Disposition of Unused Medical Supplies

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Rachel Baur

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Mentor: Dr. Gene Fliedner

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Abstract

This research project investigates the waste associated with the disposal of unused medical supplies, the current methods used to repurpose and donate unused medical supplies, and the barriers associated with repurposing and donating unused medical supplies. A literature review and an interview with an expert in the field has been conducted. The research done for this project suggests that it is possible to decrease the disposal of unused medical supplies. One example of a means waste disposal can be decreased is by resterilizing open and unused medical supplies with hydrogen peroxide vapor. Another means the waste of disposal can be decreased is through the establishment of a collection, repurposing, and donation program. Examples of programs that currently exist include Recovered Medical Equipment for the Developing World (REMEDY), Recycling Unused Medical Supplies (RUMS), MedShare, and Project Commission on Urgent Relief and Equipment (CURE). Studies done with hydrogen peroxide vapor and the collection, repurposing, and donation programs show a decrease in money spent in healthcare systems and reduced waste in landfills. Along with the positive aspects of these methods, there are a handful of barriers that need to be addressed. These include deterioration of desterilized supplies, warranty issues of donated supplies, the responsibility of impoverished countries to desterilize the donated supplies, an overabundance of incorrect supplies donated to charities, the fallacy that individual action will not create a measurable difference, and little regulation of medical supplies that are in hospital supply rooms. Results of this project can help future investigations devise plans to effectively collect, repurpose, and donate medical supplies. Healthcare systems worldwide will benefit from this project because they will have a better understanding of the issue along with the barriers that still need to be overcome.

Introduction

It is a common practice in medicine to dispose of any medical supply that is or could have possibly been contaminated. Even if the packaging of the medical supply was never opened, many healthcare workers will opt to throw away the supply due to the idea that anything taken out of a supply room and not used, has to be thrown away because of possible contamination that can occur once the supply is in the patient's room. While medical supplies should be disposed of if they are directly and obviously contaminated, medical supplies that are unused or not directly contaminated should not be. The disposal of unused medical supplies is not a new problem and it is costly to not only hospitals, but also the environment.

The World Health Organization (WHO) defines medical supplies as any instrument, apparatus, implement, machine, appliance, implant, reagent for in vitro use, software, material or other similar or related article, intended by the manufacturer to be used, alone or in combination for a medical purpose (WHO, 2022). Some examples of supplies that are commonly disposed of include nasal cannulas, nebulizers, suction supplies, catheter needles, endotracheal tubes, masks, cleansing supplies, IV supplies, phlebotomy tubes, syringes, urology supplies, vital sign equipment, eye protection, gloves, gowns, towels, speculums, procedure kits, scissors, clamps, forceps, scalpels, sutures, tape, and gauze (Muldoon et al., 2019).

While unused medical supplies are disposed of in almost all medical facilities, the most common places that dispose of medical supplies include emergency departments, operating rooms, intensive care units, and isolation rooms. There is a large amount of unused medical supplies disposed of in emergency departments and operating rooms because both of these units have a fast patient turnover rate. Therefore, the emergency department and the operating room

employees are rushed in between the arrival and discharge of patients leaving little time, if any, to collect and sort through unused supplies.

Results of a study showed there to be 87.9 pounds of recoverable medical supplies disposed of in an emergency department over the course of thirty days (Muldoon et al., 2019). In a similar study done to find the amount of medical supplies disposed of in operating rooms, it was discovered that there were approximately two million pounds of recoverable medical supplies disposed of each year from large non-rural operating rooms (Wan et al., 2014).

Intensive care units are another major contributor to the disposal of unused medical supplies because of the patient complexity and needs requiring extensive supplies, cleaning practices, and pre-emptive supplies (Ghersin et al., 2020). Results of a study done in an intensive care unit discovered that roughly 168 pounds of unused medical supplies were disposed of over a three-week period (Ghersin et al., 2020). Isolation rooms also have a high rate of unused medical supply disposal in order to prevent items from becoming pathways for transmission of the disease the patient was isolated for (Otter et al., 2020). In the same study done regarding the amount of unused medical supplies disposed of in an intensive care unit, it was estimated that greater than 75 percent of the disposed items in the intensive care unit over the course of the three weeks came from isolation rooms (Ghersin et al., 2020).

There are multiple reasons as to how unused medical supplies are disposed of and why the disposal of unused medical supplies is so common. First, medical supplies that are opened but unused are mainly disposed of because of federal regulations, hospital protocols, and procedural excess in the United States (Muldoon et al., 2019). Second, due to a sense of immediacy in the interest of optimal surgical management and protection from litigation, more than the requisite supplies are typically opened for a given operation (Rosenblatt & Silverman,

1992). Third, most hospitals make no effort to separate non-infectious waste from infectious waste for purposes of disposal mainly because of the time constraint put on healthcare workers to get rooms ready for a new patient immediately after a patient is discharged (Pennino et al., 1998). Fourth, supplies are unnecessarily readied in the surgical field only to be disposed of unused, which results from redundant procedures, outdated policies, and unsubstantiated practices (Rosenblatt & Silverman, 1994). Fifth, there is little incentive to monitor the issue and many people decide to just accept the inevitable loss (Rosenblatt & Silverman, 1994). In other words, many healthcare workers are indifferent to this issue because there is a fallacy that individual action will not create a measurable difference (Ghersin et al., 2020).

The disposal of unused medical supplies is wasteful for a variety of reasons. For example, it has considerable cost implications. In a study done to determine the possible savings from repurposing medical supplies, the results showed that the annual cost of supplies discarded at patient hospital discharge was $387,055 (Otter et al., 2013). Results of another study done in the United States estimated there to be $200 million worth of prepared materials discarded in operating rooms each year (Rosenblatt & Silverman, 1994). A third study found that as much as 25 percent of all United States healthcare spending is wasteful, with an accumulated debt between $760 million and $935 billion (Ghersin, 2020). However, only calculating the cost of medical supplies disposed of actually underestimates the financial burden of this practice. In other words, another major cost associated with discarding these supplies is the disposal cost of the waste generated. Research has shown that disposal fees may actually exceed the purchase cost for some products (Otter et al, 2013).

There is an additional opportunity in the avoidance of medical supply disposal. Medical facilities in much of the developing world are characterized by a lack of some of the basic

supplies required for proper patient care (Miller, 2002). When medical settings in the United States dispose of their basic medical supplies, they are throwing away the chance to donate or sell these items to impoverished countries that are in need of them. For example, impoverished countries will actually reuse needles until they are too dull to pierce the skin. Disposable syringes, tubing, drains, catheters, and even gauze are recycled to be used again since there is such a low supply of them in these countries (Pennino et al, 1993). Unfortunately, medical facilities in these impoverished countries do not consistently sterilize these recycled medical supplies due to knowledge gaps and poor guideline adherence (Cuncannon et al., 2020). Having to reuse these unsterilized supplies not only limits the basic health care given to these patients, it also increases the stress of healthcare workers due to their knowledge of possible cross contamination between patients (Pennino et al, 1993).

The disposal of unused medical supplies is also dangerous for the environment. Since the greenhouse gas (GHG) emissions attributed to waste are not tangible, excessive waste has become deeply-rooted in the United States healthcare culture. Research has found that although the total amount of United States greenhouse gas production has decreased in the past ten years, the healthcare system continues to be a major contributor to overall GHG production. In a study comparing single-use versus reusable medical supplies, several medical products, such as scissors and laryngeal mask airways, were found to have lower life-cycle greenhouse gasses when used as a reusable as opposed to single-use disposable (Ghersin, 2020). Therefore, the avoidance of medical supply disposal presents another opportunity for healthcare systems.

Current research

Creating a method to combat the disposal of unused medical supplies represents an important opportunity for the environment and healthcare systems worldwide. One current

method that is in place to help this issue includes collecting unused medical supplies and resterilizing them in order to reuse the supplies at the facility they are already located in. Another method that is currently in place to assist with this issue is collecting the unused medical supplies and donating them to countries and other medical facilities in need of them.

Sterilizing unused medical supplies instead of disposing of them is an available method that healthcare systems should consider. Not only does it generate financial benefits to medical facilities, this method also benefits the environment. While the manual application of disinfectants to unused medical supplies is an impractical idea due to the amount of time it would take for it to be completed and the risk of the disinfectant not ridding the medical supplies of contamination, the use of hydrogen peroxide vapor is an alternative approach that is much more efficient and effective against a wide range of pathogens. Hydrogen peroxide vapor is the vapor form of hydrogen peroxide, which itself is simply water with one added oxygen molecule. However, it is this extra oxygen molecule that has high-oxidizing powers making hydrogen peroxide an extremely powerful disinfectant. Normally, following a patient discharge, hydrogen peroxide vapor is used to sterilize the hospital room and large pieces of equipment in the room. Hydrogen peroxide vapor is distributed homogeneously in the gas phase to ensure adequate coverage in the hospital rooms and on the large pieces of equipment. This method has been associated with a reduction in the incidence of pathogen acquisition of patients. Therefore, hydrogen peroxide vapor technology may provide a creative option to sterilize the packaging of contaminated supplies and avoid their disposal (Otter et al., 2013).

To test the effectiveness of hydrogen peroxide vapor on unused medical supplies, a study was conducted evaluating the frequency of contamination on the packaging of unused medical supplies in twenty rooms of patients under precautions for multidrug resistant organisms and

then the amount of multidrug resistant organisms remaining on the supplies after sterilization with hydrogen peroxide vapor (Otter et al., 2013). Five pairs of unused, packaged supplies were selected from the supply cart in each study room when the patients were discharged from the hospital. One item of the pair was sampled without exposure to hydrogen peroxide vapor, and the other item was sampled after hydrogen peroxide vapor exposure. The five selected items were laid out on a metal rack and placed in the patient rooms that were going to be sterilized with hydrogen peroxide vapor following the patient discharge as mentioned above. Results showed that none of the one-hundred paired supplies had multidrug resistant organisms after hydrogen peroxide vapor exposure. The data of this study demonstrates that treated supplies can be safely used on new patients when a patient under precautions is discharged.

There are multiple advantages of using hydrogen peroxide vapor to sterilize unused medical supplies. First, since hydrogen peroxide vapor is already used to sterilize environmental surfaces and medical equipment in a patient room after discharge, there is no additional work needed to sterilize the unused medical supplies. The operators of the hydrogen peroxide vapor technology simply have to keep the supplies in the intended room and continue with the normal process of hydrogen peroxide sterilization. Second, results showed there to be a direct savings associated with hydrogen peroxide vapor sterilization of $387,055 (Otter et al., 2013). Third, following the use of hydrogen peroxide vapor, the hydrogen peroxide breaks down rapidly into oxygen and water leaving no chemical residues making it environmentally friendly (Chemdaq, 2022). Fourth, hydrogen peroxide vapor is simple for the operator of the hydrogen peroxide vapor technology to use. The easy application of hydrogen peroxide vapor is advantageous because it ensures adequate coverage of the supplies, which means the supplies will be

completely sterilized (Otter et al., 2013). Overall, this method is an efficient and effective way to prevent the disposal of unused medical supplies.

Another method that can be used to combat the disposal of unused medical supplies is to collect and repurpose, or donate the unused medical supplies. Some popular programs that collect and repurpose unused medical supplies include REMEDY and Recycling Unused Medical Supplies (RUMS). REMEDY is a program designed to recover usable medical supplies that would otherwise be discarded from United States hospitals (Miller, 2002) while RUMS was created to collect unused medical supplies and outdated medical equipment from United State hospitals to reduce the environmental impact of hospital waste and provide direct support to Third World hospitals (Pennino et al., 1993).

REMEDY began in June of 1991 and went through an eleven-month trial at the Yale-New Haven hospital in Connecticut. Prior to the start of REMEDY, the nursing and technical staff at Yale-New Haven hospital were informed of program goals and guidelines. They were also provided lists of recoverable supplies as well as exclusion criteria. The list of recoverable supplies included surgical gloves, sutures, surgical staples, sterile laparotomy sponges, non sterile sponges, sterile 4x4 sponges, cautery pencils/pads, endotracheal tubes, syringes, drapes and gowns, surgical drains, suction hose, nursing/surgical miscellany, anesthesia miscellany, and urology misscellany. Next, a bag for collection of recovered supplies was placed on the case cart prepared for each operative procedure. The collection of supplies was accomplished with the volunteer efforts of the nursing and technical staff and the cooperation of the hospital administration and Department of Anesthesiology (Rosenblatt & Silverman, 1992).

The exact setup of REMEDY for the eleven-month trial included the following (Rosenblatt & Silverman, 1992). Throughout an operation, non-sharp and non-exposed sharp

items whose sterile packaging had been violated, but had not been used in the surgical procedure or noticeably contaminated were placed in the bag on the case cart. Immediately following the procedure, the bag accompanied contaminated surgical instruments to the central decontamination area. At the end of each day, the bags were emptied by a designated individual who inspected the contents for unsuitable materials such as accidentally recovered opened sutures and spoiled sponges. The remaining contents underwent ethylene oxide sterilization and aeration, which is identical to the sterilization protocol used for reusable supplies at Yale-New Haven Hospital. This sterilization protocol meets or exceeds the sterilization procedures used by established charities that receive the supplies. In addition to these daily collections, the nursing staff and supply managers periodically reviewed the operating room inventory for items that were no longer used due to changes in surgical techniques or expiration.

Results of the REMEDY program were positive (Rosenblatt & Silverman, 1992). The operating room staff responded enthusiastically to this effort. A survey completed by fifty nurses and technical staff revealed no reports of injury, interference with patient care, or increased operating room time or labor. Along with the new sense of cooperative achievement among the operating room staff, REMEDY also identified areas of unnecessary waste and reduced biohazard bag disposal at Yale-New Haven Hospital at a savings greater than the minor costs of the program. The total direct cost for the paper bags and other items for the implementation and maintenance of the program was $420. The inspection and sorting of supplies by volunteers required one and a half to two hours per week once the program became more established. Throughout the eleven-month trial, 3,776.5 pounds of supplies were collected from operating rooms with an estimated value of $158,854. Recovered supplies were distributed to established charitable organizations with a history of medical supply relief work that had requested supplies.

Highly sophisticated supplies such as cardiopulmonary bypass oxygenators were donated directly to colleagues abroad known to be experienced with the relevant technology.

The REMEDY program has also been in place at the Albert Einstein College of Medicine in New York since 1997 (Miller, 2002). REMEDY at the Albert Einstein College of Medicine uses several collection techniques, with the bulk of material originating from Jacobi Hospital surgical floors. Similar to the trial done at the Yale-New Haven hospital, training sessions with the operating room nursing staff at Albert Einstein College of Medicine are performed to familiarize employees with the purpose and scope of REMEDY. The staff is instructed to only recover clean items and to not recover sharps and body fluids. Following the instructions, unused and uncontaminated surgical supplies that would have been discarded were collected on a case-by-case basis by operating room nurses and placed in REMEDY storage containers. Common items collected were sutures, gloves, gauze, drapes, sterilization kits, catheters, intravenous tubing, airway tubing, sponges, staplers, syringes, and reusable surgical tools. These containers are then transported on a regular basis by medical students to the REMEDY supply room, where they are inspected and sorted by volunteer staff trained in universal precautions. Supplies to be donated are inventoried and stored for donation, and defective material is discarded. Donation and shipping of REMEDY supplies to their final destination relies on contacts made with institutions and established United States based charities.

The cost of the REMEDY program at the Albert Einstein College of Medicine is extremely low, consisting primarily of collection containers and use of storage space (Miller, 2002). REMEDY at Albert Einstein College of Medicine uses large recycling bins that can be brought into the operating room after a procedure during cleanup, minimizing the amount of time

that operating room nurses separate usable items from medical waste. For an annual budget of approximately $200 spent mostly on boxes for storage and shipping, REMEDY is able to recover thousands of dollars of usable medical equipment. There is also no cost associated with the staff that collect and sort the supplies since volunteer labor is provided by hospital staff, medical students, and other interested parties. The resulting reduction in medical supply disposal actually saves the hospital six to ten times the cost of the program, as well as raising staff members' awareness of waste and recycling issues. Additionally, the data generated from the types of supplies recovered can be used to increase the efficiency of operating room supply management.

A common concern with the REMEDY program is how it is able to organize the supplies collected and distributed to the correct locations (Rosenblatt & Silverman, 1994). To monitor the nature and quantity of recovered supplies in any medical setting, REMEDY uses a computer database that inventories approximately 100 types of general operating room supplies and 320 types of sutures on a case-specific basis. Since recovery and inventory occur daily, detailed case-by-case assessments are applied periodically to a large sample and has been facilitated by a barcode system applied to both item stock and procedure numbers. Recovered inventory can be compared to a surgical pick list and use list. In addition to permitting REMEDY to project charitable donations from institutions adopting the REMEDY model, this database has evolved into a powerful resource utilization assessment tool. In other words, REMEDY has reduced the amount of excessively prepared supplies. Using the REMEDY database, the nursing administration and operating room supply managers at the locations that use REMEDY have initiated a campaign of heightened awareness and reevaluated operating room supply handling of all cases.

Another important question regarding the REMEDY program is the effect that these supplies have on the quality of care at the receiving institutions. In order to address this issue, primary medical centers in South America were surveyed regarding which supplies that they received through REMEDY would be clinically useful (Miller, 2002). In general, primary care clinics, particularly in rural settings of South America, stated that the most basic supplies such as gloves, gauze, sutures, syringes, sterilization solution for smaller rural clinics and advanced supplies such as ultrasound and electrocardiogram machines for larger clinics and hospitals would be the most useful to receive. Therefore, the supplies REMEDY donates are very effective in providing high quality care since most of the supplies donated are the ones in high demand in impoverished countries.

RUMS is a program similar to REMEDY. At its inception, RUMS involved twelve hospitals, two-free standing surgical centers, one pharmacy, and several nursing homes, health centers, and private doctors' offices (Pennino et al., 1993). RUMS is managed by a small paid staff to provide reliability and consistency in the collection of materials, maintenance of the database, grant writing, public relations, and day-to-day operations. Funding and supplies also have come from community and organizations in Rochester, New York. The Rochester Chapter of the Association of Operating Room Nurses has provided financial support as well as many nurses who not only salvage hospital supplies, but also volunteer to sort and inventory them. RUMS has received grants from two local foundations, and a local grocery chain has donated gift certificates to purchase recycling bins and regularly provides 40-gallon pressed cardboard drums from its bakery for shipping supplies. A local business donates 2000 square feet of warehouse space, and an automobile dealer provides a van to pick up large items. Local media

have provided excellent publicity for the project encouraging individuals to contribute money and to become volunteers.

RUMS is divided into four phases: setup and education, collection, sorting and inventory, and distribution (Pennino et al., 1993). The setup phase is used to elicit support from hospitals and health-care facilities in the community. Similar to REMEDY, the RUMS program offers numerous slide presentations to nurses, administrators and allied health personnel to educate them about this program, which allows hospital personnel to recycle medical supplies overseas and locally reduce the environmental impact of disposing of them. Special emphasis is given to the supplies that could be collected which include anesthesia items, bassinets, catheters, cautery supplies, collection containers, drapes, dressings, endotracheal tubes, gloves, gowns, hospital beds, incubators, irrigation sets, needles, orthopedic items, packs and procedure sets, petroleum gauze, scrub brushes, specialty items, sponges, staples and removers, surgical instruments, sutures, syringes, tape, and tubing. Additionally, any outdated medical supplies that are still functioning but normally would be discarded are collected.

During the collection phase, paid collectors make regularly scheduled pickups at each facility and deliver the supplies to the warehouse (Pennino et al., 1993). The collector initially presorts materials into general categories, such as paper goods, tubing, instruments, sutures, and dressings. In the sorting and inventory phase, volunteers work under the guidance of volunteer nurses and technicians to sort the collected materials into designated categories. Those categories are divided into numerous subcategories for accurate record keeping. Supplies are packed in boxes, labeled, and weighed for shipping; an inventory sheet is completed for each box; and statistics are entered into a computer database to track the inventoried supplies along with their value, weight, and destination.

In the distribution phase, RUMS works with organizations in the United States that provide medical relief to underdeveloped countries (Pennino et al., 1993). The organizations RUMS works with are in close proximity to where RUMS is taking place. Therefore, the supplies that are distributed to these organizations can be sent via large vehicles driven by volunteers or via mail carriers.

RUMS collected more than 30,000 pounds of supplies, with a retail value greater than $500,000 during its first ten months of operation (Pennino et al., 1993). These numbers represent only the supplies and equipment that were inventoried and packed in boxes. The amount of supplies collected was so great that it was not possible to inventory all of it.

The success of RUMS depended on community involvement. Volunteers, mainly nurses and other healthcare personnel, sort and inventory the collected materials and equipment, because familiarity with the supplies is key to tracking them (Pennino et al., 1993). As a result of RUMS, three shipments of medical supplies were sent to a hospital in Novgorod in Russia, a Somali refugee hospital in Kenya, a hospital in Uganda, and hospitals in Poland, Jamaica, Haiti, El Salvador, and Nicaragua.

While these programs collect, sort, and repurpose the unused medical supplies, they are not the ones that directly give the supplies to the countries in need. There are separate organizations that programs such as REMEDY and RUMS work with directly in order to get these supplies to the correct destinations. Two of the most popular organizations that specialize in the donation of unused medical supplies include MedShare and Project CURE.

MedShare is a 501c(3) humanitarian aid organization, which is a non profit organization established for charitable purposes, dedicated to improving the quality of life of people, communities, and the planet by sourcing and directly delivering surplus medical supplies to

communities in need around the world (MedShare, 2022). In 1998, A.B. Short and Bob Freeman were concerned with the large amount of discarded medical supplies and the critical healthcare needs of medically underserved populations. In an effort to address these disparities, MedShare was born. MedShare works with hospitals, distributors, and manufacturers to collect and redistribute medical supplies to qualified healthcare facilities in medically underserved communities. MedShare also helps increase health system capacity and drives sustainability by providing biomedical equipment training and service to healthcare organizations and medical professionals serving populations in need. MedShare's deliveries of vital medical supplies has decreased the nation's carbon footprint by decreasing the amount of unused medical supplies found in landfills and it has brought health, healing and promise of better lives to 100 countries and countless patients.

MedShare works specifically with hospitals in Metro Atlanta, Northern California, and the New York Metropolitan area to set up recovery programs. From these hospitals, MedShare accepts donations of unused, unexpired medical surplus supplies and used biomedical equipment. Common supplies that MedShare often recovers includes supplies that have cosmetically-damaged packaging, production overages, usable returned products, and new products that a company wishes to donate to charity. Some of the most frequently visited areas that MedShare donates to include but are not limited to Haiti, Kenya, Nicaragua, and Guatemala (MedShare, 2022).

MedShare has collected over $240 million worth of life saving medical supplies from hundreds of hospitals and corporations. It has also diverted over 17.5 million pounds of quality and unused medical supplies from local landfills. MedShare supplies nearly 1,000 under-resourced free and safety net clinics in marginalized communities. Additionally, it has

equipped over 930,000 healthcare professionals in underserved communities around the world and it has built an annual volunteer corps of 16,000 humanitarians. MedShare helps strengthen local health systems and serves over 32 million people in medically underserved areas around the world. It has delivered lifesaving medical supplies and equipment to 117 countries and territories worldwide. MedShare has provided biomedical training and support to over 7,000 healthcare professionals in 18 countries on equipment delivered to healthcare facilities around the world (MedShare, 2022).

Project CURE is another donation organization (Project CURE, 2022). It was founded in 1987 in Colorado to address the staggering shortage of medical resources around the world. Since then, Project CURE has become the world's largest distributor of donated medical supplies serving the sick and dying in more than 135 countries. Each week Project CURE delivers approximately three to five semi-truck-sized ocean containers packed with the medical supplies desperately needed to save lives in hospitals and clinics in resource-limited countries. Additionally, each year hundreds of healthcare professionals travel with Project CURE to provide medical treatment to communities in need and training to those dedicated to serving them. Project CURE is supported by over 30,000 volunteers annually and operates distribution warehouses in seven U.S. cities. In addition to its global work, Project CURE pivoted in response to the COVID-19 pandemic to support the need for personal protective equipment (PPE) and medical supplies in the United States. Since March 2020, Project CURE has provided more than 15 semi-truck loads of medical aid, which equates to 4.5+ million pieces and nearly $5 million of PPE for healthcare workers and first responders.

Project CURE is funded by grants from the United States government, non-governmental organizations, and by the generous support of philanthropic foundations, corporate partners and

individual donors from all walks of life. It is regularly ranked as one of the top charities in America by Charity Navigator, The Chronicle of Philanthropy, Guidestar, Top Nonprofits, and Forbes Magazine, and it was recently given a Top COVID-Relief distinction by Charity Navigator (Project CURE, 2022).

Overall, the collection and repurposing programs REMEDY and RUMS and the donation programs MedShare and Project CURE have each demonstrated positive results. If more healthcare systems were to adopt these methods, there may be a dramatic decrease in the disposal of unused medical supplies. This has the potential to save medical facilities money as well as decrease the amount of waste in landfills productively helping the environment.

Methods

In an attempt to further the issue of the disposal of unused medical supplies and to investigate some additional remedies, the Vice President of Supply Chain Management at Henry Ford Hospital in Detroit, Michigan, Mr. Joe Pettinato was interviewed. Mr. Pettinato previously worked in supply chain management at other hospitals, including Ascension Health, Trinity Hospital, and Beaumont Hospital. Mr. Pettinato is responsible for implementing procurement policies, developing operations playbooks, and developing outlined standards for the supply chain team at Henry Ford Hospital. Mr. Pettinato was asked the following questions and provided the noted answers:

1. What unused supplies are disposed of the most? Mr. Pettinato responded by stating that the most impactful unused supplies that have a long history of being disposed of are physician preference items due to clinical practice changes, new technology, and/or retiring surgeons or attrition. He continued by noting that physician preference items are the supplies that are typically purchased for a single physician and these supplies are

usually the highest dollar product. While he didn't note the exact kinds of supplies that are the most disposed of following physician preference items, he stated that other unused supplies are disposed of because of lack of standardization or change in technology, which can change up to every six months.

2. What items that are not allowed to be disposed of? Mr. Pettinato responded by saying that many items cannot be disposed of because of what their regulations are for disposal. He gave examples of chemicals, fluids such as saline, and drugs. Supplies such as these have to be disposed of in certain containers no matter the state of them.
3. What are the most costly items that are disposed of? Mr. Pettinato responded with physician preference items.
4. What are the cost implications of disposing of unused medical supplies? Mr. Pettinato didn't know the exact numbers, but he mentioned that along with the costs of the supplies that are disposed of, the storage costs of these supplies also contribute to the issue. Mr. Pettinato also said that supplies purchased during Covid were purchased in large quantities due to usage which created storage issues.
5. What units of the hospital dispose of the most unused medical supplies? Mr. Pettinato stated that a large percentage of the waste is surgical waste from the physician preference items and inaccurate surgical cards, which state the supplies needed for certain surgical procedures. He said items asked for by a surgeon are not always used and result in the product being returned to the shelves, when the product is handled so many times the packaging breaks down and the supplies must be disposed. Additionally, he stated that the waste that comes from the nursing units are usually all low cost products and not largely impactful as compared to items used in surgery.

6. Are there any methods that are currently in place at the hospital to help with the issue of unused medical supplies? Mr. Pettinato responded by saying that expired supplies are collected at each of the sites. However, he noted that the hospital recently donated disinfectant wipes to other hospitals and companies in need of them. The hospital also sells and/or donates its expired products to facilities that accept them. He pointed out that many places do not want to accept expired products so the hospital ends up disposing of them or selling them to WestMed, Centargin, and live auctions likely for education purposes. When asked about the advantages of donating or selling some medical supplies, he stated that it is mainly just a simple solution for disposal and the hospital does not generate much revenue from it.

Repurposing and Donating Barriers

It is apparent that while there are alternative methods in place to help address the issue of medical supply disposal, there are barriers that need to be addressed in order to improve existing methods to be more sustainable and effective. First, while the sterilization of unused medical supplies with hydrogen peroxide vapor is cost effective and environmentally friendly, research has found that multiple desterilizations might compromise device integrity (Rosenblatt & Silverman, 1992). For example, most surgical supplies are made of metal and metal is known to be susceptible to electrochemical corrosion. Microscopic pictures of desterilized metal medical supplies show wear and fatigue on the item (Alfa, 2012). Therefore, if a facility decides to desterilize its unused medical supplies, it runs the risk of the supply not functioning properly, which can put the patient at risk of injury or illness.

Collection and repurposing programs, such as REMEDY and RUMS, and donation programs, such as MedShare and Project CURE, run the risk of having issues with interference

from implied warranty. For example, a manufacturer's warranty may no longer be valid upon reuse of single-use products (Rosenblatt & Silverman, 1992). Therefore, collection and donation programs must take the extra time to make note of this to the recipients of the medical supplies. For instance, REMEDY tells its recipients that the hospital offers these goods for donation "as is," and with no express or implied warranties, including no implied warranty of merchantability (Rosenblatt & Silverman, 1992). REMEDY also states that these goods are being disposed of by the hospital as a casual sale or donation and not as part of the hospital's normal business of providing medical services (Rosenblatt & Silverman, 1992). Additionally, many of the unused medical supplies that are disposed of in the so-called wasteful procedures are based on concerns about patient care and medicolegal issues (Rosenblatt & Silverman, 1992). While saving costs in healthcare systems and improving the environment are important, the health and safety of patients is even more important and therefore, guidelines concerning the safety of patients must be followed even if it is wasteful.

Another barrier with collection and donation programs is the fact that the sterilization of supplies being donated happens before they are sorted by volunteers in order to ensure the safety of the volunteers. Following the sorting of supplies, they are packaged to be shipped to their destinations and they are not desterilized. Therefore, the recipient of the donation has to be responsible enough to desterilize the supplies upon receipt. The recipients also need to be responsible enough to establish standards and determine whether a given product meets such standards (Rosenblatt & Silverman, 1992). This can be an issue because many of the medical facilities receiving these supplies do not have the money, resources, or education necessary to desterilize the donated supplies. If the donated supplies are not desterilized, medical facilities run

the risk of cross contamination between the donated supplies and patients the supplies are used on, which puts the patient at risk of illness or injury.

An additional barrier includes how overburdened charities such as MedShare and Project CURE are with unrequested, unusable, and unsortable donations. This can be attributed to the fact that most guidelines for donation of unused medical supplies are lacking (Rosenblatt & Silverman, 1992). Therefore, programs such as REMEDY and RUMS will send their collected supplies without considering what the charities they are donating to are seeking. This causes charities to have an excess of supplies that cannot be donated to impoverished countries due to regulations, liability issues and safety concerns, which leads to charities disposing of those excess supplies. This completely counteracts the goal of trying to redirect the disposal of unused medical supplies.

Medical supplies are easily accessible and sparsely regulated in hospitals, which also serves as a barrier to disposal (Ghersin et al., 2020). For instance, some units of hospitals do not have a padlock on its supply room door. Therefore, anyone can go into the room at any time and take any supply. While most units do have a padlock on its supply room door, the staff that have access to the room will often take more than the necessary amount of supplies needed. These supplies end up adding up in a patient's room and then the supplies are typically disposed of unused once the patient is discharged because of potential contamination.

There is also a fallacy that individual action will not create a measurable difference (Ghersin et al., 2020). Therefore, trying to convince healthcare workers to only take the necessary supplies out of the supply room is difficult because no one is there to regulate how many supplies they take and most healthcare workers do not think that what they do as a singular person will have enough of an effect to change anything. This is a barrier because it proves that it

will be extremely difficult for healthcare systems to implement a plan to combat the issue of unused medical supply disposal since they can not force healthcare workers to do work outside of their job description. In other words, no one wants to spend the extra time it would take to communicate with their peers to figure out methods that would help to solve this issue.

Discussion

The barriers to the existing methods used to combat the disposal of unused medical supplies are a good starting point to figuring out what needs to be done next. First, the observation that metal medical supplies become more fatigued with multiple sterilizations suggests that a study should be completed comparing and contrasting different disinfectants and the effects they have on the metal medical supplies that undergo multiple desterilizations. For instance, on one metal medical supply hydrogen peroxide vapor could be used to sterilize with subsequent sterilizations using ethylene oxide. These are both common disinfectants following standardized safety procedures developed to prevent metal fatigue from appearing.

There is not much that can be done to get around the warranty and regulation issues of the disposal of unused medical supplies since procedures and regulations have the safety of the patients in their best interest. However, if healthcare workers receive training regarding the disposal of unused medical supplies and the costs incurred by the hospitals and the environment, it might make workers more apt to only take out what they need from the supply room. For example, upon hiring a healthcare worker could be required to watch a video that explains how harmful the disposal of unused medical supplies can be. This should ensure awareness of the issue and possibly encourage employees to equip facilities with only necessary supplies. By doing this, the unused medical supplies that have to be disposed of due to liability and regulations will decrease since only the needed supplies are being used.

Once the unused medical supplies are donated and received by the medical facilities in need, one might believe that the programs in place, such as REMEDY, RUMS, MedShare, and Project CURE, will be successful. However, if the supplies received are not sterile, it will actually put these medical facilities at greater risk. Therefore, once the unused medical supplies are sorted by volunteers, they should go through an additional sterilization process. This could be done by placing the supplies in an already sterile room and then using disinfectants such as hydrogen peroxide vapor or ethylene oxide. As previously mentioned, sterilization can be a low cost procedure and it will ensure that the supplies are able to be safely used once they reach their final destination. Putting the responsibility of desterilization on medical facilities that barely have the basic supplies needed to provide healthcare is improbable. However, adding this step will reduce the risk for contamination between donated supplies and patients.

The overabundance of unused medical supplies provided to charities such as MedShare and Project CURE from collection and repurposing programs such as REMEDY and RUMS is counteractive. Improved communication between the programs offers a potential solution to this problem. For example, if MedShare were to receive medical supplies that it cannot donate, it could directly inform the programs of REMEDY and RUMS so they can make note of it and make sure to not send them until the need arises. Eventually, this should lessen the amount of incorrect supplies sent to charities preventing the accumulation of unused medical supplies and their disposal at the charities.

A possible solution to help regulate the amount of supplies taken out of hospital supply rooms is to have a volunteer in place near the supply room. Since it would be a volunteer, there would be no cost to this method. The volunteer could be given a standardized list of supplies needed for certain procedures. Then, when a healthcare worker needs supplies, the volunteer can

provide only the necessary amount of supplies. This would not only reduce the disposal of unused medical supplies, but it could also increase efficiency. For example, it can be difficult to find supplies in the supply room since there are so many options available. Therefore, if one volunteer becomes familiar with the supply room, they will be able to provide the necessary supplies in a shorter amount of time compared to the healthcare worker.

Healthcare systems cannot force healthcare workers to do things outside of their job description. Therefore, getting healthcare workers on board with collecting unused medical supplies or decreasing the amount of supplies taken out of the supply room can be challenging. A solution to this issue could be to provide an incentive. For instance, the healthcare system could set a goal of the amount of unused medical supplies it hopes to collect and donate. Or they could set a goal of the amount of money it hopes to save that month. If the goal is reached, an incentive for healthcare workers at that hospital could be provided. While there is some cost associated with possible incentives, the costs associated with the disposal of unused medical supplies may be greater and it affects the hospital and environment in a detrimental way.

Conclusion

The disposal of unused medical supplies is an issue that should no longer be ignored. While the desterilization of unused medical supplies with hydrogen peroxide vapor and collection, repurposing, and donation programs such as REMEDY, RUMS, MedShare, and Project CURE are all good starts to address this issue, there are still many barriers that need to be resolved to completely fix the issue. By looking at each of these barriers, more effective and efficient solutions may be created. Through the creation of new methods and improvements to the existing ones, hospitals in the United States can save money, hospitals in impoverished

countries can be provided with urgently needed supplies to provide proper healthcare, and there will be less waste built-up in landfills positively impacting the environment.

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