3. REDUCING THE CARBON FOOTPRINT OF THE REHABILITATION ENGINEERING UNIT WORKSHOP (REU)

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Background:

Wthin REU, we provide three services, which include the Special Seating Service, Functional Electrical Stimulation (FES) and Pressure Ulcer Prevention and Intervention Service (PUPIS).

The Seating Service and FES cover Swansea Bay and Hywel Dda, whilst PUPIS cover these areas and part of Cwm Taf health board. As a department, we have in-house manufacturing facilities that can manufacture devices that provide a range of benefits such as postural support and pressure relief. Within the workshop, common materials used to manufacture devices include foam, metal, wood and plastic. Devices manufactured are highly bespoke and can rarely be classified for multi-patient use.

As a department we have implemented many strategies to reduce our carbon footprint, costs and improve patient care. Below are some of methods already implemented to reduce carbon emissions of the department:

- Visits in the community are grouped together so journeys are not for single patient visits
- Visits in the community are grouped together by post code when possible to save miles driven
- Virtual appointments scheduled where possible for reviews and fact finding etc. MDT meetings in particular
- Request images from service users to save journeys into the community to identify the problem and a follow up journey to resolve the problem
- FES service has frequently setup packs of refurbished devices for new patients to minimise new units being purchased or being disposed of
- Majority of old wheelchairs and accessories are returned to the Cardiff Posture and Mobility Centre for decontaminating to be reused
- Good engineering practises, always try to minimise waste when cutting from sheet materials
- When machining blocks of foam, we aim to fit as many parts in per block to reduce number of blocks used
- The use of black bag waste streams where appropriate to reduce number of orange bags going for incineration. This is outlined in our local Infection control so all staff know where best to direct waste

One of the barriers to reducing waste in our department is that the devices we develop are highly bespoke to the service user and are rarely re-issued to another service user. In addition, the materials we used are often 'non-recyclable' due to their plastic content, which makes it more difficult to recycle waste into its original state. Therefore, the process of repurposing waste material is more likely to be successful.

Specific Aims:

This project focussed on our materials aiming to

1) To reduce non-recyclable content by switching to use of more sustainable materials
2) To reduce waste to landfill by recycling materials

Methods:

We focussed on custom moulded seating systems manufacturing stream. We manufacture 37 of these devices on average per year. These devices are manufactured from a number of blocks of foam, cut down to size and assembled to form a moulded shape for a service user. These are then interfaced onto the wheelchair using metal fixings and plastic shells that enclose and protect the foam and prevent it from deforming during use.

We use an open cell foam for the majority of our custom moulded systems and occasionally a higher density closed cell foam if additional support is required. The plastic shell that holds the foam on the wheelchair is manufactured from ABS plastic.

We identified three possible methods of reducing the carbon footprint of this manufacturing stream.

- Switching to an eco-friendlier plastic that can be used instead of ABS plastic. We are aware that a similar service had implemented this switch. However, this switch requires testing and scoping to ensure the material properties of Polypropylene satisfy our requirements. before a decision can be made on this.
- Our supplier of white foam agreed to collecting the offcuts when they deliver new blocks of foam, for them to recycle into new products such as chipfoam or carpet underlay. We discussed returning offcuts of other materials with suppliers but unfortunately this has not been possible for out other materials.
- Third, we looked at sourcing materials closer to the department to save on CO2 emitted from delivering the materials (see discussion section).

Measurement:

Environmental sustainability:

Swansea Bay Health Board dispose of waste via an 'Energy from Waste' stream as opposed to landfill. We calculated the total weight of each material that we dispose of per year and applied tis to the emissions factor for Energy from Waste disposal from Rizan et al 2021[3].

We also calculated the CO2e emissions factor for changing our plastic material from ABS to Polypropylene. Polypropylene is less dense

Economic sustainability:
Cost of materials was obtained and compared.

Patient outcomes: We will test polypropylene o ensure it satisfies requirements for quality of our devices for patient care before implementing the change in material use.

Social sustainability: Not measured for this project however potential impacts discussed in results section.

Results:

Environmental Rsustainability:

To manufacture 37 custom moulded seating systems, in the past 18 months, we have ordered 310.962kg of ABS. With a lower density, the total weight of Polypropylene would be 263.016kg

Material	Amount used*	Emissions Factor	CO2e
ABS plastic	310.962kg	3.76kgCO2e/kg	1169.217kgCO2
Polypropylene	263.016kg	3.10kgCO2e/kg	815.350kgCO2
		Saving	353.867kgCO2

*Polypropylene is a lower density than ABS, so a lower weight required.

The total CO2 emissions from sending the waste product to Energy from Waste plants is seen below:

Material	Amount disposed in tonnes	Emissions Factor for disposal (waste from energy)	CO2e
White foam	**0.2232**	172kgCO2e / tonne	**38.38 kgCO2e**
Evazote	0.1148		19.7 kgCO2e
ABS Plastic	0.11913		20.49 kgCO2e

Our suppliers of white foam agreed to collect the offcuts of white foam to recycle, so we saved 38.38kgCO2e per year. This saving only applies to one type of device that we manufacture and leaves scope to apply this to other devices we make. Unfortunately, returning the closed cell foam Evazote was not viable, as the department would need to cover the cost of a courier to send the waste back to the supplier. Similarly, the ABS offcuts would cost £25 to be collected and this would not be the same day as the delivery of new material and therefore increasing the number of journeys and CO2 emissions.

Combining the two changes, we have a total saving of **392.247kgCO2e**. This is equivalent to 1,129.7 miles driven in an average car.

Economic sustainability:

It is not possible to calculate the financial impact of switching from ABS to polypropylene subject to testing of the material to ensure it is durable and appropriate for our service users. Our current material, 6mm ABS, costs £157.41 per sheet. If we can switch to a 6mm Polypropylene at a cost of £115.20, we will save £42.21 per sheet. However, a 9mm Polypropylene may be more appropriate and at a cost of £168.30, this will be an increased cost of £10.89 per sheet.

Our white foam supplier has agreed to collect offcuts for free. There will be a small financial savings from reducing waste.

Social sustainability:

Although difficult to measure, this arrangement with the foam supplier is mutually beneficial as it allows them to reclaim usable material to use in production of new products with no additional resources invested.

Discussion:

During the competition phase we have been able to identify one material switch to reduce our CO2e, however this still requires testing to ensure use of polypropylene over ABS will not impact on the quality of our devices. Positively, we have also identified a foam supplier that is working

towards producing foams containing plant-based polyols as an alternative to petrochemical-based ingredients[1]. This is something we will continue to explore in the future.

A barrier we encountered was a lack of recycling options for smaller scale operations such as ourselves. We were able to identify a company in the Netherlands that would take our foam offcuts and recycle these, but the minimum quantity was in the magnitude of shipping containers. We also encountered similar issues when considering other waste materials produced by the department such as textiles and scrap metal. Similarly, in these cases it was found not to be economically viable. Positively, there is additional research being carried out in to recycling closed cell foams[2].

Identifying local suppliers of the materials we use was attempted and found to be challenging, as often the cost of the material was much higher. For example, our current supplier of ABS is based near Brighton. We identified a supplier in Cardiff however switching suppliers would lead to a £90 increase in the price per sheet of ABS. The department has ordered a total of 30 sheets in the past 18 months, meaning a £2,700 increase in cost for the same material.

Conclusions:

Throughout the process, we have been able to identify two areas where we can save on CO2e emissions when manufacturing one type of device, albeit this device is one of the more labour and material intensive devices that we manufacture. Further CO2e savings can be achieved through sourcing more eco-friendly and sustainable versions of the materials we use. We will continue to explore options for this.

References:

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