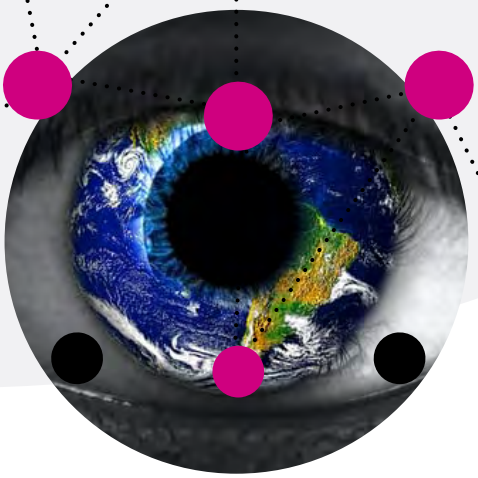

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MEDICYCLE

The Challenge: What We Were Trying to Achieve

Medical plastics are essential for successful medical interventions across the globe. Used extensively to support over 4.7 million surgical admissions each year in the NHS, each procedure will produce significant volumes of waste including plastics that are routinely incinerated as default to remove risks associated with potential infectious material entering linear waste streams.

The British Medical Journal estimates that of all waste produced in a hospital, 29% will be produced in theatres and 40% of this is potentially recyclable. This includes a combination of paper/card, plastics, and a small amount of glass and metals from sharps disposal. While most of the waste produced in theaters is packaging necessary for maintaining sterility, it is single-use and carries a low risk of being infectious. However, because it originates from theaters, all waste is classified as clinical waste and incinerated at a significant cost to the NHS and the environment.

The NHS produces approximately 700,000 tonnes of waste annually. This implies that a significant amount could be diverted to recycling, resulting in cost savings, reduction in greenhouse gas emissions from incineration, and lowering the amount of virgin plastic used in medical packaging. NHS NET Zero and Greener NHS targets highlight the opportunity to move to sustainable outcomes for the increasing reliance on plastic to package medical devices, consumables and pharmaceuticals.

Our Project addresses the challenge to create a disruptive process that will provide a safe route for recyclable medical plastic waste out of hospital operating theatres and into established recycling facilities.

The Approach: How We Tackled the Challenge

The project aimed to create a safe route to divert a new-to-market waste stream away from clinical waste and incineration. An audit analyzed typical waste streams produced by theatres, revealing that two-thirds of the waste was recyclable, with rigid plastics comprising 15% of the total. Waste segregation in the NHS is largely informed by its place of origin, and once waste is sealed in a bag, no second sorting can take place, consigning recyclable waste to incineration.

The biggest issue is sorting waste at the point of generation. The project addressed the requirements of contamination and rendering unusable independently. The Medicycle prototype was created to shred and irradiate waste using UV-C light delivering a commercially acceptable recyclate that can enter an established market. Diverting the waste stream at the point of waste generation allows established NHS protocols to remain largely unchanged, and commercial operations can benefit from a new-to-market waste stream of premium and consistent quality.

Shredding reduces the volume into an acceptable format for processing and satisfies the HTM requirement to make it unusable and unrecognisable. Small scale NIR spectroscopy technology was integrated to identify polymers by type to separate PP and PET and also non-recyclable waste that can be re-classified into general waste. A simple light ID system with confidence levels will support accurate sorting to deliver quality uncontaminated resource for re-processing.

The project employed a commercial testing laboratory to inoculate and test processed samples. The results have evidenced that the process works well and to a high standard. The natural characteristics of PET and PP have evidenced how these should be treated independently to optimize sterilization results.

Unexpected Outcomes: What We Learned Along the Way

The audit process has shown that composite materials are widely used in operating theaters to ensure high performance and optimal infection control. The challenge is to identify areas where these materials can be replaced with more sustainable options and where better separation for recycling can be achieved. Historically, manufacturers of medical devices and packaging have not been required to address these issues, resulting in a lack of effort to incorporate sustainability into their designs.

"Our Project addresses the challenge to create a disruptive process that will provide a safe route for recyclable medical plastic waste out of hospital operating theatres and into established recycling facilities."

However, the new PPT and PPN notices have highlighted the importance of sustainability and will encourage the use of recyclable materials.

A long-standing myth has maintained that medical packaging must be made from virgin materials, but the new legal requirements will promote more sustainable alternatives. The trusts we have worked with and shared audit data have used this information to make informed procurement decisions and engage in conversations about recyclability.

Key Learning: What We Would Do Differently Next Time

Although our Medicycle process has worked well, we now have improved our understanding of how the different properties of polymers used in medical packaging and devices can be better processed. For example, the nature of PET, being ~80% UV-C opaque, has required the shredding process to be reviewed several times. Also, the soft nature of PP means that overheating can bond facets together potentially sealing in pathogens.

Identification and sorting of plastic waste is a significant barrier to recycling with critical decisions needing to be made by clinical staff with no knowledge of plastics.

Understanding the process from waste generation through the organization to entering a waste stream, including why certain materials are used, is crucial for our project. This understanding has informed our solutions, which are more likely to be adopted by the host organisation. While we initially believed that our waste audit would be important for the project, we now realise the need to dedicate more time to this process, as it has been invaluable in developing both the prototype and future business relationships.

The Outcome: What We Achieved and How It Has Impacted the Business, Society and Key Stakeholders

Our project has evidenced a safe diversion for medical plastic waste produced in theatres into a recycling stream. Bioburden testing following on from processing in Medicycle with UV-C light has produced results that we believe will satisfy the NHS estates and waste management, so we can 'Render Safe' this waste stream.

These results will inform the business plans for presentation to NHS estates departments to pilot the Medicycle process on-site. This will provide further data to refine the business proposals to NHS and private hospital groups.

Discussions with transport companies have informed the necessary functions of vehicles and operatives, and cost implications will be integrated into the matrix. The model of on-site document shredding will guide how the process will operate on-site, given that it is a current activity. Modifications to vehicles, operator training, and safety protocols will enhance these established practices.

Our NHS collaborators will benefit from informing the Medicycle process from outset to better fit with waste management practice and improve the opportunity to be adopted in new trusts. Additionally, plastic waste processors will have access to a new-to-market waste stream comprising high quality recyclate.

Looking Forward: Next Steps and Future Directions

A (currently unfunded) pilot project aims to determine the most effective waste processing route from theatres. This will enable each trust to process waste on-site using modified vehicles, resulting in reduced travel distance. By joining the trusts' waste management team, we can identify specific departments to target for contamination risk reduction upstream of the sterilisation process. We can also standardise waste streams and support training and education initiatives.

By delivering clean, high-quality recyclables directly to re-processors and adhering to established NHS protocols, we can implement a low-impact and low-friction disruptive technology that satisfies the PPN and PPT requirements, NHS Net Zero and Greener NHS targets, reduces waste costs, and generate a new revenue stream for Medicycle. This revenue stream will include charging for the removal of waste from NHS sites (less than clinical waste but more than recycling costs) and selling high-quality, new-to-market recyclables to re-processors at market prices. This project can be commercially viable at scale and deliver a return on investment.

This project presents a new opportunity to overcome a significant barrier to acceptance of our PET-based product. Therefore, the impact of this project on our business has focused on creating a new opportunity rather than supporting existing business.

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