

Reducing Anesthesia Related Regulated Medical Waste – A Quality Improvement Study

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NURS 703B: DNP Project

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Abstract

Overuse of disposable equipment, lack of education regarding proper designation of OR waste, and improper disposal of hazardous waste contribute to unnecessary regulated medical waste (RMW) production. This quality improvement project explored the issue of improper disposal of medical waste produced by anesthesia team members in operating rooms (ORs) and the negative impact this has on healthcare's contribution to environmental waste production. The aim of this QI project was to reduce the total weight and thus the cost of RMW disposal at a PNW institution by 20%. Utilizing the 8-step Kotter Change model, a pre and post education intervention was designed. This included a comprehensive assessment of regulated medical waste disposal practices at the institution and the development of education materials designed for anesthesia team members about appropriate RMW disposal practices. The findings from this project revealed the need for an institutional policy change to support medical waste reduction efforts. The current RMS policy prevented the presentation of evidence-based recommendations to reduce medical waste in the operating room. This QI project, once implemented, may contribute to decreasing the negative environmental impact of this institution.

Keywords: Regulated medical waste, environmental waste, medical waste disposal, quality improvement

Introduction

Problem Description

There is growing attention on the impact of climate change on health and the impact of the healthcare industry on the environment and climate change. Operating rooms represent a small physical footprint in any given hospital, yet they have a huge impact on hospital budgets and the environment. (Practice Greenhealth) In the United States, operating rooms (ORs) produce up to 2,000 tons of medical waste in a single day, significantly contributing to healthcare's environmental waste production (Yeoh et al., 2020). National estimates of OR waste is approximately 30% of overall hospital waste production.

The “greening” of hospitals began in the 1970s with grassroots efforts encouraging departments to make simple changes such as recycling bottles and cans. Organizational programs, such as the Hospitals for a Healthy Environment program, were developed to help operating facilities implement these changes and develop more strategies to reduce energy use, supply costs, and waste generated by the operating rooms. In January of 2008, the program was reorganized and renamed Practice Greenhealth, which became the leading proponent for greening the OR. Proactive frameworks for decreasing the OR's environmental impact include assessment of the following: HVAC systems, LED surgical lighting, medical device reprocessing, OR kit reformulation, reusable medical products, reusable sterilization containers, fluid management systems, anesthesia gas reduction and reduction of regulated medical waste (RMW) (Practice Greenhealth). Yeoh and colleagues estimate that 85% of hospital waste is disposed of as hazardous solid waste, though only 15% of this waste constitutes true hazardous medical waste. These numbers have steadily increased as use of disposable (“single use”) medical equipment for procedures has also increased (Denny et al., 2019).

At a large academic institution in the Pacific Northwest, knowledge of the problem of environmental waste in healthcare is gaining traction. However, despite identifying as an extremely pro-environment state and city and being a member of Practice Greenhealth, this institution does not dedicate any resources to promoting environmentally friendly practices. The institution's Sustainability Steering Committee, designed to address environmental issues, has no funding or power to implement or control practices aimed at decreasing environmental impact. The need for increased awareness of the scope of the problem and improvement of existing efforts to address it remains.

Available retrospective studies found that unnecessary RMW is the primary contributor to OR waste (Meyer et. al, 2022). Regulated medical waste (RMW), also called red bag waste or biohazard waste, is the most expensive waste stream to manage due to the disposal process and is where most disposable equipment is placed after usage. Overuse of disposable equipment, lack of education regarding designation of OR waste, and improper disposal of hazardous waste all lead to a disproportionate amount of RMW produced by the OR.

Reduction in single-use equipment utilization among institutions has resulted in a substantial reduction in RMW as well as costs associated with disposal of this waste. Among cohort studies, education regarding disposal equipment waste designation has been shown to decrease overutilization of materials and decrease overall production of waste from the OR (Meyer et. al, 2022).

Lack of staff education regarding proper segregation of hazardous and nonhazardous waste is a significant barrier to reduction of waste in the OR (Kristen Bowden, personal communication, November 16th, 2022). In a study by Agrawal et al. (2017), 1000 hospital staff were surveyed regarding proper waste segregation. Less than 1% of the employees showed an

understanding of medical waste processes. This lack of understanding showed 50% of the waste was disposed of as RMW when only 10% was considered true RMW. This knowledge gap highlights the lack of proper segregation and the need for improved staff education. To minimize the environmental impact of the ORs, it is crucial to increase the awareness of the scope of the problem. Taking proactive measures to tackle this issue is essential in mitigating the environmental consequences associated with OR waste.

Available Knowledge

Healthcare is the leading driver of economic growth and innovation in the United States. Global spending on healthcare has grown 4.4% per year due to rapid population growth, increased life expectancy, and increased use of disposable medical products (Salas & Solomon, 2019). Energy and material consumption, emissions, and waste have reached unsustainable levels in the healthcare sector (Thiel et. al, 2015). The recent push for disposable, single-use medical products has exacerbated waste production, with anesthesia specific equipment being a main contributor (Denny et. al, 2019). Items such as laryngoscope handles and blades, breathing circuits, and a myriad of other items have been utilized for convenience, ease, cost of maintenance, and reasonable upfront cost and value (Denny et al., 2019). Disposable equipment imposes the need for recurring monetary investments by healthcare facilities, it is notoriously detrimental to the environment in terms of waste, and does not demonstrate any advantage in bolstering infection control (Hubbard et. al, 2017). Current evidence demonstrates that use of disposable equipment has considerable economic and environmental disadvantages, and a reduction in single-use equipment may result in a substantial decrease in RMW, as well as cost associated with disposal of this waste (Kagoma et. al, 2016).

When assessing the environmental implications of disposable equipment, one must consider their ecological footprint from production to disposal, including material procurement, labor, manufacturing, energy use prior to purchase, equipment disposal labor, landfill costs, energy, and the overall environmental impact after placement in a designated waste container (Thiel et. al, 2015). Waste and disposal containers within an OR are designated as: waste to landfill, incineration, autoclave, or recycle. Despite the significant disadvantages related to single use disposable equipment in the OR, the disposal of non-regulated materials into regulated medical waste receptacles has demonstrated higher costs and severe environmental impacts. Materials designated as hazardous require incineration, which produces greenhouse gasses such as carbon dioxide and other pollutants (Hubbard et al., 2017). Improper disposal and the subsequent need to render waste as noninfectious can cost the hospital 10 to 20 times more for disposal (Meyer et. al., 2022).

Staff education regarding disposal equipment waste designation has been shown to decrease overutilization of materials and decrease overall production of waste from the OR (Meyer et. al, 2022). However, education regarding proper disposal practices at this institution are not regularly implemented among OR faculty. Information on what is considered RMW and non-RMW is not readily available, and unnecessary medical waste continues to be disposed of improperly (Kristin Bowden, personal communication, November 16th, 2022). This lack of education potentiates the increasing production of RMW among the 15 ORs, creating significant hospital systems cost and greenhouse emissions.

Rationale

The volume of anesthetic equipment routinely used for patient care in the OR, combined with inefficient and erroneous waste separation of this equipment, makes it one of the more

visible contributions to excess RMW in the operating room. A major factor in improper waste segregation is the result of lack of OR staff education regarding what constitutes biohazard and non-biohazard material and fear of negative repercussions from governing bodies if biohazard material is inadvertently discarded into regular non-hazardous waste bin (Kristin Bowden, personal communication, November 16, 2022). To address these issues, the intervention for this project was based on the Kotter Change model, with the main idea focusing on education regarding biohazard waste and proper separation of medical waste.

The Kotter Change model utilizes an 8-step process that focuses on identifying the issue, creating a team to develop change, educate and empower others to act on the change, and use the results to further the vision of change. According to Dr. Kotter et al. (2021), many interventions fail due to a lack of urgency and understanding of what needs to be changed. By fully identifying the barriers behind proper separation of RMW, this project is better equipped to develop an educational intervention that creates a sense of urgency and motivates others to act in order to create change.

Specific Aim

This quality improvement project aims to reduce inappropriate disposal of regulated medical waste produced by anesthesia providers in the ORs, thus mitigating the cost of disposal of RMW and the institution's impact on the environment. This team's goal is to reduce the monthly RMW weight and, therefore, cost of the disposal of RMW produced by anesthesia by 20% by December 1st, 2023.

Methods

Context

The setting for this project is an outpatient surgical center, associated with a major academic health institution with clinics in the Pacific Northwest. This outpatient surgical center utilizes 15 ORs, producing 21,622 cases in 2021 (Hospital 2022 Fact Book, 2023).

Current practice defines regulated medical waste as materials that are contaminated with blood or body substances; however, the waste must be saturated or clearly visible to be considered RMW. Additionally, any used or unused sharps must be disposed of as regulated medical waste. RMW is disposed of in red bags or hard plastic containers specifically designed for sharps and transported to contracted disposal companies. At this institution, there are resources and leadership available to promote environmentally friendly practices. However, there is a knowledge gap regarding proper separation of regulated medical waste which contributes to environmental waste.

Intervention

National estimates of OR waste is approximately 30% of overall hospital waste production, with supplies related to administration of anesthesia alone comprising 7.5% of this waste (Denny et al., 2019). Anesthesia providers have an opportunity to create a more environmentally friendly practice which may help decrease waste and lessen the impact of climate change. To effectively create change, the problem needs to be identified and shared with those impacted by it. Once the problem is identified, a shared vision for a solution needs to be created. For this vision to come into fruition, obstacles need to be removed to open the way for short term wins and change. This change needs to be incorporated into the culture to make it stick. Continuous efforts need to be in place to solidify this in the institution's culture.

The QI project began with a comprehensive assessment of disposal practices among the operating rooms. This involved identifying how much waste was produced within the ORs at the facility, analyzing waste materials from several ORs, and identifying areas for improvement. During the month of October in 2022, this facility's ORs produced 14,449lbs of waste. This cost the hospital approximately \$25,801 for a single month of waste disposal (Matthew Adamson, personal communication, November 28th, 2022). The initial visual inspection of RMW found around 75% of items being disposed of did not meet the Occupational Safety and Health Administration criteria for RMW. Specifically, items such as anesthesia circuits, used gloves, suction canisters and tubing, saline bags, and regular trash items.

After thorough examination and analysis of the situation, the results of the comprehensive assessment were presented to anesthesia leadership positions within the institution. Through these collaborative discussions, a consensus emerged to create educational materials that would serve as a catalyst for change, empowering staff to act.

Simultaneous steps creating evidence-based education and determining potential obstacles to implementation revealed an unknown policy that classified all anesthesia material as RMW. Recognizing the impact of this policy on the effective management of waste, the team undertook a concerted effort to challenge and revise it. Through a series of meetings, the team engaged stakeholders in meaningful dialogue, highlighting the potential benefits of reevaluating the existing policy. By fostering a shared understanding of the issues and the need for change, the team worked towards gaining consensus and support for revising the policy regarding anesthesia material classification.

Following the enactment of the policy change, this QI project would have progressed by conducting staff education using the developed educational material. Material, such as a

presentation and flyer, were created to disseminate the information which would have been specifically targeted towards anesthesia staff. The educational material contained evidence-based information on the proper disposal of RMW, financial and environmental implications, and the impact of non-compliance. Additionally, the flyer would have been included to notify staff about key points of anesthesia-specific disposal practices of RMW. The materials were to be distributed during educational sessions or incorporated into monthly staff meetings to maximize their reach and impact.

To gauge the effectiveness of the intervention, a subsequent comprehensive assessment would have been conducted at two and four months, which would have involved another process of reviewing and analyzing the disposal practices of the operating rooms. By visibly examining the discarded waste, the QI team would have been able to determine if the educational materials and information led to improved adherence to proper disposal practices.

After the completion of the final reassessment, a comprehensive presentation would have been delivered to all anesthesia staff members. The purpose of this presentation would be to highlight and communicate the impact they had on RMW practices. The presentation would have showcased the improvements achieved and the outcomes resulting from their efforts.

Furthermore, to ensure the sustainability of the progress made, recommendations for ongoing awareness regarding the contents of RMW would have been proposed.

One such recommendation would involve maintaining informative flyers in the operating rooms, which would serve as visual reminders of what should and should not be disposed of in the RMW bins. These flyers would provide staff members with clear guidelines and instructions on proper waste segregation. Additionally, strategies for organizing the trash bins would have been suggested to minimize the likelihood of regular trash being mistakenly disposed of in the

RMW bins. By implementing effective organizational methods, staff members would be encouraged to differentiate between various waste streams and dispose of them accordingly. These ongoing awareness and organizational efforts would ensure compliance with waste management protocols and maintaining the progress achieved through the quality improvement project.

Study of Interventions

This QI project was meant to be a pre/post education study that measured the objective and subjective medical waste produced in the outpatient setting.

Ethical Considerations

This project was deemed non-research by the IRB at the participating institution. Consent by staff is implied through participation in the project. Consent from relevant institutional authorities responsible for overseeing waste management processes was obtained, and universal precautions were taken to ensure personal protection from hazardous material.

Results

This project aimed to reduce inappropriate disposal of RMW produced by the administration of anesthesia in the ORs, thus mitigating the cost of disposal of RMW and the institution's impact on the environment. Given that approximately 70% of OR waste was inappropriately identified, this significant finding emphasized the need for improving staff knowledge and practices regarding RMW disposal. With the assistance of leadership, educational material was developed to effectively educate the staff on the significance of proper RMW disposal and to provide guidance on the best practices for RMW disposal. However, prior to distributing the material, conflicting evidence regarding the educational material was identified, necessitating a new plan.

A second PDSA cycle focused on the next steps regarding the gathering of research-based evidence in relation to RMW practices across the state of Oregon. The objective was to educate policy holders and advocate for changes in the existing policy by providing clarity and promoting a standardized understanding of RMW. As part of the efforts to advocate for changes in existing facility policy, a representative from OSHA was contacted, with the sole purpose to clarify the definition of RMW as per OSHA guidelines.

The policy holders at the institution were contacted to advocate for a policy change regarding RMW. In discussions with the policy holders, the implications of altering the policy were explored, as the decision ultimately rested with them in redefining the separation of RMW. Recognizing the need for change, efforts were initiated to update the policy wording. Currently, the policy change process is underway, and ongoing communication is being maintained with the relevant teams involved.

Discussion

Summary

The original goal of this QI project was to reduce anesthesia's contribution to OR RMW and thus negative environmental impact by identifying sources of OR waste and providing education to anesthesia staff on proper disposal of anesthesia paraphernalia, specifically appropriate designation of Regulated Medical Waste and Non-regulated Medical Waste, as RWM has a higher environmental burden. The planned PDSA cycle was to obtain objective data on the monthly weight of RMW produced by the facility, provide a staff education intervention addressing proper disposal of RWM according to guidelines, and re-analyze the quantifiable RMW data to assess for an objective reduction of RWM. Prior to the education session, an

outdated policy surfaced that precludes disposal of anesthesia paraphernalia into non-regulated medical waste receptacles, necessitating a re-evaluation of the project's goals.

Interpretation

The initial PDSA cycle revealed a need for education defining RMW waste criteria and standard disposable waste materials, while the second PDSA cycle revealed a need to update current policy regarding RMW waste criteria (Chair, E. 2021). The lead environmental protection manager at the academic facility was informed of this project's aim and the roadblocks that currently reside in the institution's specific policies surrounding waste disposal. Before focusing on staff education regarding proper RMW disposal practice, the project had to focus on updating policy change.

Current policy considers all anesthesia material as regulated medical waste, despite the Occupational Safety and Health Administration (OSHA) categorizing regulated medical waste as "contaminated items that would release blood or other potentially infectious material (OPIM) in a liquid or semi-liquid state if compressed; items that are caked with dried blood or OPIM and are capable of releasing these materials during handling; contaminated sharps; and pathological and microbiological wastes containing blood or OPIM" (OHSA, 2009). During the conversation with the OSHA representative, it was confirmed that the definition of RMW remained consistent with established guidelines; however, some hospitals have the autonomy to adopt stricter policies regarding RMW (S. Ladd-Wilson, personal communication, March 28, 2023). These policies can require a broader range of materials to be considered as RMW, going beyond the minimum criteria set by OSHA.

Modification in the policy has been proposed and is currently underway. Communication with the environmental health and safety team and all other relevant parties will remain ongoing

through this policy change until clear RMW waste criteria is established and education may be implemented.

Limitations

The primary limitation of this project was the unknown old policy wording, which classified all anesthesia paraphernalia as regulated medical waste (Chair, E. 2021). This lack of clarity hindered the implementation of the initial intervention, which focused on education and further assessment of RMW separation practices. As a result, the project focus was redirected towards advocating for policy change.

Conclusions

Regulated medical waste produced by anesthesia providers in the OR is a known contributor to environmental waste with environmental implications. The project's findings included a current institutional policy that prevents proper, OSHA-sanctioned waste disposal practice by anesthesia staff. This policy precluded staff education intervention and anesthesia practice changes, necessitating a policy change prior to advancing with the project's original intent of providing staff education on appropriate RMW. The findings provide an opportunity for future interventions aimed at ensuring the institution's policy reflects more environmentally conscious waste practices.

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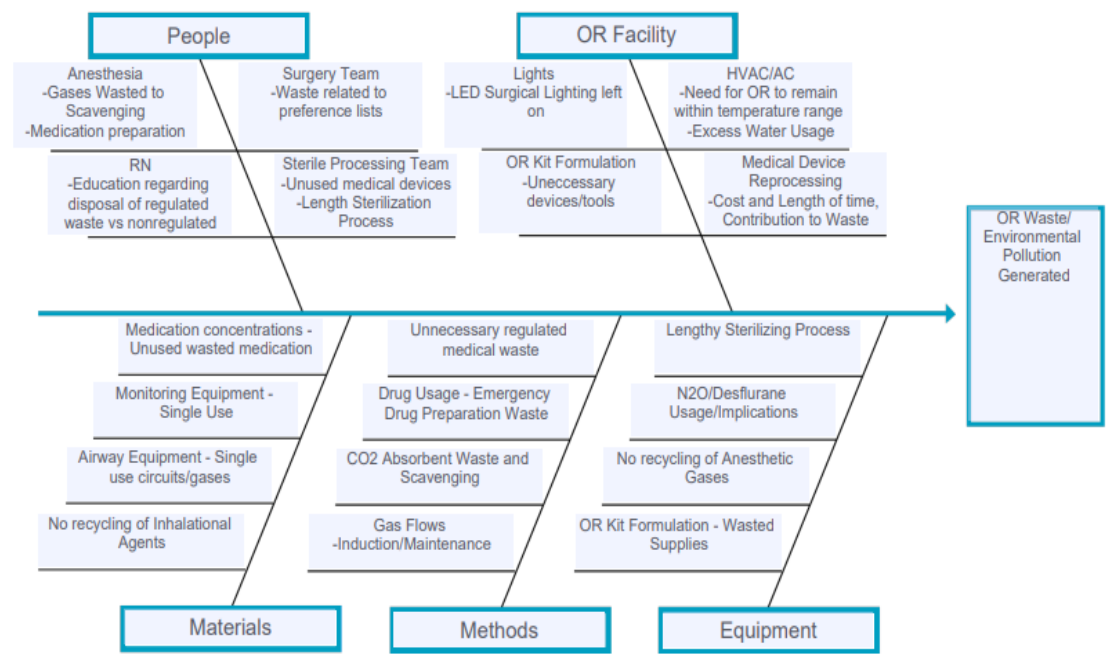
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Appendix A

Regulated Medical Waste Cause and Effect Diagram



Appendix B

Letter of Support from Project Implementation Site

Letter of Support from Clinical Agency

Date: 10/02/2022

Dear Luke Armstrong, Alivia Chang, & Rachel Hunsaker

This letter confirms that I, [DNP Project Preceptor Name], allow Luke Armstrong, Alivia Chang, & Rachel Hunsaker (OHSU Doctor of Nursing Practice Students) access to complete his/her DNP Final Project at our clinical site. The project will take place from approximately December 2, 2022 to December 1, 2023.

This letter summarizes the core elements of the project proposal, already reviewed by the DNP Project Preceptor and clinical liaison (if applicable):

- **Project Site(s):** OHSU Center for Health & Healing
3303 S. Bond Ave., Portland, OR 97239
- **Project Plan: Use the following guidance to describe your project in a brief paragraph.**
 - **Identified Clinical Problem:** Currently, the OR contributes around 30% of a hospital's environment waste production (RMW). One major contributing factor to this issue is inappropriate disposal of regulated medical waste. Currently, OHSU produces around 56,000 pounds of regulated medical waste a month. However, much of this waste has little to no organization as to what is considered RMW.
 - **Rationale:** Lack of OR staff education regarding what constitutes a RMW and regular waste contributes to the volume of waste that is being produced within the ORs. With the increasing amount of equipment being utilized in ORs, education of proper disposal practice must be instituted in order to assist in decreasing the impact of the ORs.
 - **Specific Aims:** Reduce unnecessary regulated medical waste from the OR by 20% by December 1, 2023
 - **Methods/Interventions/Measures:** This project will utilize the Lean Six Sigma method which includes five sequential steps: defining the problem, identifying and measuring endpoints, analyzing the change, improving the process, and controlling the implementation of the newly adopted process. Education will be implemented through PowerPoint presentations and educational flyers placed throughout the ORs. Outcomes will be measured by monthly RMW production, the number of staff implementing new practice guidelines, and staff satisfaction of education intervention.
 - **Data Management:** Data will be collected through an anonymous survey that will only identify surveyors by their profession. The data will be collected and stored using Qualtrics software and secured via OHSU encryption, password protection, and two-factor authentication.
 - **Site(s) Support:** The site will provide access to faculty emails to send surveys. Students will also need access to ORs and morning huddles to provide educational information and flyers to OR faculty. Open communication with Environmental Services from the site will provide information regarding RMW statistics.
 - **Other:** During the project, the students will present educational information and findings at OHSU's Grand Rounds.

During the project implementation and evaluation, Luke Armstrong, Alivia Chang, & Rachel Hunsaker will provide regular updates and communicate any necessary changes to the DNP Project Preceptor.

Our organization looks forward to working with this student to complete their DNP project. If we have any concerns related to this project, we will contact Luke Armstrong, Alivia Chang, & Rachel Hunsaker and Mikelle Adamczyk (student's DNP Project Chairperson).

Regards,

DNP Project Preceptor (Name, Job Title, Email, Phone): Catherine Malinin, Lead ORNA

over ambulatory services, Malinin@ohsu.edu, 952-649-1824

Catherine Malinin
Signature

12.6.2022
Date Signed

Appendix C

Oregon Health & Science University IRB Determination



NOT HUMAN RESEARCH

January 27, 2023

Dear Investigator:

On 1/27/2023, the IRB reviewed the following submission:

Title of Study:	Reducing Regulated Medical Waste in Operating Rooms: A Quality Improvement Project
Investigator:	Mikelle Adamczyk
IRB ID:	STUDY00025361
Funding:	None

The IRB determined that the proposed activity is not research involving human subjects. IRB review and approval is not required.

Certain changes to the research plan may affect this determination. Contact the IRB Office if your project changes and you have questions regarding the need for IRB oversight.

If this project involves the collection, use, or disclosure of Protected Health Information (PHI), you must comply with all applicable requirements under HIPAA. See the [HIPAA and Research website](#) and the [Information Privacy and Security website](#) for more information.

Sincerely,

The OHSU IRB Office