Abstract

Over the 2020-2021 academic year, student Eco-Rep Johanna Inamagua (CAS ‘21) collaborated with staff from the Penn School of Nursing to develop a waste reduction plan for the nursing simulation lab. The Helene Fuld Pavilion for Innovative Learning and Simulation (hereafter referred to as the sim lab) is an on-campus space for nursing students to obtain hands-on clinical experience under faculty supervision. Related Eco-Reps projects previously identified the sim lab as a potential site for intervention to improve waste diversion. The primary goal of this project was to compile recommendations from a sustainability consultant to create a plan for a more sustainable waste stream at the sim labs.

Introduction

The University’s Climate and Sustainability Action Plan 3.0 includes the aim to “embrace circular economy principles to reduce waste and single-use products.” Penn Nursing staff have thus identified the sim labs for the opportunity to improve material recycling and reuse on campus. The sim lab purchases sterile field kits and other medical materials to replicate the conditions of healthcare environments that students will enter. However, these materials are often discarded after single use or improperly recycled which cause greater waste production. In previous years, student Eco-Reps studied nursing simulation labs at peer institutions to identify successful green initiatives. Eco-reps applied and were approved for a Green Fund grant to hire a sustainability consultant who could specifically evaluate the Penn sim lab. This year, the student Eco-Rep worked with project partners to guide future implementation of waste diversion practices at the sim lab which will be presented in this report.

Project Overview

Medical materials are a burgeoning category of single-use waste that present an opportunity for diversion from landfills. The challenge of recycling these materials is that they are often mixed-material items (ex. simultaneously contain silicone and rigid plastic) which can not be recycled without separation of the component materials. In the Penn Nursing sim labs, the effort to properly separate waste materials and avoid contamination is one that becomes secondary to the primary aim of demonstrating competence with nursing curriculum. The overall goal of this project was to create a foundational plan for the effective implementation of changes to the sim lab waste stream in future semesters. The aim is to reduce waste production from the labs without compromising the accuracy of the simulated health care environment for students.

First, the lab schedule was consulted to identify a day for an external consultant to conduct a waste audit of the nursing sim lab. Samantha Wittchen, consultant at iSpring, was hired to assess the sim lab and provide recommendations on best practices for waste reduction. The waste audit was also conducted with the student Eco-Rep and project partner Diana Alberti and focused on quantification of waste which will be presented later in this report. After the in-person waste audit, Samantha Wittchen provided the group with her official report of the data obtained from the audit. The Eco-rep and nursing project partners then met several times to discuss specific ways to improve the adoption of sustainable practices by staff and students at all
levels of Penn Nursing. Key ideas from these conversations and guidelines for project continuity will be presented in this report.

Research Findings

Part A: Sim Lab Operations & Waste Audit

At the start of the fall semester, the student Eco-Rep coordinated with the simulation lab’s Operations Manager, Diana Alberti, for a site visit to the sim labs. The labs were still in use during the University’s online Fall 2020 semester and operated at reduced capacity for COVID-19 precautions. During this visit, the student Eco-Rep observed one type of undergraduate lab in which nursing students were assessed on their ability to support cardiac cases. Multiple cameras around the sim lab allowed recording and monitoring of the labs from a separate room behind a one-way mirror following social distancing protocols. Figure 1 shows the monitor view of lab filming and an example of a nursing student working in the lab. Two students at a time were observed during a lab session with a faculty member present to read lines as the patient and to take notes assessing the student’s performance. As students opened medical equipment, they discarded packaging and all waste material into nearby trash receptacles. This introductory visit to the sim labs showed that most students do not differentiate between recyclable and landfill materials when disposing of waste during their lab classes.

Using the grant provided by the Green Fund, the project partners then hired Samantha Wittchen to conduct an audit on November 11, 2020 of the waste generated during the previous two days of lab courses. Waste was kept separate between graduate and undergraduate labs to identify any discrepancies in the materials used. Lab kits were also separated from other waste and their individual parts were evaluated for potential reuse instead of recycling potential. Waste was sorted into categories by material or instrument type and laid out as shown in Figure 2 before each category was weighed.

Figure 1: Observing sim lab operations
Part B: Data from iSpring

Samantha Wittchen from iSpring created a report of quantitative and qualitative data gathered from the waste audit. Waste breakdowns were created separately for graduate labs, undergraduate labs, and the lab kits. Figure 3 shows the breakdown of graduate lab waste by weight and as a percentage of the total. Each category was created specifically for the healthcare setting of the labs and given a descriptive name including object names, where applicable. Items highlighted in blue were identified as reusable and those highlighted in green represent materials that are recyclable. It is important to note that the weights for most categories were light, even
when the waste type had substantial volume. For example, sterile gowns were one category with a significant volume collected across the labs, but are lightweight so that their total weight constituted only 9.4% of the total waste weight. This was also seen in other categories made of lightweight material such as paper or face masks. 8.7% of waste was identified as recyclable and 1.8% was identified as reusable. Figure 4 presents the waste breakdown for undergraduate labs using the same highlighting convention of Figure 3. The types of categories created did not differ from those made for graduate labs so landfill waste was described in aggregate by the label “mixed trash” for simplicity. 28.8% of undergraduate waste was identified as recyclable and 6.4% was identified as reusable. During the waste audit it was noted that materials were not properly sorted into blue recyclable bags and clear bags for waste, indicating that most recyclable materials are not being successfully diverted from landfills.

Lab kits were kept separate from other lab waste because it was suspected that many of the materials inside the kits could be reused rather than recycled. Lab kits in the sim labs contain medical equipment specific to a certain type of medical situation and are currently used once during labs before being disposed of by nursing students. In preparation of the waste audit, three types of kits were saved; lumbar puncture, chest tube insertion, and central line kits. After assessing the components of the lumbar puncture kits, it was determined that 97.2% of the component materials could be reused and thus diverted from landfills. Similar results were seen
in evaluating the chest tube insertion and central line kits, identifying the lab kits as having high potential for waste reduction through intervention.

**Results and Evaluation**

The sim lab sustainability project was designed to be a multi-year endeavor requiring investment both in terms of financial funding and effort from University staff and students. Meetings between the student Eco-Rep and project partners during the Spring 2021 semester thus generated ideas for future changes to create a more sustainable waste stream. Samantha Wittchen’s report identified the need for recyclable materials such as mixed cardboard, paper/paperboard, and plastics to be properly diverted from trash through recycling. Although the waste audit found recyclable materials to compromise a small percentage of total waste, this fraction of waste can still be captured by improved recycling practices. Co-location of recycling and trash receptacles is important as the site visit showed there are some lab rooms or areas of the sim lab space where only trash bins are available. Signage that is consistent in placement above recycling/trash bins will also help clarify the importance of separating materials appropriately. Images of common lab materials such as gloves, gowns, and paperboard products can be included on signage to clarify whether a material is recyclable or reusable at a glance.

The lab kits were identified as having the greatest potential for waste diversion through reuse of kit components. This would require collecting kits in receptacles separate from recycling and trash. The kits would be cleaned, repackaged, and stored for re-use as was found to be common practice at other peer institutions by Eco-Reps during the 2019-2020 sim lab project. This intervention also poses an opportunity for cost savings by reducing the demand for purchasing of new kits. The project partners proposed that a student worker position could be created to meet the demands associated with reusing kits. This worker would keep inventory of the kit components and ensure the repackaged kits are stored properly so they are ready available for the associated sim lab courses. The greatest challenge foreseen for this intervention is ensuring washed materials such as tubing can be fully dried and sanitized to meet the standard of medical sterility currently replicated in the sim labs. Moving forward, estimates must be created of the time needed to collect, clean, and repackage kit materials. This estimate is necessary to create an initial job description for the student worker position at the sim labs.

The overview of current recycling practices also emphasizes the need for faculty engagement in the ongoing sim lab sustainability project. Cooperation is needed by faculty who observe nursing students in the sim labs and occupy the space on a day to day basis. Ideally, a pilot will be organized to test out improved recycling infrastructure and kit reuse on a small scale at the sim labs. This pilot would require support from faculty to ensure accurate data collection on the extent to which the two mentioned changes can serve to divert waste. Interview-style meetings with nursing faculty will be planned to spread awareness of the new sustainability initiatives and ask for feedback on which kit components can be reused and how to best clean those materials. Periodic instruction on common lab materials that are recyclable could be given to nursing faculty and new nursing students through Knowledgelink courses. This would ensure familiarity with the distinction between the blue recycling and black trash bins as well as teach others to save the lab kits. During in-person lab courses, faculty could also remind students to dispose of materials properly. Ongoing education will help build habits for more sustainable waste diversion and increase buy-in from those who use the sim labs most frequently. Faculty, students, and operations staff must be knowledgeable of any initiatives at the sim lab in order to ensure the project’s success.
Finally, the work presented in this report can be extended to other on-campus spaces across the University. Upgrading a place’s waste stream can be achieved by focusing attention on any of several approaches including recycling, re-use, composting, or refusal to purchase single-use products. Penn Nursing’s lead in pursuing sustainability initiatives can be supported by the other three Penn health schools; Penn Vet, PSOM, and Penn Dental. Future meetings could be set up with operations leadership at these schools to present the work done so far at the nursing sim labs and obtain feedback. Other campus spaces that could be inspired to pursue similar projects include member labs of the Green Labs group. The methodology presented here of site visits, waste audits, small discussion groups, and interviews can be replicated to identify initiatives tailored to the types of materials most frequently used in other campus spaces. Site visits and waste audits are most useful to identify how to efficiently design small-scale changes to waste management. For example, lab spaces might focus on avoiding single-use plastics or properly recycling those materials while cafe spaces in the health schools could focus on adding composting to their waste stream. Another waste audit can be conducted to follow up on new initiatives and assess their overall contribution to meeting sustainability goals. In the case of the nursing sim labs, this quantitative data will include the number of kits saved by reuse and calculation of recycling contamination rates to assess any change following the improved recycling infrastructure.

**Conclusion**

This project enabled the exploration of sustainability practices specific to the simulated nursing environment. The overall goal of the 2020 - 2021 project was to create a foundational plan for future implementation of material reuse and recycling in a pilot program. This goal was accomplished by site visits to understand daily operations, hiring a sustainability consultant for waste audits, and group discussion of the best strategies to improve recycling and begin reusing equipment. The future of this project will tackle implementation of a pilot program based on the recommendations outlined in the results and evaluation section of this report.

**Appendices**

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Student Eco-Rep Johanna Inamagua worked with Penn Nursing staff to create a waste reduction plan for future implementation at the nursing simulation labs. This plan focuses on the re-use of lab kit items which was identified by waste audits conducted using a Green Fund Grant.