Thesis Project Portfolio

Blue Wrap Waste Stream Analysis

(Technical Report)

Leadership and Sustainability: A Sociotechnical Approach to Blue Wrap Waste Management in Healthcare

(STS Research Paper)

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Executive Summary

Hospitals face a growing challenge in managing medical waste's environmental and financial costs, which account for more than 6 million tons in the United States each year. A major contributor to this waste is blue wrap—a spunbond-meltblown-spunbond (SMS) polypropylene fabric used to maintain the sterility of surgical instruments. On average, approximately 115 million kilograms of blue wrap are discarded annually, producing about 823,000kg of CO2 emissions over a 10-year span. While initiatives exist to reduce, recycle, and remanufacture blue wrap, contamination, adhesive labels, and institutional barriers often lead to it being discarded as landfill waste. These challenges have limited hospitals' ability to implement sustainable blue wrap waste solutions at scale. UVA Hospital is one of many institutions that struggle with this issue, generating over 12 tons of blue wrap waste annually. The central problem examined in the reports is the following: How can hospitals develop and implement effective and sustainable strategies for blue wrap waste management? The two reports focus on different facets of this challenge–one through the development of technical solutions and the other through a sociotechnical examination of the hospital leadership factors that influence waste management initiatives.

The technical report first aims to quantify the environmental impact of blue wrap waste at UVA Hospital, using a Life Cycle Assessment (LCA) to evaluate its total impact on global warming potential (GWP), energy consumption, and water usage. Data were collected through interviews and shadowing in the Anesthesia Department at UVA Hospital. The analysis found that the disposal of blue wrap at UVA Hospital contributes 22,901.12 kg of CO_2, 5,248.04 MJ of energy, and 169.38 m^3 of water usage annually. Additionally, an experiment was conducted to measure the processing rate of blue wrap, in terms of labels and stickers, revealing 0.13 pounds

of blue wrap per minute. A sample recycled blue wrap product was produced, and its properties were analyzed through Fourier Transform Infrared Spectroscopy (FTIR), which indicated the presence of uncertain additives in the material. The tensile strength of the recycled product was assessed using dog bone testing. The lower values observed in both Young's modulus and ultimate tensile strength, compared to the original polypropylene, suggest potential limitations in remanufacturing blue wrap. Based on these findings, a pilot program is proposed to further evaluate the feasibility of large-scale blue wrap remanufacturing at UVA Hospital. The report concludes by discussing the environmental implications of the findings, as well as exploring additional applications for recycled blue wrap, including potential collaborations with UVA's Architecture and Art Schools.

The STS research paper investigates how hospital leadership impacts the success of implementing waste management initiatives, particularly in the case of blue wrap waste. The report utilizes the SCOT theory to explore the complex sociotechnical dynamics involving hospital leadership that influence waste management practices. Using a literature review of case studies, the paper examines leadership strategies in three hospitals—Royal Brisbane and Women's Hospital, Farabi Hospital, and St. Mary's Regional Medical Center—each of which successfully implemented waste reduction or sustainability programs. These case studies are analyzed through the lens of the YEL2023 report, a framework identifying best practices for leadership in environmental sustainability initiatives. Key findings suggest that effective leadership traits, such as proactive communication and staff empowerment, are crucial for driving institutional change. Applying these insights to UVA Hospital's blue wrap waste issue, the paper proposes leadership-driven interventions, including structured training programs and a

dedicated blue wrap waste management team. While these findings offer valuable guidance, further research is recommended to explore stakeholder alignment.

Both the technical and STS projects have been successful. Although the technical project initially aimed to develop an effective shredder for blue wrap, it became clear that a shredder was not required. The goals of the technical project were modified to focus on evaluating blue wrap's environmental impact and exploring its remanufacturing potential. Despite this unexpected shift in scope, the project was able to achieve its goal and successfully proposed a pilot program for UVA Hospital. For the STS research, the investigation into the role of hospital leadership in waste management initiatives yielded valuable insights that were directly applicable to the UVA Hospital setting. Given the promising results from the technical analysis, future researchers should implement the proposed pilot program at UVA Hospital. This would provide the opportunity to test the feasibility of large-scale blue wrap remanufacturing and have the potential to influence broader policy changes across the healthcare system. Future researchers should also explore how hospital leadership can navigate sociotechnical dynamics and resistance to change while enhancing stakeholder collaboration, as it could drive meaningful change in waste management and reduce environmental impact across medical institutions.