Original Article

Recycling of Renewable Resources in Extracorporeal Circulation Technology

Lisa M. Bliss, RN, BS, Jodie M. Ecklund, BS, CCP, Jeffrey B. Riley, BA, CCP, CCT

Program in Extracorporeal Circulation, Clinical Services Department, College of Health Professions, The Medical University of South Carolina, Charleston, South Carolina

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ABSTRACT

This project evaluated the cost effectiveness and feasibility for recycling of renewable resources and disposing of non-recyclable materials generated in the perfusion department of an open heart surgery program. Forty-one adult and pediatric open heart cases were randomly assigned to participate as the control or the recycling group. The control group had no separation of materials. In the recycling group, packaging materials such as glass bottles, corrugated cardboard, and plastics were recycled, providing there was no contamination with blood or body fluids. Non-infectious waste was also separated from infectious waste. The recycled bags, the non-infectious waste bags, and the infectious waste bags were weighed to the nearest one-half pound. The type, weight, and number of bags were recorded. The results from the two groups were analyzed using a one sided Student's t-test. A p value < 0.05 was considered significant. The results indicated that recycling and proper separating of waste significantly decreased the amount of waste discarded as "contaminated". Because contaminated or infectious waste costs $5.60 per red bag and non-infectious waste costs $0.02 per pound, decreasing both forms of waste is economically attractive to hospitals. The perfusionist can decrease the amount of waste products generated in the operating room that must be either incinerated or disposed of in landfill. Recycling and proper separation of waste significantly decreased the expenditure for waste disposal, and decreased the impact of perfusion services on our environment.

Address all correspondence to:
Lisa M. Bliss, RN, BS
68215 Estio Road
Cathedral City, CA 92234

INTRODUCTION

This project evaluated the recycling of renewable resources and proper separation of refuse in perfusion technology. Packaging materials, including corrugated cardboard, plastic, and Styrofoam™ are all perfusion-related items that may be returned for recycling. Corrugated cardboard is in short supply, but only fifty percent of all corrugated cardboard is recovered in the United States each year (1). Glass bottles, such as ACPD, THAM™, sodium bicarbonate, and heparin may also be recycled provided they are not contaminated with blood or body fluids (2).

Many renewable resources are needlessly disposed of in hospital waste containers, which are then thrown in landfills, or incinerated with infectious waste (1,3). Separating recyclable material from noninfectious waste and infectious waste contaminated with blood or body fluids would decrease the amount of refuse generated by the medical system (2,4) Recycling and proper separation of non-contaminated and contaminated waste provides an excellent means to decrease hospital costs for waste disposal (2,4). Approximately fifty percent of hospital waste is generated in the operating room (5) with the majority being disposed of as infectious waste. It is estimated that the actual amount of infectious waste could fit into one red infectious waste bag for most surgical procedures (2). Open heart procedures require the addition of one red bag for the pump circuit. Red is the designated color in the medical community indicating the contents contain infectious waste and require special handling. Unfortunately, more than one red bag leaves each operating room suite at our institution.

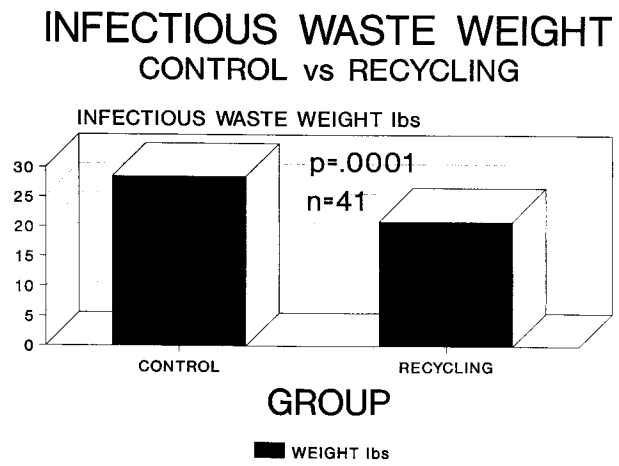
The null hypothesis states there is no difference in the weight of red bags generated by perfusion services in open heart procedures participating or not participating in recycling practices.

MATERIALS & METHODS

Forty-one adult and pediatric open heart cases were randomly assigned to the control or recycling group. The control group had no separation of materials. The recycling group had separation of recyclable plastics, corrugated cardboard, Styrofoam™, and glass during perfusion apparatus set-up, provided there was no contamination with blood or body fluids. Non-infectious trash was also separated from infectious trash throughout the procedure for the recycling group. The weight to the nearest 0.5 pound, and number of recyclable bags, non-infectious waste bags, and infectious waste bags were noted. Seventeen paired observations were required for a power of 0.8.

Refuse from the perfusion work-rooms was also separated for recyclable materials. When weekly supplies were delivered, packaging materials were sorted and recycled. Cardboard and glass were weighed to the nearest 0.5 pound and recorded for a five week period to determine the average amount of recyclable perfusion materials per week.

Figure 1: Infectious waste weight: control vs. recycling



A one sided Student's t-test was performed on infectious waste bag weights between control and recycling cases. Cost for disposal of waste was estimated per bag and by weight according to institutional waste removal methods and fee schedules.

RESULTS

There was a significant ($p = .0001$, $n = 41$) weight reduction with red bags in the group that recycled and separated non-contaminated rubbish versus the control group. The average weight of the infectious waste bags was 21.0 pounds (±4.87 pounds) for the recycling group and 28.5 pounds (±5.86 pounds) for the control group (Figure 1).

The average weight of the recycle bags was 3.0 pounds (±0.82 pounds). The average weight of the non-recyclable non-infectious waste bags was 4.0 pounds (±1.47 pounds) (Figure 2).

The number of red bags was reduced by one bag per case by recycling and separating non-infectious trash, for both pediatric and adult cases. The total waste disposal cost was reduced from $11.20 per case without separation and recycling to less than $6.00 per case with separation and recycling (Figure 3).

An average of 70 pounds of cardboard and glass has been recycled per week from the perfusion workrooms. The work-rooms are estimated to generate about 3,640 pounds of recyclable material per year.

DISCUSSION

Perfusion recyclable materials may include corrugated cardboard and plastic packaging that contain perfusion supplies such as oxygenators, cardiotomies, etc. Many of the packaging

Figure 2: Breakdown of waste according to weight

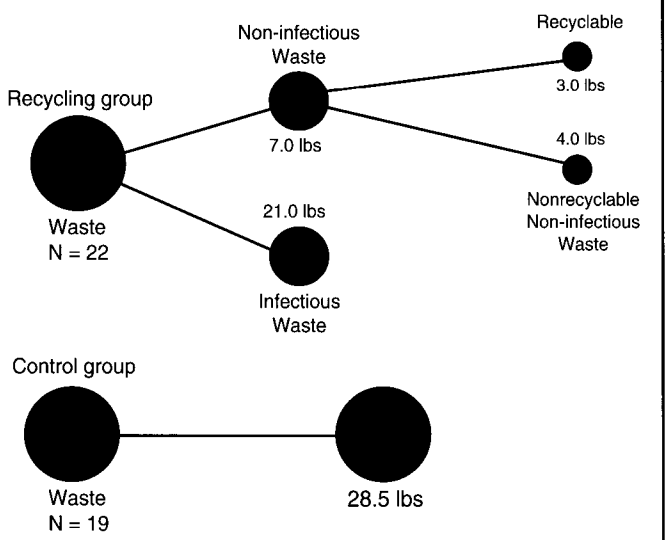
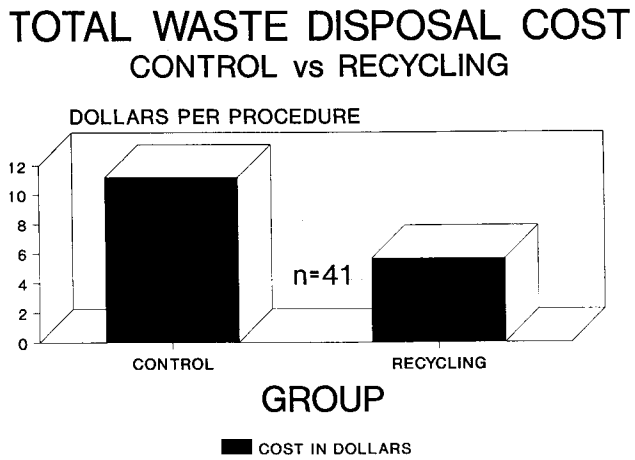


Figure 3: Total waste disposal cost



materials such as plastics and Styrofoam™ are bulky items that occupy relatively large amounts of space while weighing very little. Glass and plastic bottles that contain solutions such as THAM™ and ACPD and medications like heparin and sodium bicarbonate are also recyclable. In this study, recycling plastic, Styrofoam™, and glass, in addition to the proper separation of non-infectious waste, significantly reduced the amount of materials discarded as infectious waste.

Non-infectious waste, regarded as nonregulated waste (6), costs approximately five cents per pound to dispose of (1992 estimates) (2) and goes to landfill (7). Infectious waste is regulated (7), costs approximately fifty cents per pound (2), and must be incinerated (1992 estimates) (7). At our institution, infectious waste costs $5.60 per bag regardless of weight, and non-infectious waste costs $0.02 per pound to dispose of (1993), (Figure 3). Decreasing the amount of waste by recycling is cost effective. Our results suggest that eliminating even one infectious waste bag per case by recycling and proper waste separation will save $3,433.00 per year in perfusion related costs alone.

Unfortunately, both landfills and incinerators have a negative impact on the environment. The United States is running out of landfill area, and incinerators are major sources of air pollution (5, 7). The perfusionist may utilize recycling as a method to decrease the amount of waste products generated in the operating room that must be either incinerated or disposed in landfill (2). Some companies have not only decreased their disposal waste budget by recycling, but have also generated income by selling materials to recycling centers (9).

As our results indicate and others have reported, recycling decreases the expenditure for waste disposal (5), and decreases the impact of operating room waste on the environment. Separating recyclable material, noninfectious waste, and infectious waste is both economically and environmentally sound.

SUMMARY

1. Recycling and proper separation of noninfectious waste from infectious waste significantly decreased the amount of waste requiring incineration.
2. Recycling and proper separation of waste decreased the expenditure for waste disposal.
3. At our institution, infectious waste costs ten times more than noninfectious waste for disposal. This study suggests a savings of $3,433.00 per year for perfusion related disposables alone.

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