Reduction and Recycling Process of Sterilization Wrap

Analysis of Factors that Lead to Successful Blue Wrap Recycling Programs

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

One of the most important aspects of medical care is maintaining sterility during patient care. This is especially crucial during surgeries and invasive procedures, where instruments and medical devices, if contaminated, could cause detrimental and even fatal infections (De Lissovoy et al., 2009). To ensure this sterility, sterilization wrap, more commonly known as blue wrap, is wrapped around surgical instruments and keeps the environment contained. The material allows the sterilizing agent, most often steam, to pass through to the instruments and then structurally changes to close the pores in the blue wrap to prevent any contaminants from entering the pouch after sterilization (Bahk, 2024). Blue wrap is single use because as soon as the instruments are opened, the material is no longer considered "sterile" to be reused in a medical setting as the pores have closed and will not allow a sterilizing agent to pass through (Minnesota Technical Assistance Program [MnTAP], n.d.). Although sterilization wrap has been an efficient way to sterilize surgical instruments, it cannot be reused and even uncontaminated blue wrap is thrown away contributing to a significant portion of a hospital's waste stream. Sterilization wrap accounts for about 19% of all waste in the surgical department according to the US Environmental Protection Agency (Environmental Protection Agency [EPA], 2002).

Despite sterilization wrap being such a high percentage of hospital waste, there are very few programs to recycle and repurpose this material. This is concerning as this amount accounts to around 255 million pounds of blue wrap disposed of each year from the operating room that end up in landfills (HealthTrust, 2021). In terms of the physical recycling of the sterilization wrap, there are very few machines across the US that can actually shred the sterilization wrap so it can be further processed. This lack of infrastructure needs to be addressed because even if hospitals want to be a part of this program, there might be no availability. This equipment

shortage, along with the cost transporting wrap to these facilities discourages many hospitals from making sustainable choices. I aim to create a process to reduce, recycle, and repurpose blue wrap for the University of Virginia Hospital.

Not only does disposing of blue wrap in landfills have damaging effects to the environment, but it also has a significant effect on healthcare worker morale. Many doctors report a negative feeling when disposing of single use or disposable materials because they are aware of the waste. Around 95% of surgeons even report a willingness to change their operating room workflow behaviors to reduce waste (Meyer et al., 2022). However, little has been done to address this concern as sustainability efforts often come second compared to patient care. Although some hospitals have programs to recycle and repurpose blue wrap, the programs are very localized and few have been able to expand nationally. This raises the question: despite the clear interest in reducing blue wrap waste, why have such practices not been widely adopted?

My technical project will focus on creating a shredder that can process blue wrap as well as identifying and publishing methods to reduce and repurpose blue wrap at the University of Virginia Hospital to make the life cycle of this plastic more sustainable. To dig further, my STS topic is the analysis of factors that lead to successful blue wrap recycling programs.

Reducing and Repurposing Blue Wrap Use

Sterilization wrap is made from SMS (spunbond-meltblown-spunbond) polypropylene which cannot be recycled using conventional recycling processes as it is considered a soft, flexible, #5 plastic and is not recycled by many facilities (EPA, 2002). The polypropylene material of blue wrap tends to clog the plastic shredders leading to operational issues and increased energy consumption of the machines in conventional recycling plants (NERC, 2018). Due to the high flexibility of the material, in a shredder, the blue wrap starts to bunch up while

shredding and not allow for the shredder blades to slice the material into smaller pieces for further processing to be melted and processed. This creates an issue as only a small percentage of blue wrap is recovered and repurposed into items such as tote bags, but most blue wrap ends up in a landfill. In addition to this, hospitals often put stickers and tapes on blue wrap to indicate sterility of the instruments. These plastics contaminate blue wrap polypropylene if processed together because it melts at a different temperature (MnTAP, n.d.). Separating the materials is very labor intensive and not always possible as residues will remain on the blue wrap.

To address these challenges, viable methods will be explored and identified to reduce the amount of blue wrap used in the University of Virginia (UVA) Hospital, as well as recycling and repurposing it in ways that minimize environmental impact. Currently, dual-shaft shredders are used to process solid plastic waste from UVA Hospital. However, blue wrap is not shredded using this equipment as the fibrous material will clog the shredders. A small portion of the blue wrap UVA Hospital produces is sent to their Medical Equipment Recovery of Clean Inventory (MERCI) volunteer program that sorts the blue wrap by size and ships it internationally to be used (Kramer, 2024).

The current waste from the University of Virginia Hospital will first be quantified and a life-cycle assessment on the blue wrap they use will be performed to assess the environmental impact and the financial implications. Next, a shredder that can process blue wrap down to less than 1mm pieces with an efficiency of around 10 kilograms per day will be constructed to prepare the plastic to be melted so the material can be repurposed. Since blue wrap is a thermoplastic, it can be heated and cooled to form a hardened plastic that can be repurposed and recycled several times without changing its chemical properties (*What is a thermoplastic? (definition and examples),* n.d.). After successful data collection and shredder design, the results

of this study will be published to encourage hospitals across the nation to adopt similar blue wrap waste reduction strategies to reduce their carbon footprint.

Factors that Lead to Successful Blue Wrap Recycling Programs

In a fast paced environment such as hospitals, sustainability efforts often fail to keep up. However, addressing the blue wrap waste is still a pressing issue for all parties involved. Specifically, there have been many efforts across the country that have attempted to implement blue wrap recycling programs. Some of these programs have seen great success and significantly reduced their waste streams. One such program is the Blue Renew recycling initiative that was first started in Halyard Health in 2012 and has since scaled to 400 hospitals across the United States (Workman, 2017). On the other hand, some blue wrap recycling programs such as the one in Shawnee Mission Medical Center have failed to expand to other healthcare institutions but have successfully been able to reduce blue wrap waste within the hospital (Ogden, 2009). With the increasing need for blue wrap waste reduction and recovery, understanding the barriers to widespread adoption of recycling programs is essential.

I will apply the Social Construction of Technology (SCOT) framework to analyze the adoption of blue wrap recycling programs in hospitals. My research will focus on investigating what factors lead to successful local programs within each hospital, and compare them to the characteristics of more adopted programs. Using this framework, I aim to collect evidence on how various social groups within hospitals such as medical staff, waste management, and hospital administrators interpret and influence the implementation of blue wrap recycling programs through a collection of case studies and essays written by different members of the healthcare team. I argue that by analyzing how blue wrap is viewed and used in society, we can identify and overcome barriers to this sustainability problem. Figure 1 shows some of the factors

I will be analyzing in this paper to assess their impacts on blue wrap sustainability.

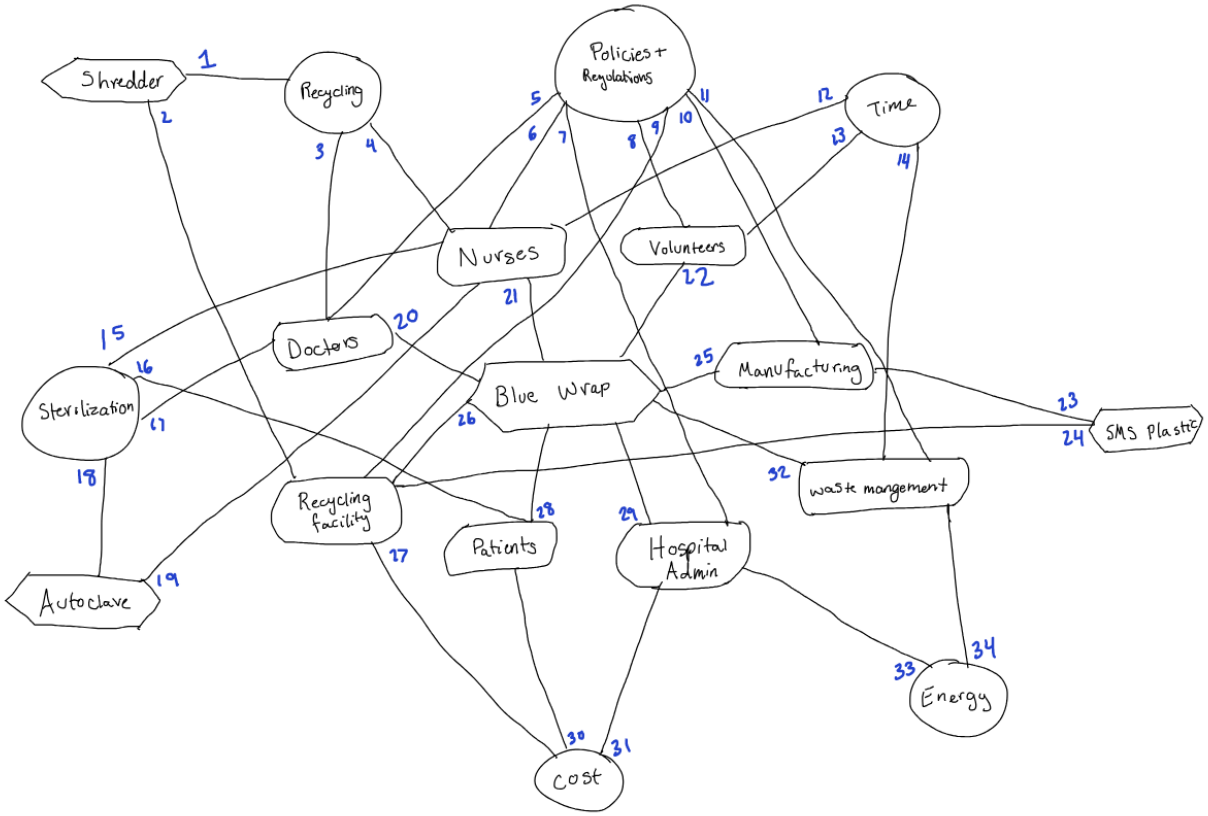

Figure 1: SCOT diagram of the social groups and problems pertaining to blue wrap.

Through a literature review, I will establish the scalability of blue wrap recycling programs. Using SCOT as a guide, I will break down how certain social, economic, and regulatory contexts influence the potential of scaling a program beyond one hospital. These groups will be prioritized from the social groups that use the blue wrap most such as hospital workers and waste management to external influences on the use of blue wrap such as regulatory factors and manufacturers. Another aspect that will be assessed is how the founding team influences the success and expansion of the blue wrap recycling program. As important as the motivations of the team are, the resources they have to begin the program and the support of the community around them also play a significant role in the success. Based on case studies

analyzed during the literature review, various factors and how much these influence a program will be determined. These factors can then be considered and prioritized when starting an initiative to ensure higher potential of success and increased adoption for blue wrap recycling programs by healthcare institutions.

Conclusion

In order to reduce the environmental impact of blue wrap waste from the University of Virginia Hospital, I will create a process to reduce, recycle, and repurpose the material. This process will not only significantly reduce the carbon footprint of the UVA Hospital, but also inspire other hospitals across the nation to implement sustainable practices. By determining the factors of a successful blue wrap recycling program, pinpointing barriers to implement programs becomes more streamlined. Founding teams will have more clarity on which factors to prioritize and will be able to optimize their resources to make the most successful blue wrap recycling program. Additionally, the successful implementation of such programs can serve as a model for other institutions, making it easier to expand these practices on a broader scale. Blue wrap recycling not only contributes to environmental sustainability but it also impacts how the healthcare teams view hospital practices. This approach will empower hospitals to take responsible actions to mitigate their waste streams and consider their impact on their internal and external communities.

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