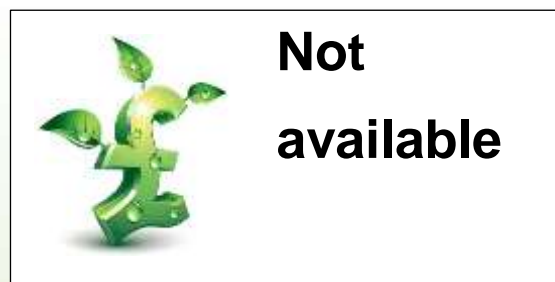
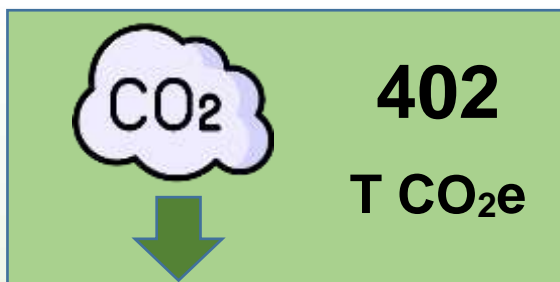


National Green Theatres Programme

Prògram Nàiseanta Lannsaireachd Uaine

Implementing lean surgical trays

Date: July 2024



1. Description of action

- 1.1 This action aims to reduce the carbon and financial costs associated with the decontamination of surgical trays, by leaning surgical trays across all specialties in NHS Scotland. This will involve local clinical teams working collaboratively to agree and remove items that are infrequently or rarely used with the aim of reducing the number of trays needed per operation/procedure.

2. Background

- 2.1 Surgical instruments are typically grouped into sets that contain instruments used for a range of procedures or operations and are placed on trays or baskets¹. After use the trays are transported to the local central decontamination unit where they will go through a process of decontamination, the trays are:
1. cleaned and disinfected,
 2. packaged, then,
 3. sterilised.
- 2.2 The process involves cleaning and microbial inactivation by means of sterilisation²; this is most commonly achieved using steam in moist heat sterilisers. Certain instruments are sterilised through low-temperature sterilisation methods using hydrogen peroxide. Once the trays and instruments are wrapped using the sterile barrier system they will go through the sterilisation process. The wrapping allows the sterilisation agent to permeate through the barrier and prevents post-treatment entry of microorganisms, ensuring sterility is maintained until the point of use³.
- 2.3 In NHS Scotland there are currently 15 decontamination centres, 14 of which are managed by NHS Scotland Boards:
- NHS Lanarkshire's service is managed through a third party company, Steris.
 - NHS Greater Glasgow & Clyde has 2 dedicated centres strategically positioned to address demand stemming from the densely populated areas they serve.
 - NHS Fife's service is provided by NHS Tayside.
- 2.4 The purpose of each decontamination centre is to ensure that surgical instruments and devices used by clinicians in essential services are clean, safe, fit for purpose and ready for use.
- 2.5 From January 2023 to January 2024 decontamination centres helped support the safe delivery of 274,873 planned operations across NHS Scotland⁴ by processing more than 38

¹ [OP-BJSU210434 1..11 \(nih.gov\)](#)

² <https://www.nss.nhs.scot/media/2066/shtm-01-01-part-a-v10-sep-2018.pdf>

³ International Organization for Standardization. ISO 11607- 1:2019 Packaging for Terminally Sterilized Medical Devices—Part 1: Requirements for Materials, sterile Barrier Systems and Packaging Systems.

<https://www.iso.org/obp/ui/#iso:std:iso:11607:-1:dis:ed2:v1:en>

⁴ Figure does not include emergency cases. Data from PHS Discovery site [accessed 16/04/24]

million surgical instruments, packs and supplemental items⁵. This service is key to delivering safe care across NHS Scotland.

- 2.6 Due to the energy-intensive processes required to ensure sterility, decontamination services generate a significant carbon footprint. An article published in the British Journal of Surgery identified that a single surgical instrument has an associated carbon footprint of 0.052kg/Co2e⁶. If this is equated to the current national demand in NHS Scotland, decontamination services carry an estimated carbon footprint of 2,010 tonnes⁷. Data from Health Facilities Scotland also indicates that it costs, on average, £1.23 to process a single surgical instrument.⁸ This price is indicative and is based on both staff costs and non-pay costs. Working on this assumption, the cost of providing decontamination services in Scotland is currently £47,554,609 per year. Whilst these services are vital it is important to work with decontamination services to understand any opportunities for reducing excess carbon emissions and supporting the implementation of these changes.
- 2.7 Globally, strategies have been adopted to improve cost-effectiveness and sustainability within the healthcare sector. Among these approaches is the streamlining of pathways and techniques. This involves a continuous process of improvement aimed at implementing small changes focussed on eliminating waste and optimising quality of care. Within operating theatres, adopting streamlined methods such as the standardisation of protocols reduces variability and enhances perioperative efficiency. An example of adopting streamlined techniques is the removal of the instruments that are infrequently used to reduce unnecessary reprocessing of instruments (lean trays)^{9,10}. This improvement also offers an opportunity to release capacity back into the decontamination services.
- 2.8 Initial feedback from clinicians and decontamination colleagues in NHS Scotland indicate that there is considerable unnecessary sterilisation attributed to unused instruments. This view is also supported within the literature, which suggests that 20-60% of instruments in certain operations may go unused^{11,12}. It is important that every individual and team considers what action they can take to reduce the unnecessary processing of surgical equipment and their associated carbon emissions.
- 2.9 There could be an estimated carbon reduction of 402 tonnes annually if surgical teams across NHS Scotland successfully lean their current surgical sets by 20%. This reduction

⁵ Health Facilities Scotland - accessed 09/05/24. Figure may vary as certain boards use the Glennie formula to calculate items processed, this assumes each tray set has 46 instruments in total. Data set incomplete due to missing returns from 2 health boards so true figure will be higher. Total number submitted: 38,669,149.

⁶ Rizan C, Lillywhite R, Reed M, and Bhutta M. [Minimizing carbon and financial costs of steam sterilization and packaging of reusable surgical instruments \(2021\)](#).

⁷ Calculation: 0.052kg/Co2e x 38,669,149 items

⁸ Health Facilities Scotland – Data accessed 09/05/2024. Price based on January 2023 – December 2023.

⁹ Cichos KH, Hyde ZB, Mabry SE, Ghanem ES, Brabston EW, Hayes LW, et al. Optimization of orthopedic surgical instrument trays: lean principles to reduce fixed operating room expenses. The Journal of arthroplasty.

¹⁰ Cichos KH, Linsky PL, Wei B, Minnich DJ, Cerfolio RJ. Cost savings of standardization of thoracic surgical instruments: the process of lean. The Annals of thoracic surgery. 2017;104(6):1889-95.

¹¹ https://www.clinicalkey.com/service/content/pdf/watermarked/1-s2.0-S0002961022006675.pdf?locale=en_US&searchIndex=

¹² Farrelly JS, Clemons C, Witkins S, Hall W, Christison-Lagay ER, Ozgediz DE et al. Surgical tray optimization as a simple means to decrease perioperative costs. J Surg Res 2017;220:320–326.

would lower energy costs, water use and associated consumables which would lessen the current financial costs associated with decontamination services.

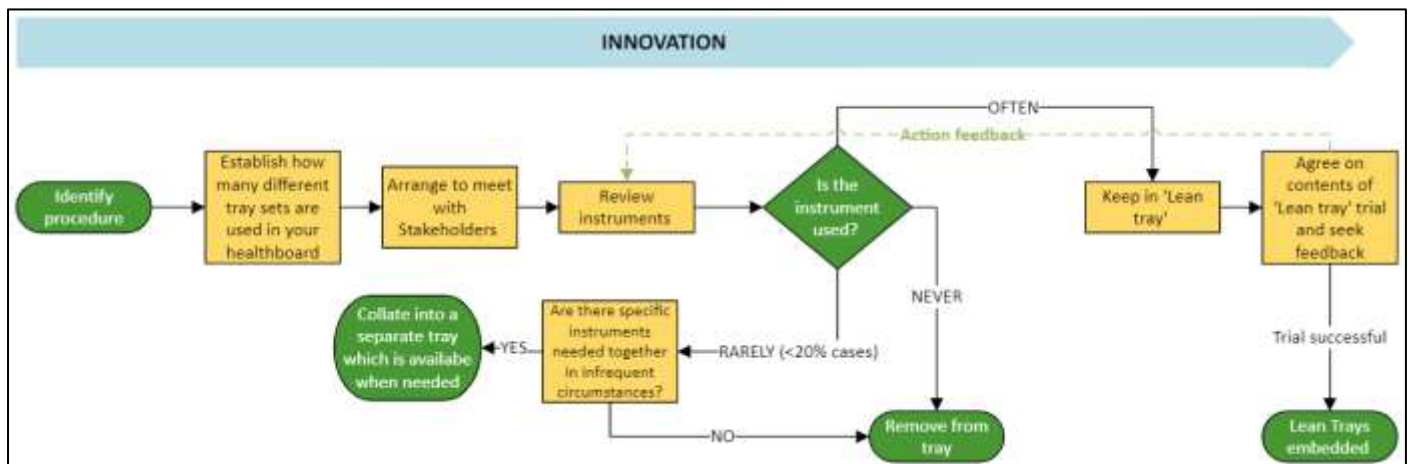
Pilot successfully trialled at the Golden Jubilee

Ghaith Al-Abbasi, Caitlin Brennan, Nick Ohly, Christopher Gee

- 2.10 The department of Orthopaedic surgery within NHS Golden Jubilee piloted the lean surgical tray project with the aim of reducing the carbon and financial costs associated with robotic-assisted total knee arthroplasty (RA-TKA). This was achieved by removing infrequently or rarely used items to reduce the number of trays requiring processing and sterilisation.
- 2.11 The contents of the trays currently in use were collected and surgeons routinely performing RA-TKA were consulted to reach a consensus on which instruments were essential and which could be removed. Instruments that were never used and rarely used (<20% cases) were removed from the trays. The removed instruments were placed in a separate 'conversion' tray that could be accessed in the unlikely event of conversion to a conventional knee arthroplasty during the procedure. The intention was to avoid additional individually sterilised and packaged supplementary items, since these create a further environmental burden, neutralising any benefit from creating leaner trays.
- 2.12 The team started by streamlining 3 out of their 10 sets over a 5 month trial period. The streamlined trays were used in 120 of the 210 RA-TKA cases. The pilot work was successful in allowing staff to recognise that many of the items on the standard trays were either not required or seldom used during RA-TKA surgery. During the project the overall count of instrument trays was reduced by 20% (5 trays down to 4), and the number of instruments reduced by 30% (from 52 to 36). During the trial, the conversion tray was only requested 5 times (4% of procedures). The department is now intending to streamline all 10 of their sets going forward.
- 2.13 During the pilot there was a reduction in the volume of trays processed by 115, providing a total carbon saving of 176 kgCo₂e (1.531kgCo₂e x 115) for avoided sterilisation processes. By decreasing the volume of trays processed and therefore the number of single use tray wraps required, a further 0.39kgCo₂e was saved per case, totalling 44.85kgCo₂e across the pilot. Overall, the new streamlined trays for use in RA-TKA led to a total carbon reduction of 220.85kgCo₂e.
- 2.14 Guidance on how to replicate this work within other specialties and procedures is included in section 3.

3. Guidance for local implementation

- 3.1 Local green theatre groups should share this Opportunity for Change with surgical colleagues for review. A nominated lead for the health board or site should be identified to coordinate the work with early engagement of the Board decontamination lead or manager responsible for decontamination. For example, tracking which specialties and teams are trialling leaning their surgical trays and for which procedure or operation type.
- 3.2 This change should be led and guided by surgeons in close collaboration with decontamination leads. The team at NHS Golden Jubilee have developed a lean methodology that can be used to illustrate the steps required to streamline surgical sets.



Step 1: Identify procedure

Identify the procedure that your team intends to streamline. We recommend focussing on common high volume procedures first.

Step 2: Establish how many different tray sets are used in your health board

Engage with colleagues within decontamination who can assist in identifying how many different tray sets are in circulation for the procedure identified. This is a good opportunity to discuss the upcoming changes and any impact this may have on their service and/or colleagues.

Once you have identified the number of different tray sets used for the procedure, collate a list of all the instruments either in written form or through images with corresponding numbers attached, as this can be easier to identify the items in question. An example is shown in figure 1.



Figure 1: Example of numbered surgical set

Instrument utilisation	Surgeon 1 response
1	Always used
2	Never used
3	Always used
4	Never used
5	Never used
6	Rarely used
7	Rarely used
8	Often used
9	Often used
10	Always used
11	Always used
12	Always used
13	Always used

Figure 2: Example poll/survey for colleagues

Step 3: Arrange to meet stakeholders

Convene a meeting or send a poll/survey with/to all clinicians who routinely perform the procedure to assess the frequency of instrument utilisation. For example, for each instrument clinicians would answer with 1 of 4 responses: always used, often used, rarely used (<20% of cases) or never used (see figure 2).

Once all responses have been gathered, meet with the clinicians and decontamination colleagues to agree which instruments can be removed from the tray set and which could be moved to a conversion tray or added as a supplementary item for use in rare occasions. Any decision must be communicated clearly to all appropriate colleagues through the most appropriate channel.

Step 4: Embed, review and report

Embed the newly leaned surgical trays into practice. The identified lead should monitor for any issues and adjust as necessary. The lead should also document the specialties and procedures within their health board or site where surgical trays have been reviewed and report the findings to their local green theatre group. A checklist on what information should be collected can be found within section 10, measurement plan.

4. Who needs to be involved in this change locally?

- 4.1 Surgical teams (which includes charge nurse and senior charge nurse colleague).
Decontamination colleagues.

5. Boundaries

- 5.1 The table below identifies the boundaries for this action:

In scope	Out of scope
Common surgical procedural trays	Complex subspecialty trays

6. What is the change and how will it be implemented?

- 6.1 This action asks clinicians to consider their current instrument use within an identified procedure with the aim of reducing the number of trays used per operation. This change will reduce the carbon footprint associated with delivering care to patients. Other associated benefits include:
- Decreased manual handling, resulting in a mitigated risk of occupational injuries.
 - Increased efficiency due to the reduction in manual counting of surgical instruments pre and post operatively.
 - Increase in decontamination service capacity will enable the consideration for transitioning certain single-use instruments to reusable ones.

7. What are the potential co-benefits of this change?

Outcome	Potential Benefits
Carbon Savings	402 tonnes
Cost Savings	Due to insufficient current data, cost savings will not be published until further analysis has been undertaken.
Staff experience	Captured in section 6.1

8. Risks and Issues

- 8.1 As part of the development of this action there has been one risk identified to date, outlined below.

Description of risk or issue	Mitigation / Action Plan
Unintentional increase in processing of items due to frequent opening of supplementary items.	Stakeholder involvement. Audit

9. Implementation Guidance

- 9.1 The opportunity for change highlights the importance of implementing this action. This change will help your site and NHS Scotland achieve net-zero emissions by 2040 as stated in NHS Scotland's Climate Emergency and Sustainability Strategy 2022-2026.
- 9.2 The National Green Theatres Programme has provided guidance below on how you can implement this change within your area.

Local Sustainability or Green Theatre Group:	
1.	Share this Opportunity for Change with surgical colleagues for review.
2.	Identify a nominated lead for the health board or site to coordinate the work with early engagement of the Board Decontamination Lead or Manager Responsible for Decontamination.
3.	Identify a surgical speciality and procedure(s) to progress as a pilot(s).
4.	Utilise a quality improvement approach to test, capture and learn from local piloting.
5.	Use local pilot work to inform and develop an implementation plan for delivering this action across all surgical specialities.
6.	Implement local plan.
7.	Report on plan, progress and improvements through National Green Theatres Programme.
8.	Monitor implementation of action.

10. Measurement plan

10.1 The identified lead is asked to coordinate this work and report on the following:

- Specialty
- Procedure identified
- Number of items included in surgical set **before** leaning process.
- Number of items included in surgical set **after** leaning process.
- Number of trays required **before** leaning surgical set.
- Number of trays required **after** leaning surgical set.

In terms of converting trays reduced into carbon savings, the following outlines information and calculations that could be utilised:

Area	Figure / Calculation
Number of procedures per year	
Number of trays used per procedure pre pilot	
Carbon associated per tray (kg)	1.53 ¹³
Carbon associated pre pilot (kg)	= Number of procedures X Number of trays pre-pilot X Carbon associated per tray
Number of trays used per procedure post pilot	
Reduction in carbon emissions with change in practice (kg)	= Number of procedures X (Number pre pilot trays – post pilot trays) X Carbon associated per tray

Beyond reducing the number of trays, it is important to highlight that there will likely be associated carbon savings through reduction in instruments and transitions to smaller trays. As further piloting work is undertaken, these may become changes where the carbon savings can also be quantified.

A reduction in instruments will increase space on existing trays, creating an opportunity to look at what reusable instruments could replace current single use instruments. This would also have an associated carbon saving.

¹³ Figure taken from: Rizan C, Lillywhite R, Reed M, and Bhutta M. [Minimizing carbon and financial costs of steam sterilization and packaging of reusable surgical instruments \(2021\)](#).

11. Acknowledgements

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- Lynn Angus, Senior Charge Nurse, NHS Golden Jubilee
- Karen Kirk, Registered Nurse, NHS Golden Jubilee
- Barbara Casey, Central Sterile Processing Department Manager, NHS Golden Jubilee

12. Further Information

12.1 If you have any questions about this case study or want to find out more, please [visit our website](#) or contact the National Green Theatres Programme by emailing cfsdgreentheatres@gjnh.scot.nhs.uk