to be contacted and in agreement with the product. This was a very important aspect, and I would highly recommend that for those new to the process of procuring new surgical products that they look for an experienced mentor.

Lastly, not all "green" products will work for everyone. In this project our surgeon feedback highlighted that the inability to use both a mechanical brush to clear the femoral canal and the lavage system would not work for them. I think this type of situation is very common when looking at new surgical instruments. Fortunately, we had already identified a greener solution in the AC powered kit which ensured that we still could provide a more sustainable option for this surgeon. Taking time to do a thorough review of all the products available is important as it allows you to find other solutions that can work.

Conclusions:

The Ecopulse pulse lavage system produced by De Soutter medical Ltd. represents a significant opportunity to reduce the carbon footprint of joint replacement operations both locally, at our trust, and on a national level. By producing a product that is not only "green" but is cost efficient in comparison to its competitors we anticipate this will produce a lasting change at our trust.

The key learning points from this project are that "Green" teams should prioritise reviewing single use items used in high volume operations such as joint replacement surgery. There is a growing market for "green" alternatives in surgical instruments and it represents a significant opportunity to make carbon savings at your trust. Ensuring that the correct clinical governance is completed is very important when introducing new products. This ensures that the product is been reviewed and deemed safe to use by the trust. Often this can be a lengthy process and so starting this early is key to the success. Finding an experienced mentor to help guide this process is a crucial step and makes the process much clearer.

In the future we plan to do a formal review of disposable pulsatile lavage systems available in the UK. By publishing this work, we aim to spread the initiative outside of our trust and lead to a reduction in the carbon footprint of joint replacement surgery across the UK. We also plan a presenting this work at our regional orthopaedic meeting. The benefits seen by introducing this green product has certainly raised awareness across the department and should encourage future initiatives.

After fully implementing the Ecopulse in our hip and knee joint replacements at Cheltenham we hope to expand the initiative to our trauma service at Gloucester. We hope to use this product for our hip hemiarthroplasty for patients with fractured hips. We estimate there is around 200-300 additional cases that could use the Ecopulse and so will provide even greater savings.

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6. Greenhouse gas reporting: conversion factors 2022 - GOV.UK (www.gov.uk)

NHS
Gloucestershire Hospitals
NHS Foundation Trust

GENMED

De Soutter Power Tool Evaluation Form

Name: ………………………………………………………………………

Procedure done: ……………………………………………………………

Is this product acceptable for clinical use? Yes / No

Please Circle tool used: TRAUMADRIVE / ORTHODRIVE

Poor ① Average ② Good ③ Very Good ④ Excellent ⑤

	1	2	3	4	5
Drill or Reaming Power and Speed					
Sawing performance					
Ease of use of Handpiece and attachments					
Ease of use for K-wiring					
Ergonomics during use					
Battery and Handpiece reliability during use					
Rep support during Trial					

Please leave any comments below:

TEAM MEMBERS:

- Matthew Chan, ST8 Trauma & Orthopaedics Registrar, matthew.chan1@nhs.net

Background:

Laminar flow ventilation systems provide exponential flow of ultra clean air to reduce airborne microbial contamination and subsequent surgical site infection (SSI). Much of the evidence for laminar flow use is based in orthopaedic surgery, especially in relation to prosthetic implantation[1]. This has led to both NICE and BOA advocating for its use in major implant and arthroplasty surgery. However, there is little evidence for the use of laminar flow in other operative indications or surgical specialities[2]. Estimates of the laminar flow use at GHNFT suggests it accounts for up to 30-60% of the overall energy output of our theatres. Consequently, inefficient, and unnecessary use of laminar flow ventilation system can lead to significant cost and environmental implications.

Specific Aims:

1) Determine the baseline use of laminar flow in emergency theatres
2) Develop strategies to improve laminar flow efficiency

Methods and measurement:

The first part of the project involved identifying the baseline use of laminar flow in orthopaedic and emergency theatres. This was done by involving the theatre staff and determine how the laminar flow is used at GHNFT. Currently, the system is on full power from the beginning of the theatre list till the end in both emergency and orthopaedic theatres. The nature of the emergency theatre means that it has variable start and end times making it difficult to pinpoint the exact usage each day. However, what is clear is that whenever the theatre is in use the laminar flow ventilation is on full power.

To estimate the current laminar flow use details of all the operations performed in August 2022 were reviewed. Each case was assessed to see if laminar flow was clinically indicated. The guideline for laminar flow use was provided by the British Orthopaedic Association who advise that any case involving use of an implant should consider the using laminar flow ventilation. The overall times of the operations were then added together to provide an estimate of the overall unnecessary use of laminar flow in emergency theatres.

Economic analysis
Details on the overall energy output (Kw/h) of the laminar flow system in both orthopaedic and emergency theatres was sought from our estates team. This involved identifying the kWh of each of the four fans used in the theatres. This was found to be a total of 6.2 kWh. The cost per kWh of electricity was then provided by the trusts energy manager (Tatiana Iona). An upper and lower estimate of the costs was provided due to the varying energy pricing and complexities of the way the trust manages its energy. Calculating the cost (£) of unnecessary laminar flow was done using following equation:
Excess Laminar flow use (kWh) X £0.17-£0.27 (Cost (£) per kWh)

Environmental analysis
The carbon footprint of the unnecessary laminar flow use was calculated using the emission factor for electricity provided by the energy manager at our trust (Tatiana Iona). Due to the way the trust uses its energy this number is different to the emissions factor used nationally. Again, an upper and lower estimate was provided. The trust emission factor for electricity was then multiplied by the total kWh of the unnecessary Laminar flow use to provide a total carbon emission.

Excess Laminar flow use (kWh) X 0.211-0.386 kgCO2e/kWh (carbon emissions factor)

Social sustainability:
Decibel measurement of full power laminar flow using a decibel meter app called "decibel X"

Solution for Emergency Theatre
As almost no orthopaedic operation happens in the emergency theatre our plan was to switch laminar flow off entirely. A standard operating procedure (SOP) has been created for this. This was disseminated across the surgical division.

Solution for Orthopaedic Theatres
The need for laminar flow is discussed at the morning surgical safety brief. The laminar flow is only switched off if there are no more cases that would require laminar flow in those days operating session. E.g. if a non-laminar flow case was sandwiched between two laminar flow cases then the laminar flow would remain on for all cases. This ensures that the laminar flow remains on when it is required and reduce labour for the theatre staff. A traffic light system to help clinicians determine which cases were appropriate for laminar flow was also created. This is shown in Appendix 1.

Results:

Baseline data:
Our audit has highlighted that only 2 of the 180 cases performed in emergency theatres in August required laminar flow ventilation. This resulted in just over 305 hours of unnecessary laminar flow use. Whilst in orthopaedic theatres around 20% of cases did not require laminar flow amounting to a total of 206 hours of wasted laminar flow use. The average laminar flow energy consumption is 6.2kWh. Consequently around 3168.2 kWHhare wasted per month. It is important to recognise that this figure represents an underestimation as we have only accounted for operation time. We have not included any of the down time between cases when the laminar flow remains at full power.

Patient outcomes:
Evidence suggests that laminar flow is potentially harmful in non-orthopaedic operations[2]. This may be related to a variety of factors such as dehydrating soft tissues and improper use leading to incorrect airflow. As the emergency theatre is almost exclusively used for non-orthopaedic operations, we anticipate improved patient outcomes in SSI and wound complications. However, we have not formally assessed this in this project.

Environmental sustainability:
Our carbon footprint calculations suggest that between 0.6-1.2 Tonnes of CO2e are wasted by our current laminar flow use in emergency and orthopaedic theatres per month. Annually we project that this accounts for between **8 -14.7 Tonnes CO2e per year** (average saving of 11,350 kgCO2e), equivalent to driving 23,041 – 42,339 miles driven in an average car.

Economic sustainability:
Our economic analysis suggests that between £538.9 and £855.41 can be saved each month by improving laminar flow efficiency in theatres. This projects to annual savings of £6,463.13 to £10,264.97 (average saving of £8,364.05.

Social sustainability:
As the laminar flow involves four powerful fans it understandably creates quite a lot of noise. Using our decibel meter this equates to 60 decibels. By switching the laminar flow off this will create a better theatre environment allowing for easier communication between staff. This has benefits in improved concentration, staff wellbeing, and training.

Discussion:

Laminar flow ventilation is commonplace in many modern theatres in the UK. By using power meters in theatre, ours estimates locally suggest it accounts for around 42% of the total energy output of the operating theatres (Total standby energy consumption of theatres is 14.7kWh). It is therefore critically important to have an efficient control of these specialised ventilation systems in theatre. This project has highlighted that the awareness of how much energy the laminar flow uses, and its clinical indications is poor. This has led to excessive use. This was especially evidenced by the use in the emergency theatres at our trust. The COVID pandemic has likely exacerbated this as one of the benefits of the laminar flow system is that it produces 450-500 air changes per hour thereby cleaning contaminated air much faster. This has led to an increase in its use. It is important for other trusts to consider if increased laminar flow use is still necessary now the peak of the COVID pandemic has ended.

Most modern laminar flow systems offer a simple method of controlling the power of the laminar flow systems. Laminar flow has a patient safety, environmental and cost impact. By introducing its use into the theatre list briefing it allows its use to be discussed and rationalised to reduce excessive use. Other considerations are to use automatic controls e.g., the laminar flow system being paired to theatre lights or motion sensors. This would provide potentially the most efficient system but does require the greatest cost to implement. Additionally, this may not be possible in older theatre ventilation systems.

Conclusions:

Laminar flow ventilation is often misunderstood and underappreciated factor in the energy consumption of theatres. Raising awareness to its use can help surgical teams make more informed decisions on if it is required for a case. Using theatre briefings or checklists offers a simple solution however, using automatic controls should also be considered as a longer-term solution particularly in newer theatres. Ventilation and theatre environment plays a role in surgical site infections. As a result, it is important that the complete clinical governance is done should this be introduced at your trust. Starting this early will help identify any stumbling blocks that may occur. This is particularly the case in older theatres where the systems may not work efficiently enough to allow changes to theatre ventilation schedules.

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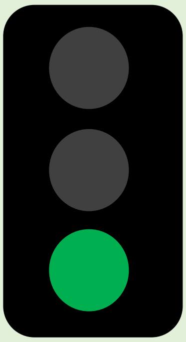
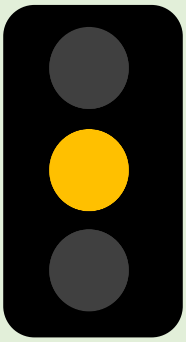
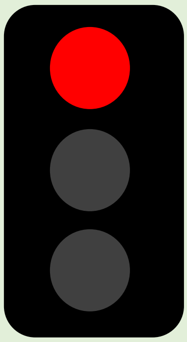
Appendix 1: Indications for Laminar Flow Ventilation in Orthopaedic Theatres

Table 1: Indications for Laminar Flow Ventilation in Orthopaedic Theatres

 **All "Green Light" cases require laminar flow ventilation**	 **All "Amber Light" cases may require laminar flow ventilation depending on surgeon preference**	 **All "Red Light" cases do <u>NOT</u> require laminar flow ventilation**
1. All joint replacement surgery **2.** All major implant surgery including *i.* Hip fracture fixation *ii.* Fracture fixation of all long bones (femur, tibia, humerus, radius & ulna shafts) *iii.* Spine fracture fixation *iv.* Open fractures *v.* Anticipated operating time >115 minutes[4] **3.** All open spinal surgery	**1.** ORIF of closed hand & wrist fracture fixation **2.** ORIF of closed foot & ankle fracture fixation **3.** Arthroscopic procedures requiring an implant e.g., suture anchor **4.** Open soft tissue washout involving joint **5.** Repair of tendon or ligament using implant/graft **6.** Patients with risk factors for SSI including: *i.* BMI >35 *ii.* Significant comorbidities *iii.* Diabetes *iv.* Smoking *v.* Elderly	**1.** All closed operations e.g., manipulations of joints **2.** Arthroscopic procedures NOT requiring implant **3.** Open operations NOT requiring an implant e.g., wound washout **4.** All musculoskeletal injections **5.** Removal of metal

4. **REDUCING DISPOSABLE BAG USE WITHIN THE PHARMACY DEPARTMENT AT GLOUCESTERSHIRE HOSPITALS NHS FOUNDATION TRUST**, PHARMACY TEAM

TEAM MEMBERS:
- Millie Harris – Clinical Pharmacist
- Jason Bell – Mental health Lead Pharmacist

Background:

At Gloucestershire Hospitals NHS Foundation Trust (GHNHSFT) pharmacy, we place all our medication supplies to wards, clinics, outpatients, and external sites in individual patient bags, which are then placed in another plastic bag for transport to the destination. We use a range of LDPE and craft paper bags for different supplies depending on who the supply is for and where it is sent. We use thousands of bags per year, creating a carbon footprint of 5,531.56 kgCO2e, which is equivalent to driving approximately 16,000 miles. We feel this bag use is unnecessary and can be eliminated entirely for inpatient wards, and supply reduced to outpatients by offering a bag instead of providing one by default. Transport bags are essential to deliver medications safely and securely to the ward however disposable bags can be replaced with reusable bags.

Specific Aims:

Phase one:

- To reduce the number of bags used for inpatient supplies by >80%.
- To reduce the number of paper bags used for outpatient supplies by >30%, for patients waiting for their prescriptions.

Phase two:

- To replace 70% of our disposable transport bags with reusable bags.

Methods:

Studying the system
The process of dispensing and sending medications to the wards and supplying to outpatients was process mapped (Appendix 1). Where the step included the introduction of a bag, this was identified as a potential change.

Alternative options were considered such as removing the bag entirely, using an elastic band to keep medicines for the patient together and removing bags for single items only. Communication and research took place to investigate how other hospital pharmacies transport medications to the ward and if we could adopt this good practice. It was found that sending medication boxes loose was common practice at 5 out of 7 (71%) Trusts within the region. It was decided to remove the bags from the process entirely for phase one of the project.

One project lead undertook small scale data collection by offering outpatients a bag instead of automatically providing one for their prescription. It was estimated that two thirds of patients decided they did not need a bag, forming the basis of our aim to reduce paper bag supplies to outpatients by over 30%. This only applies to outpatients waiting for their prescriptions in the pharmacy as bags are necessary for the safe storage of prescriptions awaiting collection.

Engaging key stakeholders

Project leads engaged pharmacy staff at two departmental meetings, using the statistic that our carbon footprint associated with bag use is equivalent to driving 16,000 miles to create a sense of shock. Dispensary leads on both sites were also engaged on an individual level. Buy-in from the Director of Pharmacy was obtained, a key stakeholder in the project.

The Divisional Director of nursing was engaged by the Director of Pharmacy and one project lead spoke at a ward manager meeting to gain support on behalf of the nursing staff. Posters were sent up to the wards informing staff of the change, and communication sent out via the trust global email.

Phase 1:
As of November 1st, 2022, dispensary staff were encouraged to stop providing bags for inpatient supplies and to offer outpatients waiting for prescriptions a bag rather than providing one by default.

Phase 2 – planned changes:
We plan to remove disposable transport bags and replacing with re-usable bags. This is outside of the scope of this project however the team are looking to order these re-usable bags and implement this change in the near future.

Measurement:

Patient outcomes:
Our change did not affect supply of medication and we do not anticipate any negative impact on quality of care. We will measure any potential unintended impacts through feedback from ward and pharmacy staff and the Trust Datix reporting system.

Environmental sustainability:
An estimate of bag use for medication supply per year within the pharmacy department was calculated using the pharmacy ordering system, EMIS, the pharmacy prescription tracking system WebTracker, and through visual spot checks.

We used a bottom up (process based) carbon footprinting methodology to calculate savings in bag reduction. This involved contacting suppliers for the range of bags we use to establish the materials used to create the bags, their country of manufacture to consider transportation emissions, as well as weighing each item to calculate waste disposal. Similar data was also collected for re-usable transport bags for sending medications from pharmacy to the ward, which will be ordered and implemented in the near future.

A reduction in quantity of single use plastic bags will be estimated by spot checking the pigeon holes in the dispensary and in the long-term using the EMIS ordering system.

There will also be a reduction in the production of sticky bag labels however this was not included in the carbon footprint reduction calculations due to difficulty in measuring this.

Economic sustainability:
Cost of each type of bag and how many are ordered/used by the department was obtained through our procurement team

Savings will be measured via our EMIS ordering system which will show a reduction in procurement and cost of both inpatient and outpatient bags.

Economic sustainability:
Cost of each type of bag and how many are ordered/used by the department was obtained through our procurement team.

Savings will be measured via our EMIS ordering system which will show a reduction in procurement and cost of both inpatient and outpatient bags.

Social sustainability:
Qualitative feedback from staff has been gained via departmental meetings.

Results:

Patient outcomes:
There have been no incidents of missed doses of medications affecting the patient care reported during out trial period. We will continue to monitor for any unintended negative consequences of our change long term.

Environmental sustainability:

Phase one
Based on an outpatient bag reduction by 30% across both sites, 134.5kgCO2e per year will be saved, equivalent to 387 miles driven in a car.

Based on an inpatient bag reduction by 80% across both sites, this results in a saving of 812.3 kgCO2e per year, or 2340 miles driven in a car per year.

Current estimated reduction **= 957 kgCO2e per year** (2,754 miles driven in a car).

There is an estimated saving of 50,000 plastic bags and 60,000 paper bags per year across both sites.

Phase two
The replacement of disposable to re-useable transport bags will result in a saving of approximately 18,500 disposable bags per year. There is an anticipated saving of **1,751.34 kgCO2e per year**, or 5,560 miles driven in a car per year. This takes into account the carbon footprint created by purchasing 80 re-usable transport bags at a cost of £44 each, across both sites, which can be used over 2000 times as per manufacturers guidance.

Total projected estimated reduction = **2,708 kgCO2e per year** (7,800 miles driven in a car).

Economic sustainability:
Phase one: Based on a reduction of 50,000 plastic bags and 60,000 paper bags per year across both sites we estimate a saving of £2,500 per year.

Phase two: Based on a replacement of 18,500 transport bags per year with 80 re-usable transport bags, we estimate a saving of £5,000 per year.

Our total projected estimated saving is therefore £7,500 per year.

Social sustainability:
There was some concern that the project could potentially increase the workload for nursing staff who will have to sort medications for patient's lockers, however there have been no reports from nursing staff that this has been the case, or that sorting loose medications into patient's lockers has hindered their work. Feedback obtained from nurses include "it doesn't matter if it's in a bag, as long as the medication gets here" and "there's no need to put everything in a bag as the medication has the patient's name on".

A change in the way of working for dispensary staff. Initially, feedback was very negative regarding increased workload and worry that items would go missing. However, there is now a more positive attitude towards the process as staff have got more familiar with it and the benefits of reducing bag use is better understood.

Discussion:

Phase one of the project was successful in reducing bag use within pharmacy. It is difficult to accurately report the exact percentage in bag reduction due to the vast workload that goes through the dispensaries on each site however the figures reported are an estimation of what the team have seen so far.

Within the next year, the EMIS ordering data can be compared to the prior year to assess the impact of the intervention. It is difficult to change a long-standing process within a system therefore it is accepted that not every member of dispensary staff will adopt this change in the early stages of the project.

There were a number of barriers faced which included resistance from dispensary staff who believed medication items would get lost and would introduce a higher workload for the team. However, Datix reports did not suggest an increase in the number of lost medication items so far. An incident was reported by a member of the pharmacy team that some medication items had been placed in the ward stock cupboards instead of the patient locker. It was accepted that this is likely due to unfamiliarity with the new process, so in response a reminder was sent out in the Trust global communication email. Dispensary staff were encouraged to be practical when considering bag use and it was agreed it is acceptable to use a bag where a large quantity of supplies is made for a single patient.

The project team encourage pharmacy staff to communicate new ideas to improve the process if it is felt necessary.

Conclusions:

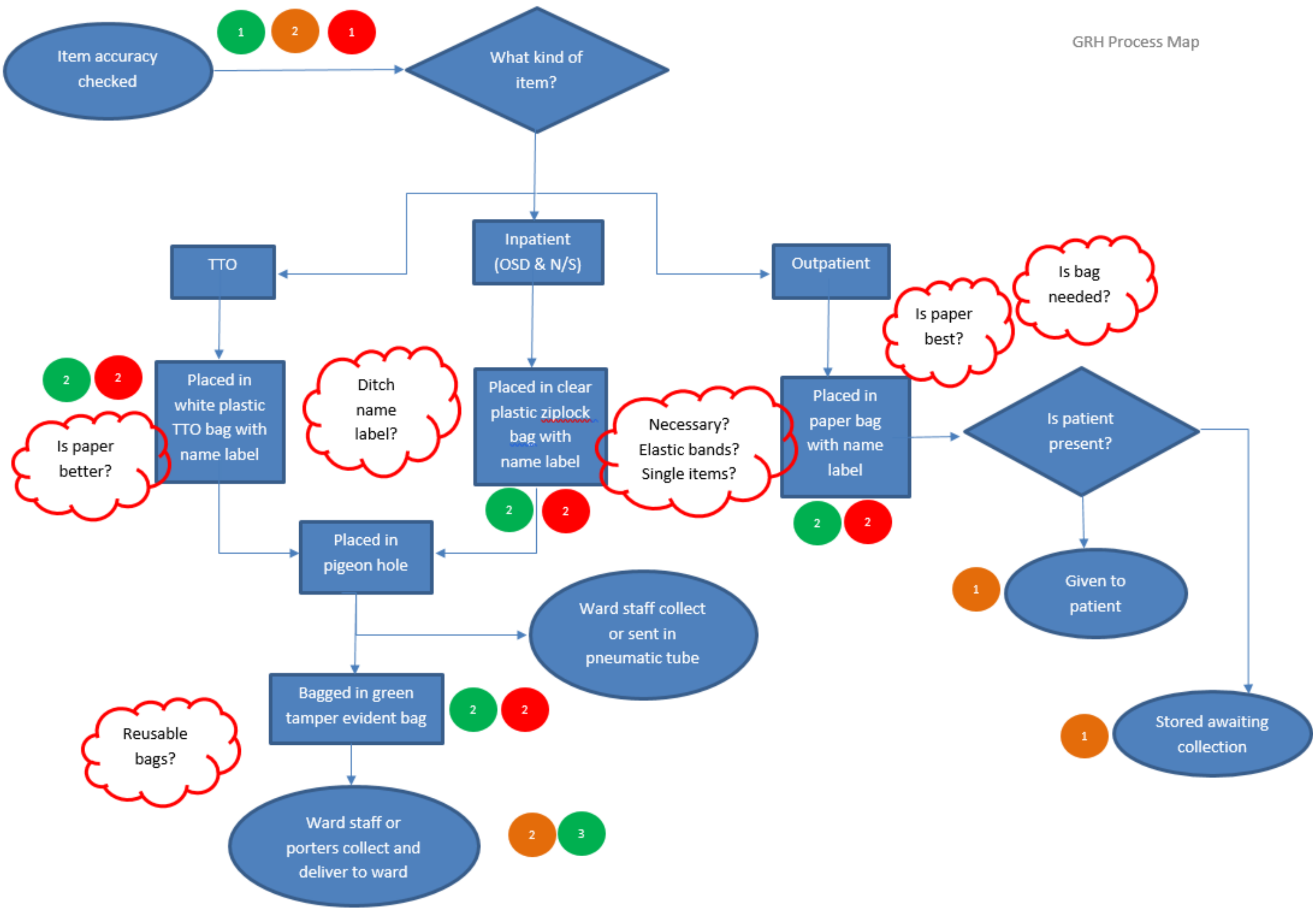
Overall, phase one of project so far has been successful. There has been a reduction in bag use and even greater reductions are yet to come during phase two with the implementation of re-usable transport bags. Whilst there have been potential issues raised by both pharmacy and ward staff regarding the new process, it is accepted that there is likely to be issues when a new process is introduced, and it takes time for staff to adapt to this. We are confident that these issues will resolve in the long term with familiarity with the process as many other trusts have already adopted this green practice and we will continue to review improvement ideas in the future.

References

Information of bag materials and place of manufacturer obtained from:

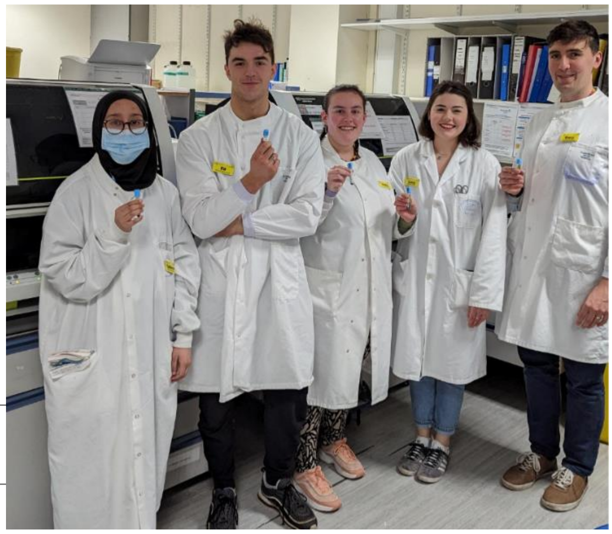
- Midco Print & Packaging Ltd – Customer service team
- Valley Northern - sales representative
- Versapak – sales representative

Appendix 1: Process map of plastic and paper bag usage in pharmacy department



Environmental resources		Social resources		Financial resources	
Medications	1	Patient/carer satisfaction	1	Medications	1
Energy use	2	Staff time	2	Cost of packaging	2
Waste disposal	3	Staff satisfaction	3	Nursing staff time	3

5. **REDUCING THE CONSUMPTION OF UNNECESSARY BLOOD SAMPLES AND IDLE EQUIPMENT**, HAEMATOLOGY LAB TEAM



TEAM MEMBERS:

- Gary Parfitt (Associate Practitioner)
- Lucy Campbell (Biomedical Scientist)
- Edward Birt (Medical Lab Assistant)
- Holly Morgan (Medical Lab Assistant)
- Tahlima Hussain (Medical Lab Assistant)

Background:

Sustainability in a laboratory setting

We are a 24-hour service providing pathology support to the hospital and GPs throughout the county which includes haematology, immunology and blood transfusion testing as well as issue of blood and blood products to patients across a wide range of specialties as well as in emergencies such as in ED, theatres and maternity. With regard to sample throughput, the haematology laboratory processes approx. 3000 samples a day for up to 6000 blood tests.

Laboratory sustainability is a difficult challenge. Before this project the haematology department was already making many green improvements. For example, we moved to sharing samples between chemistry and haematology to save blood bottles. However, due to the nature of our work as a containment level 2 lab, strict quality control and infection control procedures are required. This means we are running tests with many single use plastic items that must be disposed of to prevent cross-contamination. There is no scalable alternative to single use plastics for items such as gloves, transport bags, pipettes, aliquot tubes, blood tubes and paper blood forms. We also consume a large quantity of reagents as part of our testing. This is essential to provide assurance that our testing is controlled and accurate.

Coagulation sample waste

Each test we run needs the blood sample to be in a specific type of bottle. For coagulation tests, the bottle contains a chemical called sodium citrate, which stops the blood clotting. In our lab, our machine removes the sodium citrate and we initiate a reaction to measure how long it takes for blood to clot allowing us to identify clotting disorders indicating a variety of health disorders.

Sometimes clinicians will collect and send a sodium citrate bottle to the lab without requesting any tests. This is called a spare citrate, which we store for 24 hours, in case clinicians want to add a test on at a later time. Taking a spare sample at the same time as the other tests may a) prevent rebleeding of patient, which reduces patient discomfort, b) improve patient safety, c) save time because the clinician can phone or email the lab to add on the test, as opposed to waiting for new samples to be sent and d) save turnaround time for a test.

Sodium citrate samples when received by the lab undergo a centrifugation process before being stored in a fridge. Tests must be performed within 24 hours of blood collection. If no further request is received, spare samples are placed in a Biobin and disposed of unused in clinical waste**.**

As a team we suspected that coagulation screens can be requested inappropriately, and that spare citrates were sent often without being used. Low value or unnecessary tests increase lab processing time and pressures on lab staff to meet turnaround deadlines, which may in turn impact waiting time for patient results. They also use blood bottles reagents, clinical equipment and disposal bins, all of which is incinerated, unnecessarily.

Energy Usage

Consumption of energy in the lab is substantial. We operate many machines that run a wide range of automated blood tests for our service users. We have many PCs that our team use to track testing and analyse results. We must be able to provide rapid and accurate test results to GPs, wards and emergency departments 24 hours a day, 365 days a year. To achieve this there are pieces of equipment that must remain switched on and active constantly. However, we believe that there is some equipment which is kept on primarily for ease of use, which may be able to get switched off or put on standby to improve sustainability and efficiency in the lab – especially out of hours (overnight and at weekends) as we run a reduced service during these hours. Moreover, this could be especially beneficial in a laboratory setting as some of our equipment has high energy consumption. If we can identify which equipment can be switched off when it is out of use, we can introduce an energy cost saving for the trust.

Specific Aims:

1) Reduce low clinical value samples sent to the haematology lab from the emergency department (ED) by targeting;
    a. Unused 'spare' citrate samples
    b. Inappropriate and 'just in case' sodium citrate samples
    c. Avoidable (low clinical value) samples
2) Reduce energy usage of electrical equipment in haematology, immunology and blood transfusion at GRH and CGH.

Methods:

Project 1: Reducing low value samples sent to the haematology lab from ED.

We focused on emergency department (ED) requests on both sites due as ED as we have a steady flow of coagulation requests, and it is also is our main source of 'spare' citrates. We spoke to our ED colleagues to better understand their decision-making processes for these tests. The TrakCare Lite Environment (TCLE) system was used to show all lab episodes that had any of the most common coagulation tests on them (coagulation spare sample, coagulation screen, INR, D-Dimer, APTTH, Lupus screen, Thrombophilia screen). We were supported by the head of coagulopathies in haematology, Ceinwen Davies, in analysing our data and by head of IT in haematology, David Miles, who collected and organised the data from TrakCare Lite Environment for us to analyse. This allowed us to identify all coagulation screens and spare citrate samples.

Inappropriate and low clinical value tests

We focused on coagulation screens as there are a set number of clinical details and symptoms for accepting the test. Samples are received into the department and assessed by a biomedical scientist to see if they meet the criteria. We learned the indications guide was put together with joint input from ED and haematology consultants, and senior management, and is used by ED as well as our lab, with the aim to minimise wasted samples[1]. We have investigated whether this is working.

We looked at all coagulation screens from September 2022 and patient records to obtain data on coagulation screen referrals and reasons given by clinicians for each request. We identified which samples continued to be processed despite being avoidable (low/no clinical value). Certain requests are routinely accepted by the lab but provide low clinical value to the requesting clinician. These were also grouped to try and identify a common request which could be targeted to reduce referrals. We identified several issues including.

- Referrals with vague clinical details/indications (e.g. 'trauma'; potential to bleed, and abnormal bleeding is a reason to request a coagulation screen)
- Inadequate samples (e.g. sample overfilled or underfilled – then wasted)
- Avoidable tests (no clinical indications and/or low clinical value such as pre-op testing)

- Tests are approved for more than the list of reasons that they should be requested for

While vague clinical referrals and inadequate samples may take additional time to process due to the need to confirm the clinical rationale with the requester or receive a new sample, we eliminated these from our further review as we assumed the test would still need to be completed. We therefore focussed on identifying avoidable requests as these samples were being processed for low/no clinical value.

There may be a variation from the appropriate guidelines due to high staff turnover, new trainee doctors rotating in to ED, and high agency staff numbers. In addition to this, 'just in case' coagulation screens may be opted for because of the incredibly high pressure on our ED departments. The lab may be approving inappropriate requests in order to support ED while they remain so busy. On the other hand, if we could reduce the number of tests requested, then there is potential for ED patients to spend less time waiting on blood tests they don't need before reaching a treatment decision.

Spare citrate samples

We completed a process map from when spare sodium citrate samples are taken from ED to when they are disposed of in the lab (Appendix 1). We audited spare samples received across three months (August-October 2022). Episodes where the spare sample was a separate bottle to the one with any other coag tests were excluded and instead these separate spares were included in the unused spare samples data.

Potential change ideas:

We identified the following changes for consideration to reduce low clinical value samples sent to the haematology lab

- Haematology lab staff training for authorising and approving requests:
  - We found inconsistency among the team as some have lower thresholds to run tests than others
  - Encourage team to reject inappropriate coagulation screens
- Reduce clinician requesting test in first place via ED staff training:
  - Guidance on sunrise clinical manager may be an option for when a clinician requests a coagulation screen, enabling us to target the high turnover of staff in ED, where one off teaching sessions may prove ineffective.
- Changes to protocols/ paperwork used in ED
  - Reduce the number of wasted coagulation samples that never reach the lab by spreading education around wasted first draws, except for winged collection sets[3]
- Reduce the number of underfilled samples through similar raising of awareness[4]
- Reduce the number of spare citrates being taken via a staff awareness campaign, "Spare a thought for spares". Or a prompt pop-up message when a clinician requests a spare citrate on sunrise clinical manager e.g. "Only 14% of spare citrates are ever used. Please consider whether you need one"

We are liaising with ED to explore these change options and reduce low value / unnecessary samples. We are working with the Sunrise EPR team to look at introducing a guidance message when a spare citrate is requested.

Project 2: Reduce energy usage in (Haematology, Immunology and Boof Transfusion) labs

We identified that the vast majority of the lab equipment stays on for 24 hours a day, 7 days a week. While we are a 24-hour service, in the evenings and overnight there are significantly less staff and less equipment required. We developed a list of all equipment used in the lab and identified when the equipment is used, and what equipment could be safely switched off at certain periods of the day.

Measurement:

Patient outcomes:

Project 1: While we have not directly measured patient outcomes, we have considered potential benefits and drawbacks to a change in the decision-making process for spare citrates and coagulation screens.

Project 2: In considering which equipment we could safely turn off our chief concern was patient safety. If any equipment may be needed for emergency blood testing or could not be reliably turned off and back on again then we have decided to keep it switched on.

Environmental sustainability:

Project 1:

Calculating the wasted reagent and consumables used as part of unnecessary coagulation tests was outside the scope of this project. There are several reagents and quality control solutions, and some plastic consumables involved in a coagulation screen. Looking forward we hope to analyse this waste to determine more accurately the emissions factors for a coagulation screen.

To calculate potential carbon savings from a reduction in spare sodium citrate samples we collected data on the components of the blood tube used and applied emissions factors to each component. We calculated emissions from using a centrifuge, which spins samples at high speed to separate the blood components for testing. We weighed the waste and applied an emissions factor for waste. We calculated emissions factors for transport of citrate bottles and disposal bio-bins from the point of manufacture to the hospital. Equipment needed to take blood from the patient was excluded as this would be used anyway for other samples.

Project 2:

We assessed which machinery and electronics could be safely turned off and for how long each day in each department and liaised with our Trust energy manager to obtain accurate measurement of machine energy usage (in kwh). Our Trust has a renewable energy tariff, however energy is received from the Grid and therefore for carbon calculation purposes the Government Emission factor for energy (0.26155 per kWh) was used.

Economic sustainability:

Project 1: We collected data on cost of consumables used in collecting a spare citrate sample which included sodium citrate blood tubes (£0.0605 each), biobin and waste disposal (incineration) from the Trust procurement and waste team.

Sample processing time / running the test has no direct lab cost as the service contract for our coagulation machines includes all reagents and machine maintenance, and the number of coagulation screens doesn’t affect our staffing requirement.

Project 2: We obtained energy costings for the trust via the Trust energy manager (£0.17-£0.27) and used the average cost for our calculation.

Social sustainability:

We have not measured social sustainability however have detailed potential impacts in results section below. We spoke to our team and we are aware that sustainable changes mustn’t harm our patients. Our lab manager Alison said “Our Department is keen to be green and has felt first-hand the effects of supply problems but a lot of our consumables are difficult to reduce or change to degradable products without affecting the quality of our results.”

Results:

Patient outcomes:

Project 1:

Inappropriate coagulations tests can make clinical management more difficult, as if they are abnormal, the medical team will be required to act, though this is unlikely to impact on clinical care or wellness of the patient. If coagulation screens are requested for inappropriate clinical reasons, a rejected sample will delay the patient’s treatment, as the clinician queries this with the lab. A clinician can make faster decisions if they are waiting on fewer tests results to come back. If a clinician does require a coagulation screen and has an appropriate reason that they haven't stated, it will help the patient's outcome if they list this detail correctly. The lab will be able to process samples more confidently, and better analyse the results for that patient.

From a patient safety perspective, taking additional samples may be removing blood cells and fluids unnecessarily[2] and therefore detrimental to their health. This is especially true for anaemic patients. However, we also want to avoid rebleeding patients which may be a risk of reducing spare citrate samples at the time of an original test.

Project 2: A lot of machinery in our labs provides 24hr service to the hospital and mustn't be turned off. Clinicians require fast results to enable timely decision making, as illustrated by departmental turnaround targets for each test. These are monitored monthly at trust level. Primary machinery involved in our 24-hour service we have determined needs to be kept on.

Environmental and Economic sustainability:

Project 1:

We retrospectively analysed every coagulation screen request from ED GRH and CGH in September 2022. The results were split in two and analysed by two members of the team. Using clinical details and patient history in the same way that a BMS would during initial screening, we recorded whether tests should have been approved or rejected and compared this to how many were approved and rejected in reality. Tests of 'low clinical value' were listed as appropriate. We found that 21.45% of tests that were approved despite being clinically inappropriate. Defining which tests should not have been requested has become beyond the scope of this project.

Coagulation tests September 2022	CS screens group 1	CS screens group 2	Average
total	227	237	232
-rejected	10	8	9
-sample issue e.g. underfilled	31	28	29.5
-approved	186	201	193.5
appropriate	142	162	152
inappropriate	44	39	41.5
% inappropriate	23.66%	19.40%	21.45%
inappropriate tests kg CO2e	2.394	2.122	2.258

Reducing impropriate tests by 75% (31.12 tests per month) would be a CO2e saving of 1.68 kgCO2e, or **20.3 kgCO2e per year**. This is an underestimation as this does not take into account the CO2e associated with the processing of the test. Reducing the number of inappropriate coagulation screens by 75% could save an additional **£29.66 per year.**

Spare citrates: from August to October 2022, the average number of spare citrate samples received in the lab was 1,473.33. On average, 213.33 of these were used for a test, and 1,260 went unused each month. This equates to approximately 14.5% of these samples received ever being used (st dev 0.00264). The remaining 85.4% of samples were disposed of into bio-bins and incinerated without ever being used.

	Spare Citrates	Used Spares	unused spares	% used	Co2e (unused spares)
August	1348	192	1156	14.24%	62.9 kg CO2e
September	1425	205	1220	14.39%	66.4 kg CO2e
October	1647	243	1404	14.75%	76.4 kg CO2e

Average	1473.33	213.33	1,260.00	14.46%	68.5 kg CO2e

Projected across a year, reducing spare citrates sent to pathology by 80% would save **658 kgCO2e**, equivalent to driving 1,895 miles in an average car.

Each sodium citrate bottle costs £0.0605. Each bio-bin costs £4.79. If we could reduce the number of unused spare citrates by 80%, we could reduce discarded samples by 1,008 bottles per month – 12,096 bottles per year! This would reduce the bio-bins needed by 17.7. The cost saving of bottles and bio-bins would be **£816.64 per year**.

Project 2:

The table below summarises our energy usage for all equipment used across both sites for routine haematology, blood transfusion and immunology testing. Our potential savings have been calculated by identifying how many hours equipment could be turned off for. We have assumed that an 80% reduction in this time would be realistic as equipment being turned off consistently is dependant on a number of staff. With an 80% reduction, we will **save £52,924.30 and 62,919.8 kgCO2e per year**. This is equivalent to driving 181,220.6 miles in an average car.

Per day					
Area	Total Consumption (kWh)	Total emissions (kgCO2e)	Potential Saving (kWh)	Potential Saving (kgCO2e)	Potential Saving (£)
CGH					
Routine Haematology	1006.017909	263.1239842	199.7616	52.24764648	43.947552
Blood Transfusion	691.5264	180.8687299	122.1648	31.95220344	26.876256
GRH					
Routine Haematology	1288.608	337.0354224	138.9792	36.35000976	30.575424
Immunology	481.537536	125.9461425	264.988	69.3076114	58.29736
Blood Transfusion	542.8608	141.9852422	97.96	25.621438	21.5512
Total	4,010.55	1,048.96	823.85	215.48	181.25
Per Year					
Totals	1,463,850.99	382,870.23	300,706.56	78,649.80	66,155.44
Savings (80% applicability)				**62,919.8 kgCO2e**	**£52,924.30**

Social sustainability:

Spare citrates potential benefits:

- The lab have a turnaround time of 1 hour for which we are currently not consistently meeting this target. Lab staff will gain time from reduced vetting and processing of low value samples. This may increase turnaround time of other tests. ED will receive results of other tests more quickly.

Potential disbenefits:

- Rebleeding a patient may be required because a spare citrate wasn't taken at the time of bleeding for other tests. This should be avoided as it may cause discomfort to the patient and will delay results. Based on only 15% of spare samples being used for tests, we assume this would be an infrequent issue.

Discussion:

As we progressed with this project we found that it became more complicated than initially thought, especially with regard to inappropriate coagulation screen requests. It is difficult to categorise the reasons given for the requests, and the requestor may be asking for a coagulation screen for an appropriate reason that hasn't been provided with the request itself. Further analysis is required in collaboration with ED, perhaps in the form of audits to identify how often clinical details are left off of requests, and to expand this over several months. We suspect that in reality there is a significantly higher proportion of coagulation screens being run that are inappropriate, but to confirm this we will need further investigation.

It was more straightforward to investigate how often spare citrate tests are unused, and this would be an excellent target for reducing sample numbers sent to the lab. Each spare citrate sample must be spun, to prepare it for testing, and must be checked by a biomedical scientist. If we could free up these lab resources, we could free up time to better assess coagulation screens before running them. On the clinical side, if the sample isn't required, time and resources will be saved bleeding the patient.

The energy reduction project identified immunology as a department to target for machine switch off, as the immunology service is run only during normal working hours. There are several large analysers in immunology which are unused during the evening and night. Fridges and freezers must be kept on for sample and reagent storage, however machinery like water baths could potentially be turned off while not in use. However, this will need an assessment of how quickly each water bath can return to temperature and how stable they are after this.

Some machinery which goes into limited use during out of hours is kept on because of issues with connectivity to the lab requesting system, TCLE, and various blood test analysis software. We may be able to safely power down some equipment during out of hours if we can ensure that the connection will remain reliable when powered back up.

Limitations:

Changes to practice that affect ED must be made very carefully because ED is under such enormous pressure. When weighing sustainability against department performance, the challenges the ED department face, such as high patient numbers, lack of beds, high numbers of patients requiring admission, get first priority. It has been hard to contact staff through the short project period as they are so busy. As we progressed and better understood the issues around coagulation screen requesting, the project expanded beyond our scope. A second stage of the project would be useful to investigate more thoroughly.

Due to the increased complexity of the project, we were unable to implement any of our desired changes within the timeframe of the project. High demand on staff time during working hours within our lab also slowed our progress.

In our energy project, we used estimated power usage figures to determine current consumption. We considered using energy monitor plugs, but decided there were too many pieces of machinery, and these could not be unplugged safely.

Interpretations:

Deciding whether to request a coagulation screen is far more complex than was initially thought when we started this project. There are defined guidelines for when a coagulation screen should be requested, however for departments like ED where there is such a high demand on the workforce due to patient numbers, it may improve patient safety to pre-emptively request tests like coagulation screens where there is ongoing bleeding, even though there is no clinical suspicion of a bleeding disorder, because the delay to patient treatment when deciding later that a coagulation screen is required negatively affects the performance of the whole department and so the treatment of other patients. The same may be true of spare citrate samples. At the time of initial venepuncture, a spare citrate can be taken to save time, reduce risk to the patient and improve department workflow, even when it is likely the sample will go unused. It is likely that this is current practice, as so many unused samples currently reach the lab from ED.

Future aims

As a team we examined possibilities of reducing energy usage of electrical equipment, and reducing low clinical value samples, in order to be a more sustainable laboratory. However, there is still much room for improvement and far more areas of the laboratory to target to move towards sustainability, but which were beyond the scope of this project. For the clotting screens requests, we could look at revising and updating the requesting criteria for clotting screens. This is due to relaxed test acceptance towards low clinical value reasons for coagulation screen testing. It is important we differentiate what is considered an appropriate or inappropriate request for CS testing; as well as improving sustainability, we want to be a high-quality laboratory that is able to work closely and proactively with other hospital departments.

Moreover, another future project could entail researching how many spare citrate tests or coagulation screens are requested on their own (with no other blood bottles on that episode). The proportion of these that are unused or inappropriate would include wasted venepuncture equipment and supplies in their CO2e calculations.

Similar to the clotting screen investigation, we could set up similar studies into inappropriate haematinics requests from GP surgeries, or unused group and save samples in blood transfusion. These are just two tests we have identified as tests with high waste, and further analysis could be done to select other tests worth exploring. These projects will enable us to save costs, reduce waste and be a greener lab. If our project is successful, then other departments could reproduce the projects with tests they identify.

The next steps for this project are to implement support for ED in deciding whether to request a coagulation screen, and to improve laboratory procedure around accepting or rejecting coagulation screens. However, any changes must be made with patient safety as the number one priority, so further discussion is needed with ED and haematology leaders.

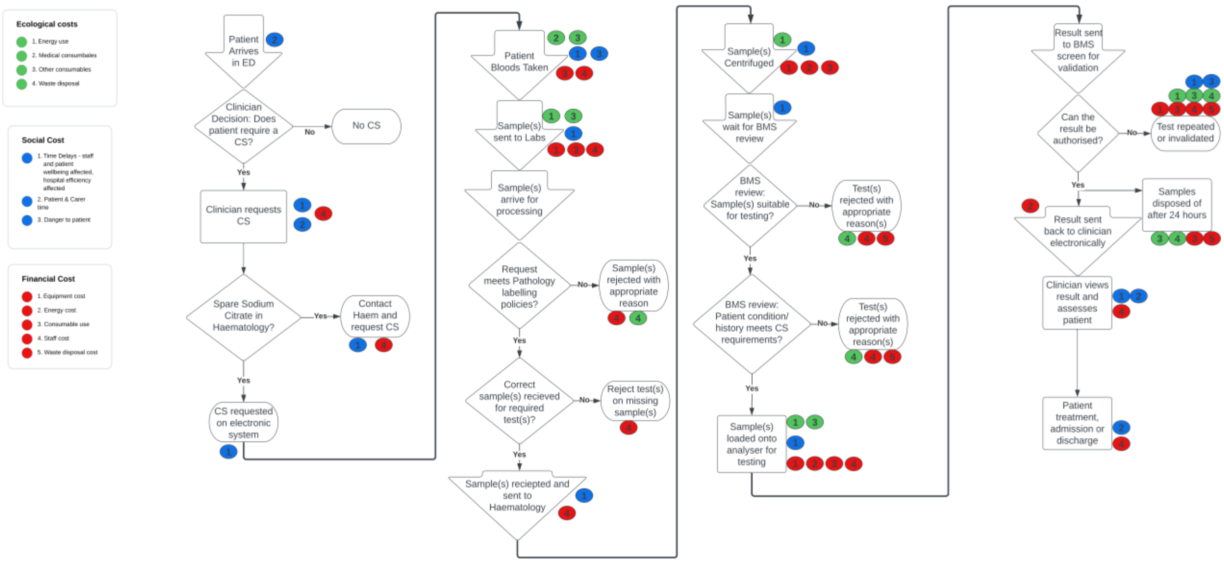
Conclusions:

There is a good opportunity to improve the sustainability of the haematology laboratory, although the implementation, and measurement of this, has not formed part of this project. Our current blood booking system was ideal for data extraction, however was limited by the information input by requesting clinicians. Staff engagement should be a goal of improving the hospitals utilisation of coagulation screens. With test requesting and equipment use, patient care must be the priority in any changes considered to current practice. Colleagues have been encouraged to switch off tertiary equipment e.g. PCs and monitors when out of use, but for primary testing equipment, further investigation is required before any changes can be made safely. Overall, the project provided a clear proof of concept for the changes we want to make in our lab, and provides a good template for future projects in our department and hopefully others in pathology.

References:

1. guide to indications for coagulation screens: https://www.gloshospitals.nhs.uk/our-services/services-we-offer/pathology/haematology/coagulation/
2. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0243782
3. https://www.labcorp.com/resource/blood-specimens-coagulation
4. https://files.labcorp.com/labcorp-d8/inline-files/Volume_Guide_For_Coag_Testing.pdf

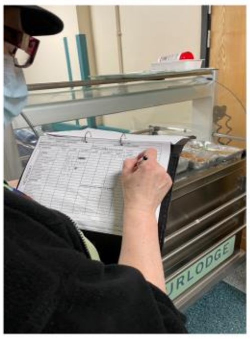
Appendix 1 – Flowchart of coagulation screen requests



6. FOOD WASTE RECYCLING, GLOUCESTERSHIRE MANAGED SERVICES TEAM

TEAM MEMBERS:

- Marc Thom, Porter Coordinator
- Corinne Always, Waste Manager
- Neraaj Arora, Assistant Catering Manager
- Bridget Hooper, Catering Manager



Background:

The UK produced around 9.5 million tonnes of food waste in 2018[1]**.** Food waste has a cascading environmental impact by increasing the amount of food grown or raised, increase in transport emissions to deliver food to hospitals, and increase in methane and carbon dioxide from disposing of uneaten food on landfill.

Unserved food and plate waste (the remaining uneaten food served to patients), is considered food waste in our hospitals, Gloucestershire Royal Hospital and Cheltenham General Hospital. Our team consists of Gloucestershire Managed Services (GMS) employees from three different departments: Catering, Waste Management and CGH Portering Services.

We are all passionate about the idea of food waste recycling having witnessed the vast amount of food reaching our waste compound daily. Our hospital sites previously wasted 20% of patient meals, equating to approximately 600 meals and £1900 a week across 18 wards. The catering department has worked hard to reduce this. In the past 12 months, we have introduced a range of initiatives such as bespoke portion sizes for patients on wards. By addressing knowledge gaps across the organisation and engaging both clinical and non-clinical staff, and making some system changes, our food waste from wards was successfully reduced to 8%, saving thousands of pounds and carbon emissions each year.

However, it is impossible to eliminate food waste entirely. Therefore, our current project has investigated how to minimise the impact of the remaining 8% of food waste. Our combined knowledge and experience in managing food waste across departments, from the kitchen, to serving on the wards, to disposal at the waste compound, make us a suitable team to target this problem. Food waste recycling, if done so responsibly, can convert waste into fertilisers for agriculture, promoting healthy soil. The gasses from decaying food that would release methane can also be collected and converted into natural energy forms. Sadly, food accounts for around 25% of the greenhouse emissions released into the atmosphere.

Specific Aims:

1) To study the current food waste disposal system, and identify what changes are needed in preparation for food waste recycling
2) To measure prospective savings from implementation of food waste recycling

Methods:

As a team we focused on our Cheltenham site. We have held and will continue to hold regular meetings to continue to progress the project.

We decided to focus on patient meals that were left untouched and therefore wasted, as we believed that this stream alone contributes a large proportion of our ongoing food waste. Meals may be untouched following delivery to patients with reduced/no appetite, patients fasting, delays in patients arriving on the ward, or patients discharging before their pre ordered meal arrived.

We reviewed our current processes. Currently, all food waste from food delivered to wards is disposed of from individual wards. This waste is incinerated at a local municipal energy from waste plant (Javelin Park).

We organised a waste food weighing process to gain accurate measurement of the volume of food wasted, broken down by food type. We procured a food weighing scale and provided training to Catering Supervisors and Catering Assistants on how the scale operated and when to weigh the food waste, and how to record the data accurately for each service. We selected Tivoli Ward as a trial site for this process as the ward has recently been renovated and is well organised.

We discussed as a team how our current food waste disposal system would need to change to accommodate recycling. This including several logistical considerations to move food waste from ward level to the waste compound, and space for storage. Our recycling process is as followed

- Food waste would go into biodegradable bags to be weighed
- A food caddy will be placed in each wards designated waste sluice.
- Ward staff will place food waste into the caddys after each mealtime (3 times daily).
- Food caddys will be collected by portering services after each mealtime (3 times daily) and placed in a designated food waste bin in the hospital waste compound. This bin will be supplied by the food waste recycling company. The food waste recycling company will collect food waste 3 times per week, on a Monday, Wednesday, and Friday, bin quantity can be increased at any time, this will accommodate all the food waste that arrives in the compound. The bins should be clean and fresh after collection (most companies replace old for new), and therefore we should never have rodent/wasp issues.
- We have storage space in the compound for all the bins we would use.

Trial implementation
The Trust will be running a pilot scheme for recycling with The Green Block and this will include a trial of food waste recycling. This is scheduled to commence in the new year (2023). Food waste will be taken for anaerobic digestion.

Measurement:

Patient outcomes: Our project will not impact on patient care and clinical outcomes.

Environmental sustainability:
We recorded the weight and type of patient meals that were left untouched for two weeks on Tivoli ward. This measurement includes servings of main meals, sides (vegetables, rice) and dessert.

We used existing data from September-October 2022 to calculate the weight of food wasted from uneaten meals across the remaining 11 wards (Appendix 2). We used this data on units/portions and weight of patient meals wasted to extrapolate potential annual savings across Cheltenham hospital. The data available captures weight and number of main meals wasted but does not include sides and desserts.

A combination of weight and financial cost were used to generate potential carbon (CO2e) savings.
We used emissions factors in waste to energy incineration (0.172/kg) from Rizan et al 2021[2] and Anaerobic Digestion (0.0089/kg) form the UK Government Database[3] to calculate the CO2e saving that would be made from redirecting food waste to recycling.

Economic sustainability:
The cost of foods wasted were obtained from our catering department.
The cost of our current waste disposal was obtained from the Trust waste team.

There is currently no quote available from Green Block. We obtained a range of supplier quotes and took an average of these to look at potential savings from implementing a recycling service.

Social sustainability:
The impact of food waste recycling was qualitatively assessed through conversations with staff and patients.

Results:

Patient outcomes:
There will be no negative impacts on patient care.

Environmental sustainability:
Our Tivoli ward audit found 36.78kg (172 units) were wasted from uneaten meals in two weeks (Appendix 1). Using the lower recorded weekly weight (17.03kg) as an estimate, this gives us a prospective annual total of 817.6kg of food (4,128 units) wasted in Tivoli ward alone.

According to our existing data across 8 weeks (September-October 2022), 244.24kg of uneaten meals were wasted on all the remaining hospital wards, this gives us a prospective annual total of 1587.56kg of food wasted.

From redirecting 2,405.16kg of uneaten meals from energy from waste to anaerobic digestion, we anticipate an annual carbon reduction of 393.23 kgCO2e per year. **This is equivalent to driving 1,132.6 miles in an average car.**

Economic sustainability:
Cost of waste to energy disposal:

- Current cost = £14.91 per 0.15 tonnes
- Current waste = 2.4763 tonnes

Cost of disposal = £246.14 / year

Cost of recycling via anaerobic digestion

- £10.50 per 240 litre bin (0.15 tonne per bin)
- Current cost = £10.50 per 0.15 tonnes
- Current waste = 2.4763 tonnes

Cost of disposal = £173.34 /year

This cost example shows that per tonne, Anaerobic Digestion recycling is cheaper, with an estimated annual saving of **£72.80.**

Social sustainability:
We asked patients and staff members their thoughts on the Trust establishing food waste recycling, with quotes below showing overall feedback is positive;

> *"I think the recycling of the hospital food waste is an excellent idea, it will reduce the hospitals carbon footprint and make everyone involved more aware of what they are throwing away"*
> Maria Paterson, Nurse
>
> *"I am surprised that it is not been done already, normal households have been recycling their food waste for years now, it is beneficial for the environment and it would show the NHS cares". -*
> Patient

"*Good idea, it is what is needed and will make a difference, considering the amount of food waste that the hospital produces, it is great that the staff are so committed in making this change*". - Derek Gess, Medical Engineering

"Everyone should recycle, be it food, cardboard, plastic, or anything recyclable, it is all about sustainability, about our environment, the food waste recycling project is a must, I will make sure I finish eating all my hospital meals from today, I promise". - Patient

Discussion:

Our project has identified approximately 2.4 tonnes of food waste annually from uneaten meals delivered to wards alone. This has not included a large percentage of sides and deserts, plate waste, cold food available on the wards (e.g., sandwiches) or retail waste from the hospital cafeterias. These waste streams were not measured due to the limited time scale for the project. Therefore, our current projected savings of food waste recycling are significantly underestimated.

Removing food waste from other waste streams will enable better recycling as food waste will not contaminate other materials – instead these will be clean and dry to be easier segregated, baled and sent for recycling. This will then help increase our more general recycling rates and reduce the volume of black bag waste which is currently sent to a waste-to-energy plant. NHS Estates[4] project that waste volume needs to halve by 2025 if trusts are to reach net zero by 2040 and therefore recycling of food waste is an essential step to take.

In additional to food waste recycling, we have future plans to continue to reduce food waste int he first place, targeting the cafeterias, by offering cooked meals at a reduced price towards the end of serving times. This will reduce waste while benefitting staff at the same time.

Conclusions:

We are a dedicated and passionate team who are always in the process of thinking of new ideas to reduce food waste under the guidance of our Waste and Catering Management. One larger project currently underway is targeting our patient ordering system. Currently, patients order meals the night before the next day's meals. We have plans for an electronic meal ordering system, with the aim of reducing patient food waste down further to under 5% by allowing patients to order meals on the day (lunch in the morning and dinner in the afternoon). This will further reduce waste as patients are more likely to receive a meal they prefer at the time as well as reduce meals sent in patient's absence for reasons such as discharges, operations and ward moves.

The Trust's Green Plan[5] includes an aim to recycle 100% of our food waste by 2025. So, collecting food waste from ward kitchens in Cheltenham General is just the beginning of a larger project. It will extend to cover patient meal services at Gloucestershire Royal, all the retail outlets on both main sites and include food waste from kitchens and beverage bays used by staff across the whole trust.

References:

1. 2018 report by the charity Waste and Resources Action Programme (WRAP) - Food-surplus-and-waste-in-the-UK-key-facts-Jan-2020.pdf (wrap.org.uk)
2. Rizan C, Bhutta M, Reed M, Lillywhite R. The carbon footprint of waste streams in a UK hospital. Journal of Cleaner Production 286 (2021) 125446. https://www.sciencedirect.com/science/article/abs/pii/S0959652620354925
3. Government emission conversion factors for greenhouse gas company reporting 2022 Government conversion factors for company reporting of greenhouse gas emissions - GOV.UK (www.gov.uk)
4. NHS Estates. Estates 'Net Zero' Carbon Delivery Plan 2022 https://www.england.nhs.uk/greenernhs/publication/delivering-a-net-zero-national-health-service/
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AWARDS

WINNERS: Home Enteral Feeding

HIGHLY COMMENDED: Gloucester Managed Services

Congratulations to the WINNING team, the Home Enteral Feeding team. Their project was led by patient voices, with the team addressing their patients concerns of the impact of their care on the environment. We at CSH are looking forward to hearing updates from the team in regards to their longer term aims to scale implementation across their service as well as their ongoing collaboration with supplier, Nutricia.

ACKNOWLEDGEMENTS

CSH would like to thank the teams for all their enthusiasm, dedicated work & creativity in devising and completing their projects.

Thank you to Jen Cleary, Head of Sustainability, for partnering with us for the Green Team Competition.

Thank you to our judges for your time and keen interest in the projects.

- Deborah Evans - GHFT Chair
- Deborah Lee - GHFT Chief Executive
- Natasha Parry - Green Council Chair and Sustainability Award Winner, GHFT
- Rachel Stancliffe - Director, The Centre for Sustainable Director

Thank you to Ingeborg Steinbach - Carbon Consultant, with The Centre for Sustainable Healthcare for their careful and highly skilled work in carbon footprinting. Inge supported the teams in carrying out their own carbon footprinting and equipped teams with the knowledge and tools to carry out future calculations for projects in the future. Carbon calculations are essential to ‘triple bottom line’ integrated project reporting and make plain the true cost and impacts of services to allow better, safer and more responsible decisions to be made in healthcare organisations.

POTENTIAL ANNUAL SAVINGS

The following table provides detail on the **annual** savings available to the Trust from the 2022 Green Team Competition when projects are fully embedded.

Project	Financial Outcomes	Environmental (CO2e) Outcomes	Social Outcomes	Clinical Outcomes
Home enteral feeding	+ £369	543 kgCO2e (neurological centre) 24,722 kgCO2e (across Trust)	• Addressing patient concerns of environmental impacts of care • Increased staff awareness of the environmental impact of healthcare and actions to reduce this • 100% staff reported changes simple to implement	No change to patient care
Endoscopy	£9,568	6,619 kgCO2e	• Established a Green Endoscopy working group • 100% of staff supportive of greener practice • 81-94% of staff support reduced prophylactic use of Incopads and paper reduction • Staff time gained back from reduced printing and posting • 50% staff agreement to replace shorts with gowns due to concerns over dignity. No concerns highlighted from patients.	• Electronic communication reduced risk of patients missing information on their care and can also be translated to other languages. • Endoscopist support for reduced short and Incopad use as both could gather on the colonoscope impairing insertion.
Orthopaedic theatres	a) £6,175 b) £8,364	a) 4,501 kgCO2e b) 11,350 kgCO2e	• Ecopulse saves storage space, allowing room for important orthopaedic instruments, which may reduce loan kit requirements. • Ecopulse is heavier and simultaneous use of power tool and mechanical brushes isn't possible. Neither will impact patient care however supply of Pulsvac option still required.	• laminar flow potentially harmful in non-orthopaedic operations. • Use of the ecopulse and turning off laminar flow will create a quieter theatre environment allowing for easier communication between staff, benefitting concentration, staff wellbeing, and training.
Pharmacy	£7,500	2,708 kgCO2e	• Initially negative feedback due to concerns over increased workload and medications going missing. However, there is growing positive attitude towards the process as staff have got more familiar with new process.	No impact on patient care.
Haematology	a) £846 b) £52,924	a) 678 kgCO2e b) 62,920 kgCO2e	• Improve turnaround time of sample results supporting team to meet 1 hour targets	• ED will receive results from high priority tests faster making clinical decision making more timely and efficient. • Risk of repeat blood testing if spare citrate not taken at time of initial testing. Based on only 15% of spare samples being used for tests, we assume risk is low.
Food waste	£73	393 kgCO2e	• Positive response from patients and staff received.	No impact on patient care
Total Savings	**£85,081**	**113,891 kgCO2e**		