

Design for Life Pilot Project

The Design for Life team, in collaboration with key partners, is working with pilot sites in the NHS to explore the potential for switching from single-use to reusable medtech products. This initiative aims to identify barriers, opportunities, and the benefits of such a transition, focusing on sustainability, cost savings, and improving healthcare efficiency. By quantifying these benefits, the project supports the NHS's broader goal of reducing waste and promoting a circular economy in medical technologies.

Contributors

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This report has been developed with contributions from several, but not all, Health Boards (HBs) in Wales, in collaboration with the NHS Wales Shared Services Partnership. While we have aimed to address considerations relevant to all HBs, it is important to note that there may be local variations and specific considerations not covered within this document. Due to the time-sensitive nature of this project, only those HBs that submitted an expression of interest were included in the process, which may account for the absence of some boards' contributions.

Background/current practice:

Tray wrap, a sterile packaging material, plays a critical role in maintaining the sterility of surgical instruments during storage, transport, and use in operating theatres. It is commonly used in surgical departments to ensure patient safety by preventing contamination.

Reusable surgical instruments are typically arranged in sets tailored to specific procedures or groups of procedures, then placed in trays or containers. After use, these instruments undergo a decontamination process, which includes cleaning followed by microbial inactivation through disinfection or sterilisation (usually steam sterilisation). Tray wraps allow sterilisation agents to permeate while preventing microorganisms from entering the packaging after the sterilisation process, thus maintaining sterility until the point of use. Once back in theatre, they are unwrapped by two staff members: one removes the outer packaging, while the other scrubs in and opens the sterile wrap to expose the instruments.

Clinical areas have varied access to Hospital Sterilisation and Decontamination Units (HSDU) across HBs. For example, Within Cardiff and Vale the main sterilisation unit is remote even though it is on the same site as the main hospital UHW. There are additional sterilisation posts throughout the HB. It is common practice that the SSD is located in close proximity to theatres so normally the kits are pushed from the SSD to theatres by staff not by a vehicle, however some sites will require delivery vehicles (e.g. The Grange).

In some departments or HBs, there may be external contracts with suppliers who collect, clean and return instruments. ABUHB has 5 sites offering surgery with sterilisation on 2 sites only. After the procedure, the wrap is disposed of as clinical waste.

Across Wales, the National Distribution Centre (NDC) oversees the procurement of medical supplies for all HBs, ensuring consistency through a national framework. This framework allows flexibility at the local level, with HBs having the option to choose from pre-established suppliers. While standard operating procedures (SOPs) ensure alignment with national procurement objectives, there may be local variations in governance, stakeholder engagement, and decision-making processes. Currently, there are 3-4 suppliers offering single-use tray wraps under the national framework. Single use wrap is the current standard across Wales.

Single use tray wraps typically consist of one to three layers of materials such as polypropylene and paper. However, the single-use nature of tray wraps contributes to ongoing waste within the NHS. ([Rizan et al, 2022](#)). The use of single-use wraps can lead to issues such as holes in the wraps and damage during handling and transportation of wrapped sets. Additionally, in operating theaters, wraps can shed lint/particulates under airflows, which may compromise the sterile environment and increase the risk of infection.

There are currently two potential options for switching to a reusable alternative - wraps (often made from a mix of polyester microfibre and carbon fibre) that can be laundered or rigid containers (often made of stainless steel or aluminium).

Aims:

To explore the considerations, opportunities and challenges of transitioning to a reusable tray wrap option within NHS Wales from a range of stakeholder perspectives.

To report potential environmental and financial impacts of a transition to a reusable tray wrap option.

Stakeholder perspectives

Procurement

While Wales has infrastructure for national implementation of changes through the NHS Wales Shared Services Partnership and National Distribution Centre (NDC), the nature of the shift to reusable containers or wraps is viewed to be more appropriate to manage at a local HB level. While the national process is highly effective for large-scale contracts, it can be time-consuming, often requiring up to 18 months for planning, evaluation, and approval. The approach may also not meet the diverse needs of all HBs for this particular change as the requirements and circumstances can vary significantly between HBs.

A local approach offers the flexibility to tailor solutions that consider variations in decontamination infrastructure, clinical needs, staff training, and capacity. It also enables a more focused response to local challenges, ensuring that the change is as effective and cost-efficient as possible while allowing for the identification of the most appropriate solutions for each HB. Managing the project at a local level may also facilitate faster implementation.

Clinical

Clinical staff have mixed opinions on switching from single-use tray wrap to either reusable tray wrap or containers. There are several key considerations.

Reusable Tray Wrap

Some staff expressed a preference for reusable wraps as they are seen as a manageable alternative with minimal impact on workflow, storage and collection logistics. They were also viewed as an approach that could be more readily applied to all surgical sets (including orthopaedic and loan equipment) when compared to containers. However, the same issues such as tearing could continue as with single use wrap, which can cause delays and increase the risk of contamination. Tearing is most common with orthopaedic kits due to larger, heavier equipment.

In addition to considerations of the above options, it was also highlighted by clinical staff that a key priority should be consideration of tray rationalisation and optimisation. Reducing unnecessary sterilisation would also support in potentially reducing the impact of additional space required for containers.

Containers

Containers were understood by clinical staff to be more robust and reduce the risk of tearing/holes when compared to wraps, offering better protection during transport. This would also reduce risk of delay in theatres (e.g. should a tear be found and the team need to collect a new kit). One staff member had observed the containers in use in a hospital in Germany and reported this was a positive practice with no change in setup time for the procedure.

However, concerns arose over space required both for transport and storage. As the containers are bulkier, there were queries as to whether additional van trips would be required for any off-site decontamination. Storage capacity is at a premium already within theatre departments, particularly in orthopaedic departments, where space is already limited and was also noted as a concern. The containers are also heavier than the wraps, which could have implications from a manual handling and staff experience perspective. Some staff questioned whether additional draping would be needed to maintain a sterile field in the theatre (may not be applicable to all units).

The switch to containers may not be suitable for all surgical sets. For example in one hospital orthopaedic department hundreds of loaned sets are used daily. Spare containers or boxes would be needed to accommodate these sets. It is unclear if all orthopaedic equipment would fit properly in the containers. Consignment trays may also pose an issue. While these could be decanted into containers, it would be important to retain the original trays for traceability and correct usage.

Clinical staff also queried capacity within HSDU. As the containers are bulkier, they require more space within decontamination washers. This would reduce capacity in HSDU and impact on turnaround time.

Infection prevention and control (IPC)

From an IPC perspective, any changes to tray wrap would go through the IPC committee for assurances. It would be important for the IPC team to know and understand the process and details of the change, such as how a reusable option will be used correctly, how it would be cleaned between patients, confirmation that it meets decontamination/sterilisation requirements, and that it is of the same or higher standard of durability/integrity compared to the single use.

However, the experts and leads for the change would be the Hospital Sterilisation and Decontamination Unit (HSDU) and Theatre teams. The change and ongoing implementation/process would be managed by these teams.

If there were any issues with the change these would be picked up by incident reporting (Datix) with investigations conducted by IPC should an infection caused by the wrap be identified. As an outcome measure, any increase in surgical site infection could be monitored (sensitivity of data collected would vary across directorates and HBs). Usually, any infection has multifactorial causes but wraps may be reviewed as a part of the entire patient pathway.

Hospital Sterilisation and Decontamination Unit (HSDU)

Reusable Tray Wrap

Some HBs have trialled reusable linen wraps in the past. For example, Cardiff and Vale tried these several years ago however found the integrity was not robust. After limited use wraps were stained and torn. Repair patches were required for tears however under testing, it was found the repair not holding integrity/meeting decontamination standards.

From the HSDU perspective reusable wraps were not understood to be a better alternative to single use, as they will still have the same risk of damage, holes, and transport issues. However, reusable tray wraps seen by members of the HSDU team in the past were mainly made of polyester and it is expected that products available in today's market may be improved.

Containers

The head of decontamination at Cardiff & Vale has conducted an extensive review of alternatives to single-use tray wraps, focusing specifically on reusable containers. Some key concerns around the use of containers have been addressed, including myths about their effectiveness and usability such as;

- Concerns about wet loads: There were concerns that reusable containers could trap moisture, leading to repeat decontamination and increasing risk of spread of infection. However, a load dryness test (a blue towel placed in the tray to test for residual moisture) was passed.
- Cleaning and Residual Moisture: A common myth was that containers were difficult to clean. However, efficacy tests and load dryness tests demonstrated that containers passed the cleanliness and moisture tests
- Poor steam penetration: There were concerns about whether steam could adequately penetrate reusable containers. To address this, data loggers were placed inside containers during sterilisation, confirming that full sterilisation was achieved.
- Sterility Integrity: There were concerns regarding the sterility integrity of reusable containers. A rapid ageing test was undertaken (a 12-month shelf life was simulated by subjecting containers to high temperatures in a laboratory setting). These tests confirmed that containers maintain their sterility integrity over time.
- Filter options: Both single use and reusable paper filters are available. The HDSU have found the best-performing containers feature a single-use filter. There were concerns over how reusable filter usage would be tracked and traced as they do not last for the full lifespan of the container. There is a risk of contamination if past usage or expired filters are used, and ensuring proper matching and traceability with the instruments is therefore critical for patient safety. Filters would be an ongoing expense (however are low cost, pence per filter). This requires further investigation as with updates to technology the reusable filters may be more reliable.

A limitation to implementation of the containers is washer capacity and the number of disinfecting machines available at each HDSU. While containers can be washed in standard washers, they are bulkier and therefore reduce the number of sets that can be disinfected at a time. Cardiff and Vale can only accommodate four containers per load (1 hour per load) with their current infrastructure. This is insufficient for clinical demand. A transition to containers is therefore not possible without investment in additional washers.

To transition to the containers, considerations would include:

- Capital costs and HDSU capacity: Cardiff and Vale have estimated the new washer required for the UHW site will require a £240,000 investment. This will meet demands at UHW but not for smaller sites in the HB (e.g. Landoc). However, other sites are primarily focused on orthopaedics where the change may be less applicable.
- Space: While there is adequate space for a new washer in UHW, this may not be the case in other HBs.
- Funding of reusable containers: Purchase or rental options may be considered. A managed service contract could be a viable option, where the equipment is maintained and replaced by a third party, minimising the need for upfront capital investment. This model could ensure a quick turnaround on replacements (within one day) if containers are damaged. However, this approach would mean that the HB would not own the equipment.

- Workflow impacts:
 - The Cardiff and Vale perspective is that each container will become part of the instrument set. This is important for traceability purposes. In the case of any incident or need to look back through a patient journey, everything that came into contact with a patient would be paired. Establishing this process may be time consuming, as containers and instrument sets will need to be matched (e.g. with a barcode).
 - However, in the long term it may be possible to streamline workflows. The new washer would allow for a flow of containers in one washer while instruments go through another washer in parallel, improving efficiency and maintaining sterilisation compliance.
 - Considerations of how to ensure containers are secured in transit (e.g. secured with plastic tags to say if clean / dirty)
- Staff training: HSDU staff would need to undergo significant training and education on how to operate the new systems effectively.
- Usability study: The HSDU team at Cardiff and Vale are planning a usability study to assess manual handling, aseptic technique, storage, and instrument layout with reusable containers. The focus will be on understanding the potential impact on workflows and staff practices. While ripping won't occur with containers, there are risks such as potential warping, but they do not suffer from issues like ripping that can occur with wraps.
- Phased approach: Starting with containerising about 30-40% of trays, focusing primarily on general instrument baskets. The long-term goal is to expand this to about 60-70% of trays. This gradual, phased approach would allow for an easier transition and better management of resources.

As a next step the Cardiff and Vale team are publicising their research and exploring with their local procurement team how to add reusable containers to a Framework.

Financial impact, example projection

Current costs

Single use wraps: spend per year is estimated to be £121,572 + £25,000 in disposal costs

Projected costs

Reusable trays are estimated to cost £283,333 per year for 3 years (purchasing or lease of 700x containers in year 1, 600x in year 2 and 400x in year 3 at a cost of approximately £850,000). It is anticipated these containers will provide 80% capacity for at least 10 years. Annualised cost of investment over 10 years: $£850,000 / 10 = £85,000/\text{year}$

Savings compared to current spend: $£146,572 - £85,000 = £61,572/\text{year}$ for 10 years.

This excludes the cost of the single use filters and investment in the washer however the saving would likely cover the investment in a washer (£240,000), single use filter and washing cycle costs.

Environmental impact, example projections

A cradle-to-grave process-based carbon footprint analysis was used to estimate the GHG emissions associated with the single use sterilisation tray wraps and the reusable containers. The analysis included GHG emissions associated with raw materials, transport, disposal and for the reusable container, an additional washing cycle.

For the single use tray wrap, a 137 x 182 wrap weighing 100g was used as an approximation for all tray wraps used at UHW. The wrap was weighed by the project team and from manufacturer information the wraps are made from 100% polypropylene. CSH converted material data into GHG emissions using carbon conversion factors taken from the 2024 UK Government Greenhouse Gas Conversion Factors database. It was assumed the wraps are manufactured in Thailand and would be shipped to Felixstowe (UK) via container ship. No data on packaging type or materials were provided so therefore excluded.

For the reusable container, the weights and materials of a B Braun medical container were taken from Friedericy et al, 2021. CSH converted material data into GHG emissions using carbon conversion factors taken from the 2024 UK Government Greenhouse Gas Conversion Factors database. The reusable containers are manufactured in Germany and are assumed to be transported by road to Calais, then by train to the UK, and finally by road to the hospital.

Switching over to using reusable containers would require the containers to be washed in a dedicated wash cycle after each use. For this, 3 different scenarios were modelled. See table 1 for a description of each scenario and assumptions.

Table 1: Description of reusable container washing scenarios

Scenario	Description of scenario	Assumptions
1	No additional washing of reusable containers	
2	Additional washing of reusable containers in a 'standard' washer which fits 5 reusable containers at a time.	Energy and water consumption of a standard 12 tray/5 container washer was provided by Belimed and uses 3.5 kW of electric, 0.36 m3 gas, 65 litres water and detergent per cycle.
3	Additional washing of reusable containers in a 'large' washer which fits 30 reusable containers at a time.	Energy and water consumption of a large washer was provided by Belimed and uses 320 Litres per cycle first cycle of the day , then for cycles following it is 30 litres as the unit recycles water in the system. For electric the machine has a power rating of 120 kW. However the technical sheet states 25 - 60 kWh per average cycle. Therefore, two scenarios were modelled, consumption of 120 kW (90 kWh for 45 minutes) and 42 kWh for 45 minutes.

The carbon footprint of a single-use tray wrap is estimated at 0.402 kgCO₂e. With UHW sterilizing approximately 60,000 trays annually, the total footprint for single-use tray wraps is estimated at 24,093.9 kgCO₂e per year (table 2).

Table 2: single use tray wrap GHG emissions

	Number of trays sterilised at UHW per year	GHG emissions per tray wrap (kgCO ₂ e)	GHG emissions per year (kgCO ₂ e)
Single use tray wraps	60,000	0.402	24,093.9

The carbon footprint of a reusable container is estimated at 28 kgCO₂e per unit. With a lifespan of approximately 5,000 uses, this equates to just 0.0056 kgCO₂e per use. In the first year, UHW is expected to require 700 reusable containers. Table 3 outlines the GHG emissions associated with these containers and their additional washing cycles.

Table 3: GHG emissions of reusable sterilisation containers

	GHG emissions of containers per year (kgCO ₂ e)	GHG emissions of additional container washing per use (kgCO ₂ e)	GHG emissions of additional washing of containers per year (kgCO ₂ e)	Total GHG emissions per year
Scenario 1	337.7	n/a	n/a	337.7
Scenario 2	337.7	0.32	19,464.7	19,802.5
Scenario 3a	337.7	0.39	23,260.7	23,598.4
Scenario 3b	337.7	0.83	49,639.6	49,977.29

Table 4 shows the GHG emissions of the reusable containers is largely dependent on the electricity consumption and efficiency of the washer machine. Washing the containers in a small 3.5 kW washer reduces the carbon footprint compared to single use tray wraps. Similarly, washing the containers in a large washer with an average energy consumption of 42 kWh per 45 minute cycle also reduces the carbon footprint compared to single use tray wraps. However, if the containers are washed at the power rating of the washer as described in the Belimed technical spec (120 kW), the carbon footprint increases compared to single use tray wrap.

Table 4: GHG emission saving of switching from single use tray wrap to reusable containers per washing scenarios

	GHG emission savings per year (kgCO ₂ e)
Scenario 1	- 23,756.2
Scenario 2	- 4,291.44
Scenario 3a	- 495.48
Scenario 3b	+ 25,883.4