Thesis Project Portfolio

Blue Wrap Waste Stream Analysis

(Technical Report)

Analysis of Factors that Lead to Successful Blue Wrap Recycling Programs

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

My technical capstone and STS research focused on addressing the environmental and logistical challenges associated with blue wrap waste in hospitals. My technical project involved quantifying the environmental impact of blue wrap at University of Virginia (UVA) Hospital and designing a pilot program for collecting, processing, and repurposing this material into new products. For my STS research, I analyzed why blue wrap recycling programs often struggle to succeed, even when the technology to recycle the material already exists. While the technical work provided concrete data and a prototype for implementation, my STS research helped me understand the systemic, social, and economic factors that determine success of the programs.

Blue sterilization wrap, made of spunbond-meltblown-spunbond (SMS) polypropylene, is a single-use plastic commonly used in hospitals to maintain surgical instrument sterility. At UVA Hospital, approximately 12 tons of blue wrap are discarded annually, contributing to the 225 million pounds of plastic waste generated across U.S. healthcare facilities yearly. This project aimed to quantify the environmental impact of blue wrap disposal at UVA and evaluate its potential for recovery and reuse. A Life Cycle Assessment (LCA) was conducted to estimate environmental impacts such as greenhouse gas emissions, water use, and energy consumption. Processing experiments assessed the average melting rate of .12941 lbs/min and found that blue wrap could be melted without cutting, with smaller molds improving efficiency. Mechanical testing showed that recycled blue wrap retained strong mechanical properties approaching those of virgin polypropylene, supporting its potential for injection molding. These findings confirmed that not only is recycling blue wrap technically possible, but the recycled material could also meet quality standards for reuse in manufacturing. This study demonstrates that blue wrap can be feasibly recycled tangent to hospital settings and repurposed into new materials. Additionally, our proposed pilot program outlined specific steps for implementing a closed-loop recycling

system within UVA Hospital, offering a model that could be replicated in other healthcare institutions.

My STS research paper explores the factors that play into the success of blue wrap recycling programs in hospitals. I use the Social Construction of Technology (SCOT) framework to analyze how different stakeholder groups interpret the value and feasibility of blue wrap recycling. Specifically, I look into the economical, systemic, and social contexts that influence the implementation of a blue wrap program. Drawing from my experience working with UVA Hospital Sustainability and shadowing operating rooms, I also analyzed the Blue Renew program by Halyard Health, a major blue wrap recycling initiative that was being considered by UVA Hospital. I found that the success of these programs depends on three key factors. The first is long-term economic sustainability, the second is availability of reliable local recycling partners, and the third is strong multi-level support within hospitals. My analysis reveals that while environmental interest exists among clinicians, logistical and economic constraints, as well as differing stakeholder interpretations of blue wrap's value, often prevent successful program adoption.or instance, while clinicians may view blue wrap as clean and recyclable, administrators may see the same material as a logistical burden, and haulers may deem it unprofitable. Some factors I recommend are that hospitals focus on building partnerships with committed haulers, getting multi-level hospital support, and pursuing recycling solutions that are logistically and economically viable in a given regional context compared to adopting one-size-fits-all approaches. Ultimately, my research emphasizes that sustainable solutions must be context-specific and built through cooperation among all relevant social groups.

Working on both my technical capstone and STS research together allowed me to approach the issue of blue wrap waste from a multidimensional lens. The technical work helped

me understand the physical and environmental feasibility of recycling blue wrap and explore how to implement a program in a hospital. The STS research, on the other hand, provided insight into why these types of solutions often fail to take hold in practice. Learning this helped advocating for a UVA Hospital blue wrap recycling program easier. Through the SCOT framework, I became more aware of how social groups, such as hospital staff, administrators, and waste haulers, assign different meanings and priorities to recycling efforts, which in turn shapes the success or failure of those initiatives. This understanding prompted me to think beyond material properties and consider factors like organizational buy-in, workflow integration, and economic incentives. Working on both projects together gave me a more complete picture of what sustainable innovation actually looks like. I learned that even the most well-designed technical solutions require alignment with institutional culture and stakeholder values in order to be successful. Without this broader understanding, my technical work may have overlooked the very real constraints hospitals face in adopting new waste management systems.