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The Christie
NHS Foundation Trust

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# GREEN TEAM COMPETITION

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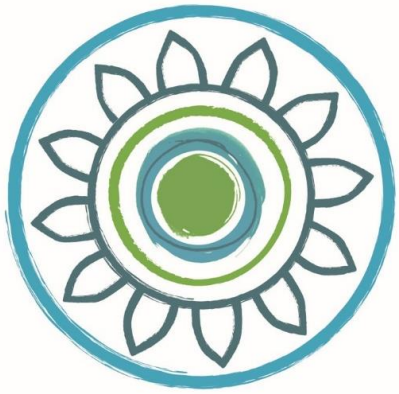

# 2022 IMPACT REPORT

## The Christie

## NHS Foundation Trust

## Green Team Competition

### POTENTIAL ANNUAL SAVING FROM PROJECTS COMBINED


**£554,525**

**99,403 kg CO2e**

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### CARBON SAVINGS EQUIVALENT TO..

The same amount as 3,976.12 mature trees absorb on average per year

286,299 miles in an average car

734 return trips between the Christie 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[4], 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 The Christie NHS Foundation Trust 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.

References


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## 1. STREAMLINING CRASH TROLLEY EQUIPMENT, OUTREACH TEAM

TEAM MEMBERS:

- Victoria Croft – Critical Care Outreach Sister
- Jude McLellan – Critical Care Outreach and AKI Team Lead
- Tara Minshall – Resuscitation equipment coordinator
- Melanie Lowe - Lead Clinical Pharmacy Technician
- Gwendolen Birkett – Senior clinical pharmacy technician


### Background:

It is a Resuscitation Council requirement that healthcare organisations have suitable emergency trolleys with appropriate equipment and medications in the clinical setting[1]. The Critical Care Outreach team are responsible for monitoring and auditing the crash trolleys, of which there are 52 strategically placed around the Christie Trust containing a vast amount of equipment needed for emergencies, vital for patient safety. Through continuously monitoring the crash trolleys, our team identified that there may be unnecessary trolleys or items not clinically indicated or required in resuscitation.

### Specific Aims:

1. To identify and remove unnecessary crash trolleys.
2. To remove unnecessary medical equipment and medications from remaining crash trolleys for environmental, financial and social benefit.

### Methods:

We completed a process map (Appendix 1) to review all crash trolley locations across the Trust. We also reviewed the full list of equipment located within each trolley, for which there is approximately 150 items excluding drugs.

Day to day maintenance of the trolleys lies with the ward/outpatient areas requiring the trolley. It can be time consuming for band 5 and 6 staff who check the trolley is sealed every morning and complete full contents checks monthly. The resuscitation equipment coordinator also helps with auditing and provides stock for the ward when required.

Through this process we identified the following steps that could be put in place to streamline the crash trolleys:

**1. Removing crash trolleys**

By reviewing crash trolley locations, we identified 2 areas where trolleys were located within 10m of each other and therefore could be reduced to 1 trolley and shared. 1 team agreed to reduce a trolley. Which has been repurposed for training purposes. Other equipment was redirected for use in clinical areas. The second team was concerned removal of a trolley may compromised patient care, leaving them feeling unsafe. We are working with the team to find a solution with the continued aim to remove another trolley while ensuring patient safety.

**2. Remove items that are not clinically indicated from the trolley**

Crash trolley contents were reviewed. Gelofusine was identified as an item rarely used that is not recommended in resuscitation anymore[1]. The gelofusine was redistributed into fluid cupboards for other purposes, as it has clinical uses outside of emergency situations.

3. **Remove medications not needed in the blue emergency boxes**

We reviewed all medications in the blue emergency boxes which contain drugs for different types of emergencies including hypotension, antiarrhythmic, anaphylaxis and asthmatic drugs etc. In discussion with the pharmacy technicians, it was identified that 2 oral drugs, Aspirin and Clopidogrel, used for acute coronary syndrome, would be clinically appropriate to remove, as both medications are readily available via emergency drug cupboards. Retrieving the drugs via the cupboard versus the crash trolley would not impact on time taken in an emergency. A memo will be sent to all outreach staff to inform them of the drug changes as the team is responsible for these drugs in an emergency.

4. **Reduce the number of intubation boxes around the trust**

Additional intubation boxes were introduced at the beginning of the COVID19 pandemic to ensure timely intubation to reduce the risk of spread. Placement of intubation boxes was reviewed with the pharmacy technicians and 5 boxes were identified as having never been used since introduction 2 years ago. These boxes were subsequently removed, ensuring patient safety by strategically placing the remaining intubation boxes in readily available positions around the Trust.

## Measurement:

***Patient outcomes:***

Crash trolleys have remained in areas that are required to have one or where staff have expressed concern at removal. It was agreed in MDT meetings the changes suggested would not impact on patient safety and care however patient safety will continue to be monitored via daily equipment checklists and our monthly audit process. In addition, spot checks of contents of all trolleys will continue by the outreach team. A yearly audit report is created in July to assess the previous 12 months. The pharmacy technicians will help to identify any issues with the emergency drug boxes.

***Environmental sustainability:***

We completed a top down, input-output methodology to calculate carbon ($CO_2e$) savings. We used the financial cost of items and applied the relevant emission factors. For pharmaceuticals and medical equipment factors from the Greener NHS 20/21 database were used. To calculate waste disposal savings, the weight of items and their packaging was used with the emissions factors for domestic and clinical waste from Rizan et al 2021[2].

***Economic sustainability:***

The cost of gelofusine was obtained from NHS supplies website. The cost of oral drugs and intubation boxes was obtained from our pharmacy procurement team. The cost of remaining items of equipment in a crash trolley was gained from either our procurement team or staff ordering system.

***Social sustainability:***

We obtained informal feedback via our departmental meetings and staff conversations.

## Results:

***Patient outcomes:***

We do not anticipate any changes to patient safety and clinical care. We will continue to monitor this via our daily checks and monthly audits.

***Environmental and Economic sustainability:***

Table 1 shows our anticipated annual savings.

| *Item* | *Per item* | | *Quantity removed* | *Total saving* | |
|---|---|---|---|---|---|
| | **kgCO2e** | **£** | | **kgCO2e** | **£** |
| Gelofusine | 0.9 | £6.07 | 52 | 44.4 | £315.64 |
| Asprin and Clopidogrel | 0.1 | £0.93 | 52 | 6.2 | £48.36 |
| Intubation boxes | 147.5 | £1,555.19 | 7 | 1,032.5 | £10,886.33 |
| Red box | 22.7 | £177.51 | 1 | 22.7 | £177.51 |
| Blue Box | 8.4 | £65.64 | 1 | 8.4 | £65.64 |
| Crash Trolley equipment | 81.13 | £185.41 | 1 | 81.13 | £185.41 |
| Crash trolley equipment waste disposal* | 10.32 | £4.39 | 1 | 10.32 | £4.39 |
| **Total annual saving** | | | | 1,205.65 kgCO2e | £11,683.28 |

*Waste disposal excludes defibrillation and suction equipment and is based on assumptions of annual turnover of equipment with 90% items disposed of in clinical, and 10% in domestic waste.

Through our changes to streamline equipment, we anticipate savings of 1,205.65 **kgCO2e per year**, equivalent to 3,472.5 miles driven in an average car. We also anticipate a financial saving of **£11,683.28 per year.**

***Social sustainability:***

Outreach will have one less trolley to input into the monthly data and one less trolley to monitor.

The Pharmacy technicians felt the reduction in intubation boxes and oral drugs would ease their workload and save time.

Ward staff responsible for daily checks of crash trolleys reported this was a very time-consuming process (taking at least 30 minutes per day), so removing any low value items is helpful for time efficiency. In the area where the crash trolley was removed, the ongoing responsibility has now been split between two teams saving time.

## Discussion:

Removing Gelofusine from crash trolleys and changing the folder information was quite time consuming given that it meant going around to the 52 crash trolleys, the equipment coordinator kindly helped with this.

An area that we were planning to remove a crash trolley from didn't go as planned, we felt that this would be beneficial for them however they felt that there was a risk with this given the department was outside the trust building which is understandable. We will continue to work with these and find a solution, using the suitcase crash trolley for this area is a possibility. This is a bag that we take outside the building or in a tricky part of the hospital if there is a crash call. The next phase would be to introduce this idea to the department and to do a mock arrest call to see if this is a suitable solution. A meeting has been set up to discuss this and a mock arrest will follow.

We are now looking at other ways in which we can reduce the waste on the crash trolleys. For example, removing some of the airway equipment. However, this needs wider discussion with the anaesthetists who

use the equipment this process has started but will be fully discussed in the new year. In addition, we are looking at going electronic with the monitoring of the crash trolleys which will save time and a significant amount of paper, which will increase our CO2e savings further. We have asked IT to help with this and hopefully will be available in the future.

At the start of the competition, we realised that there were multiple elements to the resuscitation team/equipment that we would like to change however in reducing equipment there was always an element of risk to patient safety. An MDT approach was used to ensure this patient safety.

## Conclusions:

Reviewing all the crash trolleys and their contents has been very useful and thought provoking. We will continue to review our service and aim to reduce more waste. We have had good team input from our equipment coordinator and the pharmacy technicians, their input has been invaluable. I feel this project has had a positive benefit on the relationship between the teams by facilitating joint working, which will continue when monitoring the crash trolleys.

## References:


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   PDF available from: The carbon footprint of waste streams in a UK hospital - ScienceDirect
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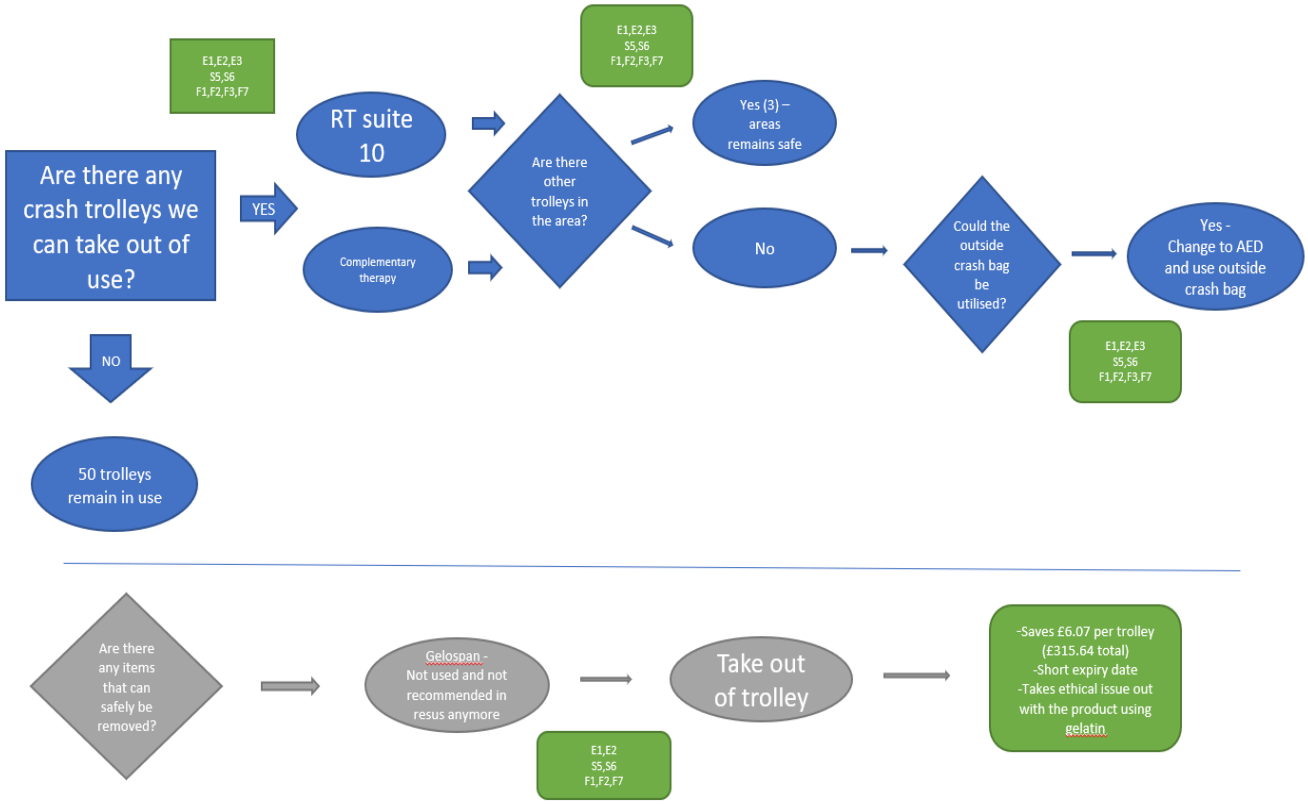
**Appendix 1:** Process map



## 2. **A SURGICAL GOLDEN PATIENT**, SURGICAL THEATRES TEAM

TEAM MEMBERS:

- Ana Maestreania – Clinical Practice Education lead for surgical theatres at The Christie
- Amy Tabern – Senior operating department practitioner for anaesthetics and recovery at The Christie

## Background:

In 2013, a report commissioned by the world health organisation stated that air pollution causes cancer. It is widely reported that the NHS is responsible for 5.4% of all the UK's greenhouse gases. With this in mind, it is essential for us at The Christie and other health care providers to find more sustainable processes so we can prevent cancer and other health conditions whilst treating them.

As the NHS heads towards providing a net zero health service, it is hard to imagine when working in an operating theatre; Surrounded by a never-ending supply of single use items double wrapped to protect their sterility. Anaesthetic drugs and gases required to keep our patients anaesthetised and comfortable. The large number of healthcare professionals required to safely take care of patients during this critical time each travelling to work. The number of bags of waste and packaging at the end of every case requiring incineration at high temperatures to prevent any cross contamination. All this can be justified when a patient receives a treatment which may potentially save or prolong their life but when that case is cancelled due to non-clinical reasons such as bed issues, we have found that a number of these items are wasted and end up in the bin without having been used.

Bed issues are faced by hospitals across the UK and The Christie has one of the best utilisation rates in the northwest it still faces difficulties. Surgical list delays and cancellations have financial, social and environmental impact. During the green team competition, we have looked to quantify the environmental and financial impact of delays and cancellations of surgical patients due to unavailability of post-surgical beds in the hospital, linking this to the social impact they have on our patients and colleagues.

'Golden patient' schemes have been adopted by many trusts. Blackpool used their golden patient scheme to identify patients for next day discharge so that elements of the patients discharge such as take-home medication and transport can be arranged in advance. This resulted in earlier discharges, freeing up bedspaces earlier. The Royal Gwent hospital's transformation team aimed to improve the start time of the list with the introduction of the 'golden patient' initiative. A protocol was agreed between the orthopaedic, anaesthetic and theatre staff where a 'golden patient' was selected for preoperative anaesthetic assessment by 14:00 the day before surgery and sent for at 08:15 as the first case on the trauma list. This initiative resulted in earlier starts to the operating list and increase theatre utilisation.

## Specific Aims:

**Short term aim:** To identify the potential environmental, financial and social impacts in reducing on the day cancellations and delays to commencing surgical procedures due to unconfirmed bedspaces

**Long term aim:** To reduce on the day cancellations and delays to commencing surgical procedures due to unconfirmed bedspaces by introducing a 'golden patient' to each operating list. The golden patient would have their bed space confirmed the day before surgery. To use the golden patient confirmation as an opportunity to highlight bed issues for the following day allowing us to start the escalation process the day before surgery rather than the morning of.

## Methods:

**Short term aim**

Our clinical practise and day to day working experience had left us feeling as though delays and cancellations due to bed issues had become an issue within our department. Feeling frustrated by this regular occurrence we looked to see if sustainability and the green team competition could be an opportunity to address this problem.

We completed a process map (appendix 2) which identified 'hotspots' of waste during delayed or cancelled procedures. This included

- equipment and medications that would be opened and discarded without use
- energy waste from theatres being turned on before use,
- inefficient use of Bank staff time and unnecessary travel
- the social and financial impact that cancellations have on our patients
- staffing issues created as a result of lists overrunning due to delayed starts
- lists that over run due to not starting on time

This process enabled us to understand that we needed to target a reduction in delays and cancellations in the first place, rather than focus on consumables or energy waste individually. A 'golden patient' initiative would target all the above aspects of waste.

To uncover if our colleagues also felt this was an issue within the department, we undertook a survey of the surgical theatre team. We involved a lead nurse for the post-operative wards to discuss our findings and the proposed solution to see if our idea, which effective on paper would be possible in action.

**Long term aim - Planned actions**

The defining element of golden patient initiatives is that action is taken a day prior to an event to avoid delays and improve efficiency. We propose that by allocating our priority patients a bed the day before surgery we can address issues of delays we currently face and the knock-on effect of overruns they cause. Early bed intervention may enable us to highlight and correct bed issues in advance to avoid cancellations on the day or where cancellations cannot be avoided look to inform the patient the night before to avoid them travelling to the hospital, fasting and facing the surgical check in process when they arrive at the hospital. Initially we would aim to introduce one golden patient for theatres, however long term this could increase to one patient per theatre, in the hope that over time all our morning patients would have their bed spaces allocated the day before surgery.

To effectively introduce the Golden patient initiative, we would require support from various departments including our post-surgical wards, the service management team, bed managers and clinicians who create priority lists for our patients. We would need a service / bed manager to oversee this change and look to audit our base line data at 1 month, 3 months and 12 months to monitor if the change had been effective in reducing these cancellations and delays.

At the time of submitting this report we have not attempted to implement this change. Instead, we plan to use this report to highlight the issue we are facing, the impact it is having and use the

green team competition as a platform to address this problem to those who are able to bring about this change.

## Measurement:

***Patient outcomes:***

Using the theatre metric system, we were able to pull 12 months of data outlining:

- On the day cancellations due to unavailability of beds
- Delayed theatre start times due to waiting for confirmation of beds
- Theatre list over runs as a result of delayed start times due to waiting for confirmation of patient beds

We collated this data and compared it to the average number of additional bank/agency staff we use on a daily basis and staff who stayed at the end of their shift to cover the over runs in theatre.

***Environmental sustainability:***

*Consumables and medications:*

We developed a list of consumables and drugs most likely to be opened and discarded un-used following a cancellation. To estimate the carbon footprint of the consumables and drugs wasted from a cancellation, an Environmentally Extended Input Output Analysis (EEIOA) was used. In EEIOA, financial spend in a sector is directly converted into kgCO2e. The cost of each item was collected and converted into kgCO2e using emissions factors taken from the 2020/21 Greener NHS database. For medical equipment the factor for medical equipment and instruments (0.465 kgCO2e/£) was used and for drugs the pharmaceutical factor (0.1277 kgCO2e/£) was used.

*Waste disposal*

Each drug and consumable as well as the packaging was weighed, separated by the type of disposal required (domestic, pharmaceutical and sharps). To estimate carbon emissions from waste disposal, emissions factors for domestic and clinical waste were used to convert weight (in tonnes) into kgCO2e. Waste emissions factors were taken from Rizan et al (2021), 'the carbon footprint of waste streams in a UK hospital'.

*Travel*

We calculated the average number of additional staff arranged per theatre each day and applied this to the number of cancellations to work out the additional travel impact of additional staff per cancellation. Distance for average miles travelled to work (commuting) were taken from the HOTT tool and converted into carbon emissions using CSH's carbon travel calculator based on national travel survey data and the BEIS database. It was assumed 0.8 bank staff travelled in per cancellation.

*Energy*

We obtained energy usage for theatres for 3 months of data. Due to having no base line data to compare a theatre in use/not in use we were unable to quantify energy wasted in a delayed theatre, additional energy required for theatre over running as a result of a delay and energy use potentially saved when a case is cancelled. Data was multiplied to give an annual estimate and divided in 12 operational hours per day, for 5 theatres, 5 days per week.

Using the quarterly energy consumption for surgical theatres we were able to access we were able to multiply to reach a yearly figure and divide that number into number representative of 12

operational hours for 5 days each week. This figure is heavily estimated but provided us we a rough guide to use in our calculations.

Electricity and gas carbon emissions factors have been taken from BEIS 2022 database and include Well-To-Tank (WTT) and Transmission and Distribution (T&D) emissions Gas is estimated at 4.828 kWh per operational hour (multiplied by 0.21364 $CO_2$ emissions factor) which shows 1.0312608 $kgCO_2e$ per kwh. Electricity is estimated at 3.757 kWh per operational hour (multiplied by 0.26155 $CO_2$ emissions factor) which shows 0.98264335 $kgCO_2e$ per kwh.

***Social sustainability*:**

We surveyed theatres employees (Appendix 1) to better understand the impact cancellations and delays have on them (both positive and negative). We also asked for input on potential changes we could make to improve our service and see their understanding of the environmental impact of our current process.

It was not possible for us to measure the social impacts on patients during the competition. However, we anticipate several potential benefits to implementation of a golden patient initiative. Moving forward with this project we would look to use patient surveys given to patients experiencing delays and cancellations to better understand the impact they have. Using this information and the potentially reduced number of on the day cancellations/ theatre delays we are able to collate from the theatre metrics system we could evaluate if the change has been successful in improving our social sustainability.

***Economic sustainability:***

No implementation costs have been applied to this theoretical change.

*Consumables and medications:* Costings of items routinely disposed of in cancelled procedures were obtained from our procurement lead and pharmacy stores.

The cost in disposing of wasted items was calculated from prices given by our waste management lead.

*Energy:* We approached our trusts sustainability lead to provide us with energy consumption records and costings.

## Results:

***Patient outcomes:***

- On the day cancellations due to unavailability of beds: 31 cases
- Delayed theatre start times due to waiting for confirmation of beds: 135 cases, 4351 minutes (72 hours) equivalent to 8 full day operating lists.
- Theatre list over run as a result of delayed start times due to waiting for confirmation of patient beds: 2426 minutes (40 hours). We would look to monitor for reduction in delays and on the day cancellations by using the data we collect through the theatre metrics system.
- Patients exposed to less cancellations and delays (causing emotional distress, unnecessary fasting, taken time off work to isolate pre surgery having a impact of their finances and work commitments)
- Treatment timelier and more efficient

***Environmental sustainability:***

***Cancelled cases***

- Consumables* set up per case – 35.3 kgCO2e
- Waste generated from cancelled case – 2.181 kgCO2e per case
- Additional staff unnecessary return travel – 9.94 kgCO2e
- Impact of average patient journey – 13.67 kgCO2e

*This is based on minimum number of consumables wasted. However, in practice more devices are frequently disposed of depending on the case cancelled, so this is likely an underestimation of CO2e per cancellation.

Total – 55.151 kgCO2e per cancelled case. With an average of 31 cancelled cases per year, this equates to 1709.681 kgCO2e. We anticipate a 50% reduction in on the day cancellations over a 12 month period would be realistic and therefore could have potential savings of 854.8405 kgCo2e.

***Overruns as a result of delays due to no bed confirmation***

The 40 hours theatres overrun awaiting confirmation of beds equates to 80.56 kg CO2e. We have assumed that starting with one golden patient would be realistic and reduce this overrun time by 20%, providing a saving of 16.11 kgCO2e over 12 months. Our long term aim is a 100% reduction (one golden patient per theatre) for the full saving of 80.56 kgCO2e

**Total savings:**

A 50% reduction in cancellations and 20% reduction in overrun could lead to savings of **870.9 kg CO2e**. This is equivalent to 2,508.3 miles driven in an average car.

***Economic sustainability:***

***Cancelled cases***

- Cost of items wasted in a cancelled case – £91.2, based on 31 cancellations per year. A 50% reduction would create a saving of £1,413.60 over 12months.

- Waste disposal costs per cancelled case - £18.26/ £566 for the 31 cases cancelled over the 12-month period analysed. A 50% reduction would create a saving of £283 per year

- Cost of additional staffing booked for an average case 1 per theatre per day. Costing £35 per hour for registered team members/ £16 per hour for non-registered. This £297.50/£136 per 8.5hour. For the 31 cancelled cases due to bed issues £9,222.50/£4,216 spent on additional staffing (dependent on whether a registered or non-registered member of staff was additionally booked) for cancelled cases over the 12-month period.

50% reduction in on the day cancellations due to no beds could save £6307.85 in wasted medical equipment, wasted pharmaceuticals & additional staffing.

*Overruns as a result of delays due to no bed confirmation*

- Overall time from over runs because of delayed start due to no bed confirmation – 2426 minutes (40hours) Over runs can be staffed by late team which covers 1 theatre per day. If more than 1 theatre overruns staff are asked to stay late on a bank pay rate or time owing. Per registered team member for an additional 40hours is £1400. Per non-registered team member for an additional 40 hours is £640 – Theatres use a minimum of 2x registered and 1x non-registered team members at any time. 40 hours of one full team on bank pay is £3,440

- Energy useage (roughly calculated from 3 month data available. Data multiplied to give an annual estimate and divided in 12 operational hours per day, for 5 theatres, 5 days per week) is £123.20 for 40 hours

A 20% reduction in overrun time from 1 golden patient would lead to savings of £712.64 (*£688 in additional staffing costs and £24.64 in additional energy usage).* However our long term aim is to reduce this by 100% for a total saving of £3563.20 per year.

**Total savings:**

A 50% reduction in cancellations and 20% reduction in overrun could lead to savings of **£7,020.49.**

***Social sustainability:***

The results of our survey found:

- **Staff who feel delays are a problem – 100%**
- Staff who feel cancellations are a problem – 62%
- Staff who feel our current bed confirmation process needs improvement – 81%
- Staff who feel day before confirmation would improve our service & prevent delays – 71%
- Staff who can see a link between cancelled cases and our carbon footprint – 43%

A more efficient service allowing us to utilise more of our operating time. Less cases requiring rebooking due to cancellations or delays would allow that time to be utilised to provide more surgery.

It was not possible for us to measure the social impacts on patients during the competition. However, we anticipate several potential benefits to implementation of a golden patient initiative. For example,

- **Treatment is timelier and more efficient: When surgery start times are delayed patients and their relatives wait for longer periods of time which may increase stress and worry.**
- Mentally patients face many worries and concerns whilst waiting for their surgery. Scared of both the risks their surgery involves and the risks they face if their procedure does not happen soon enough and their cancer advances.
- Less wasted patient & family journeys, which may also come with a cost saving.
- Patients with cancelled procedures may fast for no reason, and with delays will experience longer fasting periods.
- Patients go through a lengthy process before receiving their surgery which includes arranging time off work, balancing personal commitments, having to attend pre-op appointments, having bloods taken, taking pre-op medication, isolating pre surgery, travelling long distances.

## Discussion:

To confirm if our planned proposal was an issue our colleagues were also experiencing, we surveyed our team. The staff survey provided insight that a high percentage of the team feel delays and cancellation are a problem. 100% of staff surveyed stated they felt delays are a problem within the department. The data we were able to collate from the theatre metric system confirmed that we had encountered 72hours of delays over the 12month period analysed which is the equivalent of 8 full operating lists.

The calculated amount of 55.151 kgCO2e per cancelled case is significant. As no treatment was provided, the patient will still require surgery, which will be rebooked at a later date. This increases the overall carbon footprint for this patient. Over the 12-month period studied the cases cancelled

on the day due to no post-surgical bed equated to minimum of 1709.68 kgCO2e entering the environment before surgical intervention has taken place.

Evaluating the financial impact of this we calculated that the wasted items set up prior to cancellation came to £91.20 per case. The elements included in the calculation of this were kept to a minimum as to not exaggerate our findings and some elements that are not essential for every case we excluded for example items such as invasive monitoring are set up in advance for most patients who will require critical care post operatively however were not included as they are not used in all instances. Practitioners are occasionally able to transfer this equipment on to another theatre however this is not always possible. Preoperatively patients encounter many processes, for example, they have bloods taken which are sent to the pathology laboratory to be processed, grouped and cross matched. These bloods are then ordered to the department for the start of the case, all of which have financial, environmental, and patient impact that was not included in this report in an attempt to keep focus on surgery specific intervention however these would increase the overall carbon footprint and cost.

Both delays and cancellation have an impact on theatre staff utilisation. Theatres encounter the cost of additional staffing, which from inspection of records, was found to average at 1 member of staff per theatre per day. Additional staff booked through the bank or agency are paid at a rate of £35 per hour for qualified members of staff or £16 for unqualified with additional agency fees. These members of staff may be reallocated to another theatre if required or sent home early if not required. Team members who stay at the end of lists to cover theatre over runs as a result of delayed starts due to no bed confirmation are also often paid a bank rate to do so. The average journey of a member of staff at the christie is calculated to create 9.94 kgCO2e. Our patients and their family members/carers also encounter financial setbacks when surgery does not go ahead as planned. Patients before surgery are asked to isolate, themselves and their partners taking time off work. They arrange travel and childcare which may not be required if given notice the day before.

The proposed process (Appendix 3) introduces a new bed communication meeting at 15.30 the day before surgery. This meeting would take place following the current 15:00 scheduling meeting which finalises surgical lists for the following day. The proposed process enables us at this time to allocate golden patient beds with the aim of reducing delays on the day of surgery. This communication also provides an opportunity to highlight problems and initiate an escalation process early. The early line of communication the golden patient initiative creates enables the wards to pre-emptively make the theatre department aware of any issues for the following day. Should issues be anticipated for the following day this early communication would enable the theatre team to start the bed escalation process the day before surgery rather than the morning of. Theatres may then plan accordingly for example involving service managers in finding solutions such as rearranging list orders to have non-bed dependent cases first to avoid delays, creating priority lists so we know which theatres can start without delay and in worst case scenarios cancelling patients the night before surgery to avoid unnecessary fasting, travel and preoperative hospital interventions. This earlier cancellation prevents theatres from being set up and the associated waste and in the rare circumstance where cancellation is necessary it would allow staff to be reallocated or for additional bank staff to be cancelled. These steps are outlined in the proposed process.

On discussion with a lead nurse for CCU and the post-surgical ward, it was suggested that in addition to the golden patient a traffic light system could be applied to the hospitals bed management. Green light indicating there are no bed issues on the wards and surgical patients are unlikely to encounter delays or cancellations. An amber warning would indicate the potential for bed related issues and red indicate definite service issues allowing theatres to delay opening of equipment the next morning until receiving confirmation of the cases going ahead or look to rearrange operating lists to ensure day case patients are started first to avoid morning delays. We found that if even 50% of the cases cancelled due to no beds had been informed the night before we could have saved 854.84 kgCO2e, £6307.85 in wasted medical equipment and additional staffing.

The golden patient initiative may allow us to avoid this waste and additional staffing requirement as it opens lines of communication regarding the next day's post operative beds rather than waiting until the morning of the surgery. The theatre receiving the golden patient whose bed would be allocated and confirmed the night before would be able to set up in the morning without risk of wasting any medical equipment.

***Limitations:***

The main limitation of this study is that within the time frame available we were unable to put our plan in to practice. Due to the scope of this change and that it involves process changes across bed management, wards and theatres it would be essential to ensure the plan is robust before implementing to ensure its success. Due to not implementing this plan the conclusions drawn from the results of our findings may not be able to be applied to every scenario every day. Scenarios may occur such as overnight emergency admissions, ward closures due to infection prevention or staff shortages due to sickness that prevent the golden patient from proceeding as planned. The golden patient initiative cannot prevent this and good communication would be required to disseminate from the wards to theatres if a change has been made to the planned golden patient. Further exploration of the impact of delays and cancellations on our patients would be required to provide insight into how this initiative would improve care for them.

The proposed process of golden patient initiative in addition to an early escalation process may not be able to pre-empt or resolve all bed related problems. Following this report we also recommend further analysis of our theatre scheduling and bed requirements.

## Conclusions:

In conclusion, the golden patient can be beneficial in reducing the number of delays and cancellations encountered by surgical patients due to lack of post operative bed by opening lines of communication between the bed managers, wards and theatres earlier than the current process allows. Our surgical golden patient or patients would have confirmation of their post-surgical bed the night before their surgery allowing those patients to be brought to theatre without the delay of waiting for their bed confirmation on the day. Using this new process, we can add additional tools such as a traffic light system that warns theatres in advance of upcoming bed shortages allowing them to avoid delays by changing list orders. Where list order changes are not possible, theatres may be able to wait for confirmation before opening items that could be wasted. In extreme circumstances where it is apparent the bed issues will not be resolved, as happened 31 times over the 12-month period studied, these unfortunate patients may be able to be told in advance, avoiding unnecessary patient journeys, fasting, pre-op medication taking or blood taking.

This study was limited due to the large scope of data required and the individuality of each case and the waste it would generate. The results of the staff survey show our current process, delays and cancellation are leaving team members frustrated with 100% of those surveyed stating they feel delays are a problem within surgical theatres and 81% who feel our current bed confirmation process requires improvement. 'The golden patient' initiative will not increase the number of beds available in the hospital however apart from the time to plan and implement this process change it would not require any additional funding. We recommend further analysis of the hospitals bed requirements and highlight that other interventions or process changes may be able to address bed issues across the whole hospital.

Despite that only 43% of our colleagues surveyed could see a direct link between our bed issues and our carbon footprint we feel that this project has highlighted the large amount of Co2 and money wasted which could be potentially saved by refreshing our processes to address this problem.

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- 'Golden Patient': A quality improvement project aiming to improve trauma theatre efficiency in the Royal Gwent Hospital - PubMed (nih.gov)
- Golden Patients | Blackpool Teaching Hospitals NHS Foundation Trust (bfwh.nhs.uk)
- Air pollution, health and cancer – a new report calls for action - Cancer Research UK - Cancer news
- Every breath we take: the lifelong impact of air pollution | RCP London
- NHS England » Greener NHS campaign to tackle climate 'health emergency'

**Appendix 1:** Staff Survey

As part of the green team competition, we are looking for colleagues to complete this anonymous questionnaire regarding cancellation and delays within the department

Cancellation and Delays Staff Impact for Green Competition

Please circle your answer

1.Cancellations are a problem in my department. Yes no

If yes, what impact do they have?

I manage to catch up on training / Admin activities

I took some holiday hours

It interrupted my day

It frustrated me

Other:_____

2.Dealys are an issue in my department Yes no

If yes, what impact

I manage to catch up on training / Admin activities

I took some holiday hours

It interrupted my day

It frustrated me

Other:_____

3. Could you see any of the following as a solution to cancellations / Delays?

Confirmation of Beds the day Before Surgery

Patient Priority from day before

Different distribution of CCU Ward and IPU bed requirements during (e.g., More IPU Cases each day to reduce the pressure on Wards and CCU)

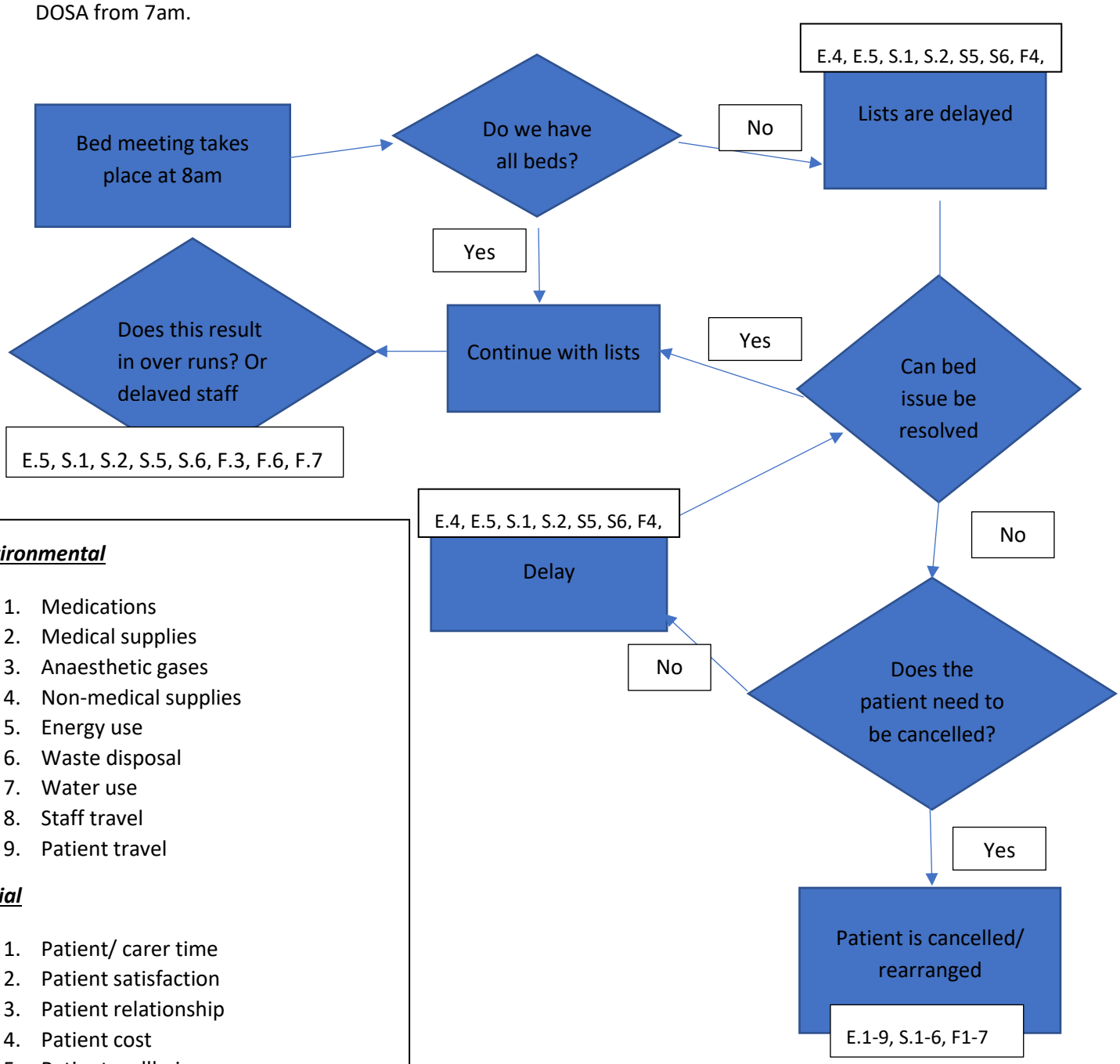
Other:_____

4. What impact do you feel cancellations have on our carbon footprint?

5. Do you feel our current bed situation is sustainable? Why?

**Appendix 2:** *Process Planning Example* – Bed Management Decisions on Morning of Surgery

Current Process – Bed managers assess available beds across the hospital along with staffing numbers and call theatres around 8am to update us on the bed availability for our surgical patients. Patients arrive at DOSA from 7am.




***Environmental***

1. Medications
2. Medical supplies
3. Anaesthetic gases
4. Non-medical supplies
5. Energy use
6. Waste disposal
7. Water use
8. Staff travel
9. Patient travel

***Social***

1. Patient/ carer time
2. Patient satisfaction
3. Patient relationship
4. Patient cost
5. Patient wellbeing
6. Staff satisfaction

***Financial***

1. Medications
2. Supplies
3. Energy use
4. Waste disposal
5. Water
6. Staff time
7. Bank staff

**Appendix 3: Proposed Process** – Day before surgery bed assessment, assigning golden patient and escalation of anticipated problems.

**Day before surgery 15:30 –** Bed meeting takes place following the scheduling meeting which confirms the next day's lists; **the golden patient is assigned and bed availability for the next day is discussed using traffic light system**. If any issues or potential issues are present, they should be discussed in detail clarifying how big the issue is using traffic light system and exactly what the problem is to avoid interpretation.

Green – **The ward has up to -3 beds.** This is likely to be resolved by next day discharges, theatres do not expect to experience delays the following day and do not need to escalate. **To improve efficiency** can additional golden patient beds be assigned.

Amber – **The ward has up to -6 beds**. This may cause delays the following morning but is likely to be resolved by the next day discharges. **Escalation steps to be taken to avoid morning delays.**

1. Escalate to Band 7 and 8 to inform scope of potential issues
2. Can the post-surgical wards be supported by other wards? / Could the discharge lounge be opened for the following day to streamline discharge process and free up bedspaces? / is additional medical support required on post-surgical wards for example to have patients reviewed or medications prescribed? / Can take home medications be ordered in advance?
3. Can lists orders be changed to minimise morning delays due to beds for example moving non-bed dependant cases first such as IPU patients or inpatients to start list.

Red – **The ward has -8 and above beds available.** This will cause delays in confirming beds and potential need for cancellations. Escalation process should be initiated –

1. Band 7 and 8 in theatres informed of scope of problem
2. Escalated to service managers
3. Priority list created by consultant or appropriate deputy
4. Support sought from other wards/ additional staffing requested /discuss if discharge lounge can be opened/can additional medical support to review patients be provided on wards to aid discharges?
5. Theatres informed of expected morning delay and information disseminated (equipment should not be opened until bed confirmation received)
6. Can theatres lists be changed to start with non-bed dependent surgery for example day case patients or inpatients.
7. If problem cannot be solved is a cancellation necessary? Discussion to take place between service managers and consultants. In un-resolvable circumstances could patient be informed in advance to avoid unnecessary travel and hospital intervention?

**Day of Surgery - Golden patient/patients to be sent for without waiting for further confirmation on the morning of surgery.**

**When Green** – theatre team to set up fully as waiting for bed confirmation

**When Amber –** theatre team to set up basic equipment whilst waiting for bed confirmation

**When Red -** theatres to set up but avoid opening single use items or pharmaceuticals until bed confirmation is received. Priority list prepared the day before surgery to be used to send for patients in order as beds are confirmed.

Patient flow to update theatres at **08:00** of updated bed status and confirmation

## 3. ASSESSING PIPED NITROUS OXIDE CLINICAL USE, WASTAGE AND ENVIRONMENTAL IMPACT: A SUSTAINABILITY QUALITY IMPROVEMENT PROJECT, ANAESTHETICS TEAM

TEAM MEMBERS:

- Muhammad Yahya, Specialty and Associate Specialist (SAS), Oncology Critical Care Unit (OCCU) and Anaesthetics
- Jonathan Allen, Consultant, OCCU and Anaesthetics

### Background:

The National Health Services (NHS) has set an ambitious goal to become the world's first net-zero health service and to achieve net-zero direct emissions, by 2040. NHS contributes approximately 5% to the national carbon emission, where anaesthetic gases accounts for around 2% of the NHS emissions. More specifically nitrous oxide ($N_2O$) accounts for at least 80% of the total anaesthetic gas footprint[1-3].

A recent audit conducted by the NHS Lothian uncovered significant flaws in $N_2O$ manifold management, utilisation, and leakage. These discoveries led to the decommissioning of $N_2O$ at one of the sites and 98% reduction in cylinder turnover in another Lothian Trust site[4]. Another audit conducted at the Cardiff and Vale University Health Board (CVUHB), identified that only 2.5% of the total purchased $N_2O$ was used for the patients. Whereas 97.5% of the $N_2O$ was wasted owing to leakage and inefficiencies, thus, suggesting using $N_2O$ portable cylinders instead of piped $N_2O$ which were found to be 74% more efficient[5].

The Christie NHS Trust has approved the "Sustainable Development Management Plan 2021-2024" and the trust is ready to embrace the commitments set-out in achieving a net-zero NHS. A key component of the proposed plan is to explore options to reduce use of anaesthetic gases. However, there was no audit conducted to assess piped $N_2O$ related emissions. As anaesthetists we were well placed to lead this project.

### Specific Aims:

To assess piped $N_2O$ usage and wastage in the anaesthetic clinical practice to identify and explore ways to reduce its environmental (Trust N2O emissions) and financial impact.

### Methods and Measurements:

The project was completed in the Christie NHS Foundation Trust Theatres and Proton Beam Therapy Unit (PBTU).

**Clinical and social impacts:**

1- **Cross-sectional Survey:** A survey (Appendix 1) was conducted among all full-time independent anaesthetic practitioners, including consultant anaesthetists and SAS anaesthetists, to assess the use of N2O in anaesthetic clinical practise at The Christie. The Christie Trust has anaesthetic service provision agreement with the University Hospital South Manchester (UHSM) and the Royal Manchester Children's Hospital (MFT/RMCH), therefore, they were also included for the survey. The responses were gathered and analysed using Microsoft XL.

**Environmental and Financial Impact:**

2- **Technical Survey:** In the second phase data was collected from the estate, pharmacy, and anaesthetic machines.

I. **Estate:** Details of the $N_2O$ cylinder manifolds were gathered and their respective serving areas were identified. Nitrous oxide cylinder turnover data and information related to leak test practices were collected by the relevant estate personal interview. Unfortunately, no logs were available for review.

II. **Pharmacy:** Details of $N_2O$ cylinders ordered by the pharmacy for last 24 months were requested and average yearly consumption was estimated.

III. **Theatre and Anaesthetic Machine Data:** With the help of medical physics and Drager® (anaesthetic equipment provider) representative, logs were reviewed for all the anaesthetic machines at the main theatres and PBTU. $N_2O$ consumption data was collected and average consumption per ventilated hour was calculated.

Total General Anaesthetic (GA) hours were calculated from theatre logs by calculating the duration for all GA cases conducted over 12 months (01/10/2021 x 30/09/2022)

Total consumption of $N_2O$, in Litre (L) at the main site was estimated using the following formula;

Average $N_2O$ (L) use / ventilated hour* x Total number of GA hours in 12 months = Total $N_2O$ clinical use over 12 months (L)

*It was assumed that all patients underwent surgeries under GA were ventilated

**Environmental impact:** CO2e was calculated based on one Kg of N2O = 298 kg of CO2[6]

**Financial impact:** $N_2O$ Financial cost: was calculated using BOC price list available on the website[7]

## Results:

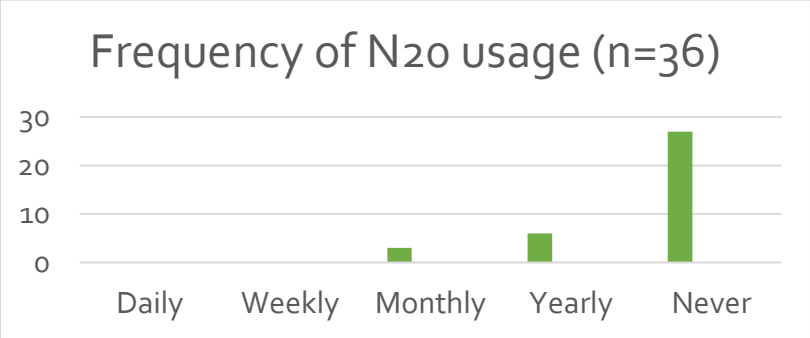
**Social Outcomes:** The project was appreciated by the department, and informal feedback from the colleagues indicates that it has raised awareness of $N_2O$ emissions and highlighted the need to transition towards greener anaesthetic practices.

**Patients Outcomes:** There is no expected negative outcome of this project on patients.

**Cross-sectional Survey results**: A total 36 anaesthetists responded to the proforma, with a breakdown of role and location summarised in table 1.

| | | |
|---|---|---|
| Total Anaesthetists surveyed (36) | SAS: 8/36 (22%) | Consultant: 28/36 (78%) |
| Response Rate | The Christie NHS | 24/27 (88%) |
| | UHSM | 5/6 (83%) |
| | MFT / RMCH | 7/29 (24%) |

Out of 36 respondents, 64% of anaesthetists had never used $N_2O$ at the Christie, 36% had used it occasionally (monthly or yearly). No one used $N_2O$ daily or weekly as shown in the graph below.




- Eighty four percent (30/36) of the anaesthetists do not intend to use $N_2O$ in the future, while 16% (6/36) intended to continue using it.
- Ninety seven percent (35/36) anaesthetists were in favour of a transition to $N_2O$ free anaesthetics in the future.
- All (36/36) the anaesthetists were happy to use $N_2O$ via cylinders only if the need arises.

**Technical Survey Results:**

The technical survey results reinforce the clinical survey results highlighting an overall minimal use of $N_2O$ in clinical practice.

I. **Estate:** There are two $N_2O$ cylinder manifolds at The Christie NHS Trust which contains size G cylinders. One of the manifolds is dedicated for PBTU, while the other serves the rest of the hospital. Its piped supply is used at the main theatres, brachytherapy unit, and PBTU. The cylinder turnover is very low. Estate does not perform routine leak tests and no logs were available for review.

**II.** **Pharmacy:** Pharmacy data suggests an estimated turnover of 15 $N_2O$ size G cylinders over the last 12 months period. This finding supports the numbers provided by the estate.

III. **Theatre and Anaesthetic Machine Data:**
Estimated $N_2O$ consumed per ventilated hours (main site) = 1.01 L (72%)
Estimated $N_2O$ consumed per ventilated hours (PBTU) = 0.385 L (28%)
Total GA hours last one year combined (main site) = 6667 hours
Estimated $N_2O$ consumed (main site) = 6733 Litres = < 1 Size G $N_2O$ cylinder / year
No data was available from the PBTU for total GA hours over 12 months.

**Environmental Impact**

- Estimated $N_2O$ Consumed (main site) = 9000 x 11 L = 99000 L = 11 Size G cylinders per year
- Estimated Clinical Use (main site) = 6733 L = < 1 Size G cylinders per year
- Lost to the atmosphere = 92,276 L = 182 Kg per year (93% of total ordered for the main site)
- $N_2O$ x 298 (Releasing 1 kg of $N_2O$ into the atmosphere is equivalent to releasing 298 kg of $CO_2$).
- 182 x 298 = **54,236 kg CO2e saved per year**. This is equivalent to 156,209 miles driven in an average car, or 394 return trips from Manchester to London.

**Financial Impact**

- Size G $N_2O$ Cylinder Cost for the main site (as per BOC website) = £296.17 / cylinder
- Total $N_2O$ Size G cylinders ordered for the main site = 11 x £3257.87 / year
- Total $N_2O$ Size G cylinders consumed for the main site = 1 x £296.17
- Total estimated financial loss = £ 2961.7
- Investment Cost for installing size E $N_2O$ cylinders on all the anaesthetic machines = £80 x 16 cylinders = £1280 cost
- Net savings = **£1681.7 per year**

## Discussion:

Based on the above findings the following recommendations were made to the anaesthetic department:

- Decommission $N_2O$ manifold at the main site which consumes approximately 70% of the $N_2O$ with no clinical benefit.
- Keep portable $N_2O$ cylinders to be made available to use when required.
- Further discussions with MFT/RMCH anaesthetic department to achieve consensus regarding decommissioning of PBTU manifold.
- Reassess $N_2O$ consumption after 12 months of implementing changes

The recommendations were largely agreed by the department without any resistance, however, some of the anaesthetists were keen to have $N_2O$ cylinders available all the time on anaesthetic machines and be ready to use when required. Therefore, a decision was made to install size E $N_2O$ cylinders on all the anaesthetic machines. The recommendations were agreed by the pharmacy and recommendations have been forwarded to the medical gases committee for final approval. Any gas left in cylinders is not recycled by the company but released into the atmosphere.

Our results show significantly less use of $N_2O$ in clinical practice at The Christie compared to the other NHS trusts. A similar survey conducted recently at the CVUHB showed that 47% of the anaesthetists never used $N_2O$ and 29% used it occasionally[5]. However, a survey conducted at The Royal Alexandra Children's Hospital, Brighton and Sussex demonstrated significant use of $N_2O$ in clinical practice, where it was used in 55% of the GA cases[8].

This stark difference in clinical use in different NHS trusts can be attributed to the type of surgical procedures and the patient population they cater. The Christie is a highly specialised cancer hospital, and the main theatres are primarily involved in the adult, mostly elective, cancer surgeries. Most of the other NHS trusts, on the other hand, have obstetric or paediatric surgical units where $N_2O$ is still regarded unavoidable. The paediatric patients undergoing PBT, at The Christie, usually have long term indwelling catheters and thus, mostly, avoid the need for inhalational induction (which mostly requires $N_2O$).

Another, intriguing aspect is the clinical benefits of Total Intravenous Anaesthesia (TIVA) in cancer surgeries, ranging from reduced incidence of post operative nausea and vomiting to increased overall survival, potentially leading to a shift in clinical practice towards TIVA and away from inhalational anaesthesia[9, 10].

Analysis of the data collected from the estate, pharmacy, and anaesthesia machines estimated that only 7% of the total purchased nitrous oxide was used in the clinical practice for the main site. This finding reinforces the results of the clinical survey.

A similar audit conducted at the CVUHB identified significant leaks from the manifold system and found that only 2.5% of the total purchased nitrous oxide reached out to the patients. The board conducted a pilot project, where portable E size cylinder was used for $N_2O$ and found it to be 74% more efficient[7].

Another project at the NHS Lothian identified a wastage of 80% at one of the manifolds and revealed that wastage from the piped manifold systems is a far more significant problem than that of persistent clinical usage and therefore decommissioned some of the manifolds[4].

Based on the above findings, which suggest minimal clinical use and significant manifold / pipeline leaks, in the context of positive outcomes of decommissioning of the manifolds at other NHS trusts, recommendation was made to decommission one of the main manifolds which consumes approx. 70% of the total purchased $N_2O$. Nitrous oxide cylinders will be installed on the anaesthetic machines for when clinical need arises. Further audits will be conducted to analyse ongoing clinical use with an aim to achieve nitrous oxide free anaesthesia.

**Limitations:**

- The response rate for the clinical survey was poor from MFT/RMCH anaesthetists and therefore does not reflect the majority in that group.
- There were no logs available to review at the estate and thus the estate data is based on the relevant personnel interview rather than physical records.
- The $N_2O$ cylinder data received from the pharmacy was used to estimate average yearly purchase of nitrous oxide.
- Data for the total number of GA hours was not available for PBTU, therefore, it was not possible to calculate total $N_2O$ clinical use at PBTU.
- Due to ongoing estate operations, it was not practically possible to run a whole site $N_2O$ leak test and therefore, leak is estimated only for the main site by subtracting estimated clinical use from the total purchased $N_2O$ cylinders for the manifolds.
- Average $N_2O$ consumption was calculated by assuming that all patients were ventilated throughout the surgery which could have resulted in an over estimation of $N_2O$ use.

**Challenges:**

The project had various dimensions and needed a significant involvement of multiple departments. Clinical survey was conducted in three different settings, and it was challenging to get a good response rate. Support and coordination were required from the non-clinical departments including medical physics, Drager® (anaesthesia equipment provider), estate and pharmacy. Gathering data was time consuming and at some departments the required record / data was not available.

**Future Goals:**

- Decommissioning of $N_2O$ main manifold (agreed by the anaesthetic department, pharmacy and now waiting for final approval from the medical gases committee)
- Further meetings and responses from the MFT/RMCH anaesthetists and decommissioning of the PBTU $N_2O$ manifold
- Audit of $N_2O$ cylinder use next year to assess clinical use with an aim to move towards $N_2O$ free anaesthesia.

## Conclusions:

Despite challenges and limitations, the project is a first of its sort at The Christie NHS trust and has established minimal use of $N_2O$ in anaesthetic clinical practice by analysing it from multiple dimensions. It has also highlighted that 93% of the purchased $N_2O$ is lost to the atmosphere due to potential leaks in the pipeline-manifold system.

By decommissioning one of the main manifolds and replacing anaesthetic machines with Size E $N_2O$ cylinders, the trust can save an estimated 54.23 tonnes of $CO_2$ emissions with some financial savings.

Although this project is a small step in the right direction, the trust has a long way to go to achieve nitrous oxide free anaesthesia.

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**Appendix 1:** Cross-sectional Survey

| Serial Number: | Anesthetist<br>SAS / Consultant |
|---|---|
| Have you ever used N2O at The Christie Theatres as part of the anesthetic | Yes / No |
| How often do you use N2O at The Christie theatres | Daily / Weekly / Monthly / Yearly / Never |
| Are you planning to use N2O at The Christie theatres in future | Yes / No |
| Would you support a transition to N2O free anesthetic at The Christie theatres | Yes / No |
| Would you be happy to use N2O via cylinders only (if required) | Yes / No |

## 4. PILOT PROJECT TO ASSESS THE IMPACT OF IDENTIFYING PATIENTS AT HIGH RISK OF FRACTURE ON AN ACUTE ONCOLOGY WARD, ENDOCRINOLOGY TEAM

TEAM MEMBERS:

- Tom Hicklin: Ward Manager Ward 11
- Claire Higham: Consultant Endocrinologist
- Mohitraje Mankumare, IMT-2 Trainee

### Background:

Six hip fractures were identified during inpatient admissions during the Christie in 2020/2021. All six patients had an interruption to their oncology management as a result (including transfer to acute hospital, orthopaedic surgery and management) and all died within 12 months of sustaining the fracture. Patients with an oncology diagnosis are likely to be at higher risk of fragility fracture for several reasons. There is a lack of local and national guidance on bone protection in adult oncology patients.

The FRAX assessment tool[1] was developed to evaluate fracture risk of patients. The FRAX algorithm provides a ten-year probability of a major osteoporotic fracture (clinical spine, hip, forearm or humerus) and/or hip fracture and can be used to identify patients at low, intermediate, high or very high risk of fracture. The FRAX online assessment tool is linked to treatment recommendations from the National Osteoporosis Guidelines Group (NOGG) UK[2]. Recommendations range from lifestyle advice to measurement of bone mineral density (BMD) via DXA scan with thresholds for medication treatment and specialist referrals.

On review of the six patients with fracture at the Christie, all had a fracture risk calculated using the FRAX algorithm which placed them into the “measure BMD” group, implying that there may have been an earlier opportunity to identify these patients were at risk and intervene to potentially prevent the fracture, with the aim to allow continuation of oncology treatment and reduce morbidity, mortality and environmental impact.

### Specific Aims:

To review the fracture risk in an unselected group of Oncology in-patients using the FRAX questionnaire and determining the workforce/environmental/medication implications of this. Environmental and financial cost of the screening will be compared to the impact of a fracture and its management**.**

### Methods:

A modified FRAX questionnaire (based on the Christie DXA service patient questionnaire) was administered to 11 inpatients on Ward 11 who were able to complete it. Dr Higham reviewed the questionnaires and calculated the FRAX score using the results and information (medications/height/weight) available on The Trusts electronic note system (Clinical Work Portal).

The outcomes of the questionnaire (lifestyle advice/DXA scan recommended/treatment) were evaluated for their workforce/economic and environmental outcomes and compared to the environmental impact of a hip fracture.

For the purposes of this audit, we were looking at potential implications of rolling this out on the wards. It is not currently in any recommendations to screen oncology inpatients and those identified from our audit as requiring treatment were already receiving treatment or under investigation. Therefore, there were no changes made to patient care.

## Measurement:

***Patient outcomes:***

- FRAX score in 13 acute oncology patients was used to extrapolate potential treatment costs for 100 patients.
- The six unselected inpatients on acute Oncology ward at the Christie (ward 11) who experienced a hip fracture during an admission in 2020/2021 were used as a model population in terms of incidence of fracture within the inpatient population at the Christie.
- A larger piece of work would be required to look at a larger population to increase accuracy and applicability of data.

***Environmental sustainability:***

The results from screening with FRAX were translated into CO2e compared to carbon footprint of a hip fracture.

The carbon emissions associated with the treatment drugs were estimated using an Environmentally Extended Input Output Analysis (EEIOA), In EEIOA, financial spend in a sector is directly converted into kgCO2e. The cost of each treatment drug was collected and converted into kgCO2e using emissions factors taken from the 2020/21 Greener NHS database (pharmaceutical factor 0.1277 kgCO2e/£). Treatment carbon emissions were extrapolated to 5-year patient treatment plan.

Lifestyle advice carbon emissions were estimated based on a two-page patient leaflet. Carbon emissions associated with a DXA scan was estimated based on energy consumption of one scan (provided by Trust), energy consumption was converted into carbon emissions using electricity carbon conversion factor taken from BEIS 2022 database. A 10-page patient questionnaire and patient travel was also included. Carbon emissions associated with patient travel were estimated based on average patient journey (taken from HOTT), it was then assumed that 20% of patients have additional travel associated with a scan (80% already inpatient).

The minimum care given for a hip fracture was used to determine average CO2e however this is likely a large underestimation of the cost of a fracture.

***Economic sustainability:***

- Cost of screening DXA scan was taken from Turner et al 2018[3].
- Treatment costs for DXA scan and medications were obtained in paper by Glynn et l (2020)[4].
- The cost of a fracture was taken from a recent paper by Baid et al (2022)[5]

***Social sustainability:***

We plan to collect qualitative data from patients and staff in future and have detailed anticipated results below.

## Results:

***Patient outcomes:***

13 patients (10 females, 3 males) were evaluated for FRAX score**.** Median age 62 (range 39-77) years.

**Risk Factors for fracture:**

2 patients had previous fractures (hip, vertebral, pelvic), one on alendronate therapy
1 had history of parental hip fracture

5 were treated with glucocorticoids
2 had history of Rheumatoid Arthritis

**FRAX score:**
Mean(+/-sd) 10yr risk of hip fracture 3.5(+/-5.6)%
Mean (+/-sd) 10yr risk of Major Osteoporotic Fracture 9.3(+/-6.6)%

**NOGG interpretation of the FRAX score:**
6/13 Lifestyle treatment
5/13 Bone Mineral Density testing (DXA scan) recommended
2/13 Treatment recommended without need for Bone Mineral Density testing (DXA scan).

**Population assessment:**
2/13 died
4/13 prognosis of weeks-months

Implementation of an effective screening/surveillance program would have Oncology population level implications.

***Environmental sustainability:***

Carbon Footprint of FRAX testing in acute Oncology setting for 13 patients:

| Interventional treatment option | Carbon footprint (kgCO2e) | Number of patients recommended intervention | CO2e for 5 years |
|---|---|---|---|
| Lifestyle advice | 0.0088 | 6 | 0.0528 |
| Dex scan (x1) | 3.03955 | 5 | 15.2 |
| Vitamin D3 tablets* (per patient per week) | 0.010546529 | 0 | NA |
| Bisphosphonate: Alendronic acid (per patient week) | 0.086823729 | 2 | 45.1483 |
| Bisphosphonate: Adcal (per patient per week) | 0.047082721 | 2 | 24.48 |
| **Total** | | | 84.8819 |

*Patients will be recommended either Vitamin D or Adcal. For the purposes of our audit, the more expensive option (Adcal) was used.

The CO2e for 13 patients based on 5 years of treatment with Alendronic acid and Adcal is 84.9 kgCO2e. Projected to 100 patients this equates to 653 kgCO2e for 5 years, or 129 kgCO2e per year. This is an underestimation as dependant on result of the DXA scan, patients may have required additional treatment with Vitimin D or Alendronic Acid.

The following information was considered when interpreting our patient data into potential reduction in fractures and subsequent environmental and financial impacts.

- Randomised control trials: patients with osteopenia/osteoporosis (post menopausal women generally) have a 40-50% reduced risk of hip fracture at 3 years on Zolendronate and 5 years with Alendronate
- SCOOP trial[3] (screening of a post menopausal women in community using FRAX) showed that at 5 years the screening and following of FRAX recommendations led to a 30% RR reduction for hip fracture at 5 years compared to non-screened population. This study also demonstrated cost-effectiveness to screening.
- bisphosphonates can reduce incidence of hip fractures by 40%

**Patients in treat zone without BMD: 2/13**

- Risk of hip fracture over 10 years: 25% (12.5% over 5 years)
- Therefore, approximately 13/100 patients in an unscreened population would have hip fracture in 5 years.

Based on evidence bisphosphonates can reduce incidence of hip fractures by 40%, this would reduce from 13 to 8 patients in a screened population over 5 years.

**Patients recommended BMD scan: 5/13**

- Mean risk of hip fracture over 10 years: 1.76% (0.88% over 5 years). Therefore, an additional 1 hip fracture predicted over 5 years

Based on the above, we estimate that for 100 patients treated, the incidence of hip fractures will reduce by 5-6 fractures over 5 years. We have assumed prevention of 1 fracture per year for 100 patients treated to determine our CO2e saving estimations below.

**Carbon Footprint of one hip fracture operation:**

| Intervention | **Carbon footprint (kgCO2e) per unit** |
|---|---|
| Surgical procedure (66-132 mins) | 35.1-70.2 (Mean 52.65) |
| Inpatient bed day (low-intensity ward) | 37.9 |
| AandE (emergency department visit) | 13.8 |

Based on average 10 day stay following hip surgery for one patient this is a cost of 445.45 kgCO2e. This will be a significant underestimation as it is not including rehabilitation, ongoing pain medications, and additional care and potential complications associated with a hip fracture.

**Potential savings**

Therefore, as a rough estimate a carbon saving of **316.45 kgCO2e** for 100 patients screened. This is equivalent to 911.4 miles driven in an average car.

This is likely a significant underestimation based on reasons stated above. These results do also not account for incidence of major osteoporotic fracture (clinical spine, hip, forearm or humerus) which will also reduce with screening and treatment.

***Economic sustainability:***

The approximate cost for 100 patients screened and treated in one year is £6,500. The approximate cost for 1 hip fracture in year following treatment is £10,000. This indicates a potential saving of **£3,500 per year.** As per our environmental findings, this is likely a significant underestimation.

***Social sustainability:***

It is very distressing for patients, staff and the Trust to have patients that sustain fractures (particularly hip fracture) during oncology treatment. Prevention of this, or at least a programme for prevention could be beneficial on many levels.

Additional staff time is required to complete the Frax assessment and scoring however longer term this could be supported by integrating the scoring into the Trust electronic system. The initial admission paperwork for the Trust already captures data required for the majority of the assessment, which would save staff time.

## Discussion:

Use of effective screening tests and treatments for Oncology patients (inpatients/outpatients) for fracture risk could have implications for mortality/morbidity and carbon footprint.

**Limitations:**

- A very short timescale for this project, a covid outbreak and NHS staffing pressures meant that only a small number of questionnaires could be collected.
- Our results are estimated only on 13 patients. We need larger numbers of assessments to determine scale of this and determine more accurate results.
- The estimated reductions in fracture risk are based on post-menopausal population and we do not have the direct evidence for the same efficacy in an unselected Oncology population
- The patients on Ward 11 were of high acuity and poor prognosis at the time of assessment, potentially limiting applicability in the longer-term data – should be performed also in a group
- Collecting FRAX data ideally needs to be automated

## Conclusions:

Hip fractures have devastating consequences to the patient and the environment and **t**here are effective screening tests and treatments available that reduce fracture risk. Our study has modelled savings based on a small cohort of inpatients. There would be a large number of outpatients experiencing hip fractures requiring admissions, treatments and surgeries at local hospitals. Implementation of screening and treatment also has potential to reduce incidence of major osteoporotic fracture (clinical spine, hip, forearm or humerus). While these fractures may not require as much treatment (e.g. may not require hospitalisation) the clinical benefits for patient morbidity pain and mortality.

More work is required with a larger patient group of inpatients/outpatients to optimise screening strategy. As an outcome of this project, we have developed relationships with the Trust Frailty team who have also been looking at the use of FRAX assessment. We plan to work together to progress this work.

These pilot data, modelling of sustainability benefits and future quality improvement projects will align with the new Bone Cancer Research Trust (BRC2) Living with and beyond cancer bone health theme; led by Dr Claire Higham; looking at improving bone health and preventing fractures in Oncology patients.

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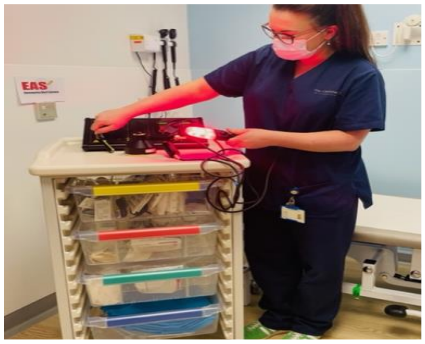
## 5. PHOTOBIOMODULATION THERAPY (PBM): USING LIGHT THERAPY FOR ORAL MUCOSITIS, PALLIATIVE CARE TEAM

TEAM MEMBERS: Alexandra Langstaff, Clinical Nurse Specialist, Supportive and Palliative Care



### Background:

The Christie NHS Foundation Trust in Manchester is one of the largest cancer treatment centres of its type in Europe. When diagnosed with head and neck cancer, many patients require radical treatment inclusive of both chemotherapy and an extensive course of radiotherapy[1]. Significant early and long-term side effects are not uncommon[2] and may include xerostomia, dysphagia, pain, nausea, fatigue, and speech difficulties[3, 4].

The most problematic of early side effects for patients with a cancer diagnosis involving base of tongue and tonsil cancer is mucositis; inflammation and breakdown of the mucosal lining in the oral cavity / oesophagus[5]. Mucositis can result in severe pain and complications such as lack of nutrition[6] requiring supplemental feeding (e.g. a nasogastric tube). Mucositis also presents a significant risk for infections and sepsis[7].

Patients experiencing significant effects of mucositis often require additional hospital appointments and admissions, sometimes for several days or more. This takes both a physical and psychological toll on the patient, having a major social impact due to limiting engagement in social activities around mealtimes and psychosocial issues due to the embarrassment of the mucositis itself, oral malodour and having a feeding tube visible on the face[8, 9].

During 2018 after consideration of available evidence, The National Institute for Health and Care Excellence (NICE) published interventional procedures guidance recommending the use of Photobiomodulation (PBM) for the prevention or treatment of oral mucositis[10]. There are more than 700 randomised controlled clinical trials available examining PBM for a variety of uses in the medical field[11], with over 50 successful trials alone evaluating PBM in relation to oral mucositis. Since NICE approval, PBM has been recommended as an adjuvant intervention for prevention of oral mucositis for head and neck cancers by Multinational Association of Supportive Care in Cancer (MASCC) and the International Society of Oral Oncology (ISOO).

PBM involves application of light to tissues to promote healing, reduce inflammation and increase cell metabolism[12, 13]. PBM stimulates the natural healing process, in turn reducing pain. Using the correct wavelength to displace mitochondrial nitric oxide (mtNO), oxidative stress is reduced and cellular adenosine triphosphate (ATP) production increases. This process promotes cell metabolism, therefore reducing inflammation and triggers the natural healing process[14].

Within our service, our team want to minimise the negative effects of radiation and improve the quality of life of our head and neck patients. There are approximately 518 patients per year who have radical

treatment for a range of head and neck cancers and therefore at high risk of mucositis potentially leading to use of controlled medications, alternative feeding routes and emergency admissions.

As the Supportive and Palliative Care Team manage patients at all different stages of their cancer treatment, PBM was raised as a potential supportive measure that may run alongside cancer treatment.

## Specific Aims:

To evaluate the clinical, social, financial and environmental impacts of PBM as a supplemental treatment for the prevention and/or reduction of oral mucositis for base of tongue and tonsil oncology patients undergoing radical radiotherapy +/- chemotherapy.

## Methods:

A representative from the equipment supplier, Thor[11], was contacted to arrange a meeting and demonstration. Due to the confidence of the equipment supplier in regard to the beneficial effects of PBM, the equipment was given on loan with no associated costs. Over a period of four months a PBM unit was sourced and trialled in a small cohort of our head and neck patients at The Christie.

A total of twenty-two patients were included in evaluation to evaluate if PBM would be an effective treatment for reducing mucositis symptoms alongside the associated treatments and admissions. There was an equal number of patients in the control and study/treatment group, both of which had a comparable mean age. All patients were undergoing radical radiotherapy +/- chemotherapy for base of tongue or tonsil cancer (due to their high risk of severe mucositis).

**Control group**: Retrospective patient data was collected from clinic records for 11 patients who had recently completed radical radiotherapy and had their six week follow up appointment. The control group did not receive PBM treatment and were treated for symptoms of mucositis as they presented.

**Treatment group:** 11 patients were identified from the head and neck new patient clinic who were to receive the same radiotherapy treatment as the control group. This group received PBM treatment alongside their radiotherapy treatment for 30 consecutive days (the common duration or a radiotherapy treatment regime).

Patients received their PBM treatment before each radiotherapy session, therefore no additional journeys were expected to be made by the patient. The first treatment was delivered with support from myself (Clinical Nurse Specialist), however subsequent treatments were self-administered by the patient.

A hand-held probe is used to deliver light to the oral mucosa, both intra and extra-orally (as pictured). Light is applied for a period of one minute per area, and seven areas are treated. The treatment takes approximately 15 minutes of patient time in total, with a direct treatment time of 7 minutes.

Following analysis of our results, our next steps are involve presenting to the Head and Neck team with a plan to implement PBM into the treatment protocol for all within this patient cohort.

## Measurement:

***Patient outcomes:*** The following was compared across the control and treatment groups:

- Severity of mucositis symptoms:
  Mucositis is graded using a national grading tool from The Radiation Therapy Oncology Group (RTOG) which scales toxicities such as mucositis and external skin damage (REF). On each day the patient's oral cavity would be examined for any reaction or deterioration and grade on the RTOG scale and document. Additionally, each patient is seen weekly by the Head and Neck team to assess side effects. During this appointment they also grade the level of mucositis, therefore the accuracy of grading was confirmed.
- Frequency and length of unplanned admissions:
  When a patient is admitted documentation is kept on our hospital database, reason for admission is listed. Therefore, I was able to identify admissions related to mucositis. This would also identify if an alternative feeding route (nasogastric tube) was needed or if admission was a mucositis related infection.
- Type and dose of medications required because of mucositis for pain:
  I regularly checked medication use with detail on when initiated, frequency taken and dose. This information is also listed with their weekly Head and Neck team assessment.
  We looked specifically at use or Morphine and Pregabalin
- Any further treatments or interventions required because of mucositis such as nasogastric tube insertion and anti-biotics for infection.

***Environmental sustainability:***

The number of bed days (from unplanned admissions) and differences in medication start dates and dosages were used to estimate carbon savings from PBM treatment.

CO2e for unplanned admissions was estimated using the 2015 Sustainable Development Unit (SDU) (now Greener NHS) emissions factor for a low intensity ward bed day (37.9 kgCO2e). Additional emissions for patient travel were also included based on average patient distance taken from the Health Outcomes for Travel Tool (HOTT) and converted into carbon emissions using CSH's patient travel calculator.

CO2e reduction for reduced medications (Morphine, Pregabalin and antibiotics) were estimated using a top-down Environmentally Extended Input Output Analysis (EEIOA). The emissions factor for pharmaceuticals (0.1277 kgCO2e/£) taken from 2021/22 Greener NHS database was used to convert drug cost saving into carbon emissions.

It was not possible to include carbon savings for nasogastric tube insertion and feeds at this stage due to many variables involved and extensive data collection that would be required.

To estimate CO2e from the PBM device and treatment, we calculated the kgCO2e from electricity usage per patient. We did not carbon footprint the device as based on the significant number of uses the CO2e per use would be very small.

***Economic sustainability:***

A bed day cost of £513 (including all overheads and running costs but no treatment or drugs) was provided by the Christie finance team.

Costings for medication taken from British National Formulary (BNF)[16]. The cheapest cost available was used for medication and therefore may be an underestimation.

The investment cost of one PBM device is £25,000. To provide the service full time to those most at risk of developing mucositis (180 patients/year) 6 devices are required. Therefore, the investment cost for

full implementation of this treatment is £150,000 (including servicing and warranty of machines). The lifespan of the device is reported by Thor as a minimum of 10 years.

***Social sustainability:***

We obtained qualitative data from patients on their experience of using the PBM device.

## Results:

**Clinical, Environmental and Economic outcomes:**
The table below summarises a comparison of the control and treatment patient group outcomes. The clinical data has been translated into financial and CO2e savings.

| Patient outcome | Control Group | PBM Treatment Group | Difference in groups | £ saving | CO2e saving |
|---|---|---|---|---|---|
| **Admissions** | | | | | |
| Number of admissions | 10 | 3 | 7 admissions | £32,319* | 2,483.39* |
| % unplanned | 35% | 10% | 25% reduction | | |
| Length – range | 1-33 nights | 1-5 nights | NA | | |
| Length - average | 7.1 nights | 2.6 nights | 4.5 days | | |
| Bed days - total | 71 days | 8 days | 63 days | *Admission savings based on bed days total and travel reductions | |
| **Medication – Morphine** | | | | | |
| number of patients prescribed *Same dosage 4 times daily | 11 (100%) | 4 (36%) | 7 (64%) | £162.40 *for 7 patients saving 4 weeks of medication | 20.74 |
| Average week of radiotherapy course medication was prescribed | 2.4 weeks | 4.3 weeks | 1.9 weeks *We have assumed 3 weeks difference due to 7 patients having no morphine | £69.60 *for 4 patients saving 3 weeks of medication | 8.89 |
| Number of patients continuing morphine 6 weeks post treatment | 55% (6/11) | 50% (2/4) | | NA - Not included in financial and carbon savings or projections | |
| **Medication - Antibiotics – 7 day course** | | | | | |
| Oral – number of patients prescribed | 4 | 0 | 4 | £30.80 | 3.93 kgCO2e |
| IV - number of patients prescribed | 1 | 1 | No difference | NA | NA |

| Medication – Pregabalin | | | | | |
|---|---|---|---|---|---|
| Number of patients prescribed | 10 | 9 | 1 | NA | NA |
| Average week of radiotherapy course medication was prescribed/ commenced | 2.4 weeks into radiotherapy course | 4.3 weeks into radiotherapy and PBM course | 1.9 weeks *We have assumed 3 weeks difference per patient as 2 patients did not need any treatment in this time | £515 | 65 kgCO2e |
| Average dosage | 98mg twice daily | 65mg twice daily | 66mg saving per day per patient | £247.90 | 31.66 kg CO2e |
| Number of patients continuing pregabalin 6 weeks post treatment | 7 patients | 3 patients | 50% reduction on patients still needing medication at week 6 | NA - Not included in financial and carbon savings or projections | |
| Nasogastric tube insertion | 4 patients | 1 patient | 75% reduction | NA – NG equipment and community needs not included in financial and carbon savings or projections | |
| Total difference | | | | £33,345 | 2,613.99 |

**Treatment:**
For 30 days of treatment, 0.04 kgCO2e is used per patient. Removing this from our savings above, gives a total carbon saving of **2,613.99 kg CO2e per year** based on 11 patients. This is equivalent to 7,528.77 miles driven in an average car.

Based on treatment eligibility to the full 180 tonsil and base of tongue cancer patients per year, having one 30-day course of radiotherapy and PBM a year, our savings will increase to 42,774 kgCO2e per year. This is equivalent to 123,197 miles driven in an average car. However, this is likely an underestimation of savings given additional benefits that were not measured (reduced nasogastric tube and associated equipment, reduced medication courses post treatment).

***Economic sustainability:***
There is a cost of 5p for electricity per patient treatment course. To treat 180 patients in a year the electricity cost would therefore be £90.00 (based on average UK electricity costs in January 2023)**.** For 6 devices the investment cost is £150,000. Assuming treatment for 180 patients per year and a 10-year lifespan for each device, the treatment cost is therefore £83.35 per patient per year.

The cost for the treatment group was therefore £916.85. Accounting for PBM treatment costs, we have saved **£32,428** in admission and medication costs in our cohort of 11 patients.

Projected to all 180 eligible tonsil and base of tongue cancer patients, our savings have potential to increase to £530,640.36 per year in admission and medication costs. However, a large proportion of this savings is due to reduced inpatient admissions, so this will not be a cash-releasing saving.

***Social sustainability:***

This intervention requires no extensive training for staff and minimal input from employees due to patient self-administration. There is potential for improved job satisfaction for employees working

within this patient cohort as staff will be aware they are reducing incidence of pain and discomfort and improving quality of life for their patients. There is potential to save waiting times for bedspaces by reducing emergency admissions to the hospital for mucositis related issues (pain, feeding, infection).

For patients, the device is easy to use, non-invasive and only takes a few minutes each treatment so it does not add significant time spent within the hospital or alter treatment completion dates. Successful treatment will improve ability to engage in social life, such as mealtimes with family and friends.

Patients felt involved in their treatment and reported they felt 'empowered' and in control in a time where loss of control has been felt throughout.

> *"It was easy to use, and I would recommend it to others undergoing head and neck radiation"*
>
> *"One doctor did remark that I was better than he expected at this stage"*
>
> *"The treatment itself was fine - not intrusive or complicated just very easy and quick to complete the daily procedure. I am assuming this treatment has been very beneficial because I did not suffer from most of the really bad side effects from radiotherapy that the doctors thought I might"*
>
> *"I hope everyone can now benefit from this treatment and would thoroughly recommend it. Also it was very mentally reassuring to think that I am benefitting from some new state of the art technology..."*

Patients did not need to attend hospital more frequently as their treatment took place after their radiotherapy session. However, we were unable to deliver treatment in the radiotherapy department and patients had to attend a different area of the hospital for PBM. This was more challenging for patients, in particular those who had reduced mobility, and was raised by patients in the evaluation.

## Discussion:

This small study demonstrates that implementation of PBM treatment has great potential to offer benefits across the triple bottom line of sustainable value while improving our patient care. There are many benefits that were not directly measured, and we therefore anticipate the savings from the implementation of PBM into treatment protocols are significantly underestimated.

Additional costs may include cost of imaging associated with nasogastric tube positioning, cost of training to use feeding equipment and cost of dietetics support in the community. Patients may also continue medications included within the study for an extended period of time which was not captured within our current study. Patients may have many more unplanned admissions which require additional appointments with the head and neck team in which consultant input is required.

**Limitations**

- Patient evaluation was not anonymous which could potentially bias patients' responses regarding their treatment.
- Size of sample and length of evaluation: Evaluation could be extended to capture a larger sample and longer time post treatment, again benefits could be underestimated as many continue to experience effects of mucositis beyond 30-day treatment period.
- We did not carbon footprint the PBM device itself. To do a full bottom-up process-based analysis we would need significant information from the company which would be very time consuming, and using financial cost would be inaccurate.

**Barriers / challenges encountered**

- Potential risks: There are no reported side effects in history of PBM according to suppliers. However, as there are options for both flashing and static light for PBM delivery, to prevent exacerbation of existing comorbidities such as migraine/epilepsy, treatment was delivered for all patients on the static setting.

- To provide further protection, protective glasses that eliminate LED light were also offered to patients. This worked well for a patient with a history of migraines.
- Other patients in head and neck cohort had heard about treatment via word of mouth. This was challenging as a practitioner unable to offer to others despite awareness of their side effects.

**Other settings:**

PBM treatment is applicable to patient cohorts beyond tonsil and base of tongue. It can support breast cancer-related lymphoma where post treatment patient's experience pain, tightness and heaviness and lymphedema; for radiation fibrosis syndrome; and for Haematopoietic stem cell transplantation (HSCT) in both paediatric and adult populations.

## Conclusions:

The study of patients PBM confirmed findings highlighted within NICE guidelines, beneficial effects were evident and revealed improvements to patient side effects, reduced admissions, reduced medication use and a quicker recovery (highlighted by discontinuation of analgesic medication. All of these factors show a knock-on effect to achieving NHS net zero targets with significant reductions in cost and carbon emissions. The supplier who provide PBM equipment were unaware of the clear environmental benefit of the product and how this will affect marketability for them by meeting NHS net zero agenda.

We are now in discussion with the head and neck team to incorporate PBM into treatment protocols for this patient group. Completion of a business case to purchase machines to deliver PBM on radiotherapy dept pre-treatment is underway. Post purchase, we will evaluate patients using PBM for a period of 1 year to assess effect with a large patient sample. We also aim to liaise with a number of NHS trusts, to disseminate sustainability information and demonstrate the 'green' element of this treatment.

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## AWARDS

### WINNERS: PALLIATIVE CARE TEAM

### HIGHLY COMMENDED: WARD 11 / ENDOCRINOLOGY TEAM

Congratulations to the WINNING team, the Palliative Care team, led by Alex Langstaff. Use of photobiomodulation therapy to prevent painful side effects of cancer treatment keeps patients at the centre of sustainable changes, and the resulting impacts are an exemplification of the triple bottom line of sustainable value and SusQI in practice. We at CSH are looking forward to hearing updates from the team as they work to embed this treatment into their everyday care pathways for head and neck cancer patients.

The winning team received a prize of £500 to invest into their sustainability work.

## ACKNOWLEDGEMENTS

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

Thank you to William Blair - Sustainability Manager, Joanne Woolley – Clinical Audit and Improvement Manager and Angela Hayes – Clinical Nursing Specialist with informal role in clinical sustainability, for partnering with us for The Christie's Green Team Competition.

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

- Christopher Harrison, Net Zero Board Lead and Executive Director
- Christine Outram, Chair
- Roger Spencer, Chief Executive
- Siobhan Parslow-Williams, QI Education Lead (Centre for Sustainable Healthcare)

Thank you to Rosie Hillson - Carbon Modelling Assistant with The Centre for Sustainable Healthcare for your careful and highly skilled work in carbon footprinting, equipping teams with the knowledge and tools to carry out 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.

> ***"I'm thrilled that Alex's fantastic work in palliative care has shown such dramatic results and demonstrated perfectly how sustainable ways of working can have so many benefits!"***
>
> Angela Hayes, Clinical Nurse Specialist, Supportive and Palliative Care.

**POTENTIAL ANNUAL SAVINGS**

The following table provides detail on the **annual** savings available to the Trust from the 2022 Green Team Competition projects. Savings in black text are based on actual changes made during the competition. Savings in red text are based on planned or potential changes that require longer to implement.

| Project | Financial Outcomes | Environmental (CO2e) Outcomes | Social Outcomes | Clinical Outcomes |
|---|---|---|---|---|
| Streamlining Crash Trolley Equipment | £11,683.28 | 1,205.65 kgCO2e | • Reduced workload for Outreach and pharmacy technician and ward teams involved in daily checks of Crash Trolleys | No impact on patient care |
| A surgical golden patient | £7,020.49 (50% reduction in cancellations, 20% reduction in overruns) | 870.9 kgCO2e (50% reduction in cancellations, 20% reduction in overruns | • Staff survey highlighted team feel cancellations and delays are a problem with 71% agreement of proposed changes.<br>• Increased service efficiency<br>• May reduce patient waiting time in hospital and anxiety regarding procedures.<br>• May reduce inconvenience to patients (e.g., more time off work, unnecessary travel to hospital) | • Treatment timelier and more efficient<br>• May reduce unnecessary or longer fasting times |
| Assessing Piped Nitrous Oxide Clinical Use, Wastage | £1,681.70 | 54,236 kgCO2e | • project appreciated by department, with informal feedback indicating it raised awareness of $N_2O$ emissions and highlighted the need to transition towards greener anaesthetic practices. | No impact on patient care |
| Identifying patients at high risk of fracture on an acute Oncology ward | £3,500 | 316.45 kg CO2e | • Reduced distress for patients, staff and Trust associated with oncology patients sustaining hip fractures.<br>• Additional staff time is required to administer the FRAX assessment, however longer term this could be embedded into admission paperwork (as majority of information needed already captured at this time) | • Prevention of health implications associated with hip fracture, in turn preventing interruptions to oncology treatment |
| Photobiomodulation therapy (PBM): Using Light Therapy for Oral Mucositis | £32,428 / 11 patients<br>£530,640.36 projected to full cohort (180 patients) | 2,613.99 kgCO2e / 11 patients.<br>42,774 kgCO2e projected to full cohort (180 patients) | • Minimal staff training required.<br>• Improved staff satisfaction seeing patients experience less side effects/pain.<br>• For patients - device quick, easy to use and can be self-administered<br>• Improved quality of life for patients<br>• No additional travel to hospital required.<br>• Potential to save waiting time for bed spaces | • Reduced admissions.<br>• Reduced doses of Pregabalin and Morphine<br>• Reduced antibiotic courses.<br>• Reduced need for nasogastric tube supplemental feeding |
| **Total Savings** | **£554,525.83** | **99,403 kgCO2e** | | |