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Using Outreach to Increase Awareness of Medical Waste

GLI Senior Capstone Final Report

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Abstract:

Increasing use of single use plastic and single use devices has led to a large uptick in medical waste globally. During our research we have found that small changes make a big impact. Some of the biggest differences were made by hospitals by switching to a reusable product or retraining staff on proper techniques. According to this research, educating healthcare professionals and the public about different types of medical waste and its generation has brought forth the most success in reducing medical waste.

Instead of directly altering the way medical systems handle their waste, we are reaching those who may begin to foster that change. In order to go about this, we are implementing a medical waste day. Our approach to the development and implementation of a medical waste day required collaborative efforts within our group and the broader community. This was done in 5 steps: finding partners with like minded interests, creating a preliminary survey to assess local need, organizing the event, hosting the event, and evaluating the impact of the event.

The goals of this project include: increasing education of medical waste, increasing awareness of the issue, and fostering connections between sustainability organizations and directors of medical equipment and waste at local medical facilities. After hosting the event it is clear there was an increased understanding of issues surrounding medical waste and what individuals can do to help drive Missoula medical waste system towards a more sustainable future.

Introduction:

Health care facilities are generators of large amounts of waste, leading to global environmental impacts that negatively impact both human health and natural systems around the world. Medical waste is usually defined quite broadly, encompassing any waste generated by a

healthcare facility. This includes anything from food waste to biomedical waste. Globally, 4.7 billion tons of healthcare waste is produced each year, which is about thirty-three pounds per hospital bed per day (Overstreet, 2021). This includes all streams of waste produced from medical facilities, including food waste, single use devices, surgical waste and more. Additionally, during the COVID-19 pandemic, 144,000 tons more of waste has been produced just by the eight billion vaccines administered in response to the pandemic, and medical waste production in many countries has increased by about 15-20% (Bateman, 2022).

While most waste products generated by hospitals and clinics is not considered biohazardous and therefore does not require special disposal processes, around 15% of medical waste is considered directly hazardous to human health, including but not limited to syringes, needles, gowns, radioactive waste, cancer treating drugs, and certain controlled substances (WHO, 2022). The proper use of medical supplies and disposal of medical waste is critical to not spread infectious disease like HIV or COVID-19, and to avoid other harmful exposures (WHO, 2022). However, the generation and disposal of this waste leads to many negative impacts to the environment and human health. Incineration of medical waste can release particulate matter as well as greenhouse gasses, both having negative effects on both air quality and climate change (EPA, 2022). Disposal of nonmedical healthcare waste usually ends up in landfills which also contributes to greenhouse gas emissions as well as requires large amounts of landfill space (Environment and Health, 2021). Disposal often leads to environmental injustice as waste is often disposed of in regions of the world that are still developing.

Production of medical waste is driven by many factors, including use of devices by healthcare professionals. This includes tools such used in inpatient and outpatient procedures. Containers that hold sharps or other materials are also considered waste. Gowns, gloves, single use materials also fall into medical waste. Materials used for wound treatment could also be considered medical waste or even hazardous medical waste. Food waste would also be considered medical waste and is often one of the biggest contributors to healthcare facility waste (EPA, 2022)

Fortunately, solutions exist and we often see the most successes with small changes. Often training and education are found to be the most effective tool (Ngo, 2022). Through education correct disposal methods are adopted which helps to decrease the amount of waste. It also causes a decrease in use of single use plastic. Hospitals have found successes switching to reusable materials such as reusable patient gowns or sharps containers (Ngo, 2022). *This literature review provides a broad overview of medical waste sources, types, and trends, as well as the negative consequences of medical waste production. Additionally, we will discuss potential solutions to this issue and our rationale for the development of our project proposal.*

Literature Review:

Types of Medical Waste & Disposal Methods:

In order to successfully reduce medical waste it is essential to first qualify and target specific types of medical waste and how they are disposed of. In this section two broad categories of medical waste will be identified. Additionally, this section of the literature review will highlight sources of waste how each respective category of medical waste contributes to ecological damage.

Sources of Waste:

Medical waste comes from a variety of sources, the most prominent of which being healthcare institutions. Healthcare waste is a direct byproduct of all of the actions done in a hospital, not just waste from patient care. For example, hospitals produce enormous amounts of food waste from its food services, including food scraps, food packaging, and plastic utensils (Padmanabhan, K., Barik, 2019). Hospitals also produce waste from vaccination campaigns, their pharmacy store, and the laboratory. Outside of medical centers medical waste is also produced by individual patients in the community. Some common sources of waste from these individuals include unused or expired medication, single use containers for insulin, and other items used in at-home healthcare (Wieczorkiewicz, Kassamali 2013).

Waste Categories:*Hazardous Waste*

The first category of medical waste is biohazardous waste. This category encompasses infectious waste, pathological waste, radioactive waste, and genotoxic waste (Padmanabhan, K., Barik, 2019). Some examples of this are discarded diagnostic samples, used swabs, bandages, scalpels, syringes, cytotoxic drugs used in cancer treatment, human tissues, organs, and human waste. Biohazardous waste poses an immediate risk to the safety of the environment and individuals that come in contact with it as it may be contaminated with infectious agents, radioactive byproducts, carcinogens and other detrimental substances (UC San Diego, 2020).

As a result of these risks to human and environmental health, biohazardous waste is carefully contained and disposed of. Incineration is widely used due to its effectiveness and relatively low cost; however, incineration of medical waste leads to pollution, such as sulfur and nitrogen oxides, ozone depletion, and dioxin pollution (Padmanabhan, K., Barik, 2019). Extended periods of dioxin exposure have been linked to depressed liver, immune, reproductive, and neurological function while also increasing the mortality rates of cardiovascular and respiratory disease and cancer (Bertazzi et al., 1998). Ferraz and Afonso (2002) highlight how incineration of Group III (“medical wastes with biological risk that must be pretreated before elimination as municipal wastes”) releases the greatest concentration of dioxins.

The second most common and far more environmentally friendly method of neutralization and disposal of biohazardous waste is autoclaving. Autoclaving is the process of utilizing moisture and pressure to kill microorganisms, effectively sterilizing harmful pathogens in the biohazardous waste (Kenny, Priyadarshini, 2021). This primary alternative to incineration promotes recycling in the form of reuse and produces virtually zero pollutants. However, autoclaving is far more expensive than incineration and can only handle specific types of waste that are able to handle the high heat. It also typically requires the waste disposal facility to have a drying mechanism and shredder to treat waste prior to autoclaving. Due to this, autoclaving is an uncommon practice in disposal of biohazardous waste (Kenny, Priyadarshini, 2021).

Nonhazardous Waste

The second category of medical waste is nonhazardous medical waste. This waste poses no immediate biological, chemical, or physical hazard, and thus can be disposed of in standard

landfills. Examples of this waste include excess food, paper cups, gloves, plastic wrapping, and plastic cutlery. This category accounts for the majority of unnecessary medical waste produced. Padmanabhan and Barik (2018) state that, “between 75% and 90% of the waste produced by health-care providers is comparable to domestic waste and usually called “nonhazardous”... It comes mostly from the administrative, kitchen and housekeeping functions at health-care facilities”.

This type of waste is typically disposed of in landfills due to the low cost. The filling of landfills from nonhazardous waste can result in soil and water contamination, release of benzene, toluene, ethylbenzene, and xylene (from the decomposition of organic compounds), and landfill leachate (Kenny, Priyadarshini, 2021). As an alternative, composting excess food waste is shown to be effective. Food waste accounts for 10 to 15% of hospital waste per day, which shows that composting even half of all excess food could decrease waste output of a hospital by 5% (Chardoul, Coddington). Establishing composting services directly incorporated into healthcare facilities is expensive, approximately \$597,000 annually, however, this cost can be mitigated by cooperating with local composting services, bringing the annual cost down to less than 87,000\$ (Chardoul, Coddington). Improper disposal of waste, both hazardous and nonhazardous, can have extreme effects on local environments and ecosystems. For example, biohazardous waste such as bodily fluids and medications can leak into water systems, leading to a gradual contamination and toxification of drinking water (Fazzo et al., 2017).

On the global scale, incineration and autoclaving is widely used in developed countries, similar to the United States. However, countries with less waste disposal infrastructure have to resort to

alternative methods. For example, a very common form of waste disposal is an open or partially controlled burn pile. Waste is gathered into a pile and burned without sorting between hazardous and nonhazardous waste (Diaz et al., 2005). Another method of disposal used by developing countries is a general dump site or pit. This method of disposal again does not sort between hazardous and nonhazardous waste, resulting in a cumulation of dangerous waste being left in the ground (Diaz et al., 2005).

Harmful Effects of Medical Waste

Medical waste can lead to harmful effects through direct contact such as with biomedical hazardous waste through infection. It can also lead to harm through negative impacts to the environment through pollution. Negative harms can also be seen to equity through inequality and medical waste can also cause harm to human health through indirect causes.

Impacts on the *Environment*:

An increasing population increases demands of the healthcare system. As the global population rises the demand for more medical services increases, this increasing impact is being seen globally (Windfeld, 2015). Increased consumption of products creates a bigger threat to the environment which puts human health at risk further impacting the environment. The disposal of this medical waste can cause several environmental hazards, which mainly include pollution of the atmosphere, waters, and soil (Ye et al., 2022). Handlers of this waste do not have the proper education or personal protective equipment to protect themselves from hazardous material (Raiz et al., 2019). Some streams of medical waste such as biomedical waste have to be

incinerated to follow implemented policy. Harmful pollutants like carbon dioxide are released into the air due to incinerators because one of the most common ways to get rid of excess medical waste is via incineration. In fact, a majority of medical waste is disposed of in this way simply because there is not enough knowledge or effort on what actually needs to be incinerated or just thrown away. We see that many industrialized countries are moving away from incineration, but developing countries are still utilizing this method of waste removal (OHCHR, 2011). Toxins can also be released into sources of water due to poor landfill structures (Andeobu et al., 2022). Even in landfills that are properly looked after, pollutants can still leach into soils and be released into the atmosphere during different precipitation events (Raiz et al., 2019). Medical waste contributes to greenhouse gas emissions not only through incineration of medical waste materials but also through waste collection and transport activities (Riaz et al., 2019).

Impacts on *Human Health*:

Not only does medical waste have dire effects on our environment, but it can also negatively impact human health. Often, we only consider the environmental impacts that medical waste poses, and we forget that with 8 billion people on Earth, there is bound to be crossover. There are a number of reasons as to why human health can be affected in this way with the major reasons being: incineration, toxic contact, and leaching into the environment (Borowy, 2019).

Low heat incineration, as mentioned above, is the technique that developing countries are fond of and has the ability to release toxic emissions into the air that contain particles like dioxins and even metals (OHCHR, 2011). If ingested, these toxins can lead to a number of adverse health effects. For example, the dioxins are also known as carcinogens and thus, can lead

to an increase of cancer, adverse effects on the respiratory system, cardiovascular system, and the immune system.

Another way that medical waste can adversely affect human health is by exposure to said medical waste. Bloodborne pathogens are very common and can live on certain medical waste for extended periods of time. Some of the most common and arguably the most dangerous bloodborne pathogens are Hepatitis B, C, and HIV. Healthcare workers that come in close contact with the medical waste (specifically sharps) can be exposed to these antimicrobial resistant pathogens. Additionally, for countries that have a population of people that may scavenge these dumping sites, there is an increased concern for human health. It is very easy for scavengers to come into contact with bloodborne pathogens due to the improper disposal of medical waste (Borowy, 2019).

The last major way that medical waste affects human health is actually through our water system. Oftentimes when people are done with their prescription drugs or any type of pill for that matter, they will dump those pills down the toilet and flush them into our water system (Harvard, 2011). From talking to those in pharmacy, we know that up to 90% of ingested drugs are also excreted in the urine as an active version of the drug because it isn't absorbed by the body when it's taken by mouth, so it's not only people dumping directly, it's people who take them and excrete via urination. A US Geological survey report found a multitude of drugs in 80% of rivers in the United States. "The drugs identified included a witches' brew of antibiotics, antidepressants, blood thinners, heart medications (ACE inhibitors, calcium-channel blockers, digoxin), hormones (estrogen, progesterone, testosterone), and painkillers" (Harvard, 2011).

There are many concerns about antimicrobial resistance as a result of antibiotics in our water. There have also been studies showing that fish and wildlife are negatively impacted (Harvard, 2011). We can assume that as these numbers climb, so will our exposure to them and the adverse effects will too.

Economic Impacts

Hospitals and other healthcare centers have to use resources to treat patients. Examples of overtreatment could mean things like running unnecessary tests or a prescription of an unneeded medication. As these resources are not needed, they get thrown away, which drives up the price of care, and generates unnecessary waste. Medical waste disposal creates a more expensive healthcare system (Martuzzi, 2010). The more products are used the more products need to be bought in order to make the hospital run. This creates a more expensive cost of care for patients as they are the ones absorbing the cost (Karliner, 2019) Once waste is disposed it also creates health hazards by contributing to climate change. Climate change also creates a greater expense to people as resources become limited they tend to increase in price. Biomedical waste is often autoclaved or incinerated, this process increases particulates and increases carbon dioxide in the air. This addition of particulate matter to the air has known consequences to health. Patients are being undertreated but are still facing all of the consequences of using resources. Healthcare quality can also be affected by medical waste. Increased waste requires a more significant disposal effort. Disposal efforts generate costs that hospitals have to divert from patient care (Wassie, 2022).

Specifically in developing regions of the world, waste management is expensive and not managed efficiently. This takes a large amount of money and time that could be used for patient care but is diverted to disposal. A more effective management system would allow for more efficient disposal as well allowing for more money to go back to patient care. Waste disposal is generally expensive, but medical waste is much more complicated. Due to potential hazards, there are increased regulations on this kind of waste.

Equity & Ethics:

The generation of medical waste also has implications for health equity and social justice. Healthcare produces medical waste through treating patients, and medical waste creates inequality. However, healthcare facilities generally overtreat white patients (Martuzzi, 2010). Overtreatment means hospitals use more resources than necessary to treat a patient, resulting in much medical waste. Examples of overtreatment could mean things like running unnecessary tests or a prescription of an unneeded medication. As these resources are not needed, they get thrown away, which drives up the price of care, disproportionately affecting poor or underdeveloped regions of the world (Martuzzi, 2010).

What makes this problem even worse is that White patients are overtreated while minority patients are often undertreated (Hughes, 2020). Minority groups are not receiving the care that they deserve while also facing the consequences of medical waste. Patients are being undertreated but are still facing all of the consequences of using resources. As medical waste increases human health will face the consequences to an even higher extent. These consequences will also be felt disproportionately by minority groups. We see this currently as well, minority

groups are often most impacted by the crisis (Patz, 2007). As minority groups face the highest consequences of medical waste they will need to seek higher medical help. However, even though minorities are facing the highest extent of the consequences White patients are the ones who are fueling the problem as they are being overtreated. This means a higher level of waste is generated for white patients but the effects are felt by minorities (Martuzzi, 2010).

Not only does medical waste create inequality through disparities based on socioeconomic status, but it also creates racial inequality. While White patients are overtreated, waste is found to create environmental injustice through disposal areas. Studies have found that waste disposal areas are disproportionately near areas with majority minorities (Martuzzi, 2010). One way we see this is in insurance. In fact, we can see that spending (and in turn, medical waste) is higher on privately insured patients, more likely upper-class, than those on Medicare or Medicaid (Nunn et al., 2020). Environmental injustice then creates more health problems within communities driving further use of medical resources; this increases waste which in turn increases the costs of hospitals and degrades the health of the environment. As our environment is degraded, human health is also affected negatively which requires an increase of healthcare needs. It is a cycle that harms everyone involved and affects everyone around the world.

Globally medical waste is a large problem, it affects every country no matter how large or small. Reuse of disposable and single use devices is seen as necessary by many hospitals, specifically hospitals in developing countries (Ngo, 2022). Medical waste management has the largest impact on those who live in lower-income countries. With the rise of population and the improper education on how to handle medical waste it is becoming more of a problem within

low-income countries. As the global population rises the demand for more medical services increases, increasing the impact of medical waste globally (Windfeld, 2015).

Inequity in care due to waste disposal does not align with the healthcare framework (AMA J Ethics, 2020). Healthcare is intended to provide quality care to everyone and reducing waste allows for this statement to remain true. Healthcare providers have taken an oath to never harm their patients. Reduction of medical waste is necessary to reduce harm to human health. Framing waste reduction in healthcare as a benefit to patient care and equity of care can be a more accessible approach for the healthcare community's discussion of sustainability. Not only does decreasing medical waste improve individual hospital systems but decreasing medical waste within hospitals can reduce its global impact (Connrardy, 2010). This reduction of global impacts results in improvements to global environmental and human health and reduction in inequality.

Drivers & Barriers:

Lack of Knowledge

Lack of knowledge and education of healthcare professionals and the general public is a commonly cited driver of unnecessary medical waste or improper disposal. Improper disposal of medical products is the main cause of the medical waste issue. According to Jim Anderson, one in four providers in home healthcare confess to being less than confident in their knowledge of how to properly dispose of medical waste (Anderson, 2022). In other medical waste focused projects, there were studies on the health care workers that gauged their knowledge level regarding proper disposal. It was found that only 17% of polled workers had a good knowledge

level, 58% had fair, and 25% had poor understanding of proper disposal methods (Elnour et al., 2015). Nurses and other hospital staff are the first line of defense when it comes to medical practice, and so they deal with the most medical products (and waste) (Anderson, 2022). If there is a lack of knowledge surrounding how to properly dispose of said medical products, then there will be a larger amount of medical waste in general. This is often thought of as the first offense when it comes to medical waste. Thus, it is the aspect that can be focused on more easily.

One hospital retrained staff over proper use of gloves and found that their consumption of gloves decreased significantly (Ngo, 2022). Overuse of these products meant that products were used when not necessary and contributed to landfills. Lack of education also contributes in a large way to medical waste. If providers and patients alike do not fully grasp how to dispose of their medical waste, there is more created than need be. According to Jim Anderson, one in four providers in home healthcare confess to being less than confident in their knowledge of how to properly dispose of medical waste (Anderson, 2022). Additionally, it was found that only 17% of polled workers had a good knowledge level, 58% had fair, and 25% had poor understanding of proper disposal methods (Elnour et al., 2015). This is a global issue and one that can be rectified with better education on disposal.

Prevalence of Single-Use Items

Another major barrier to more sustainable healthcare is the prevalence of single-use items. This can be anything from masks, syringes, scalpels, or gowns. Both before and during COVID, we have seen major increases in these items, with a steep incline ahead. The most problematic of these items are face masks and PPE kits (Hasija, 2022). It is a matter of ease and

cost efficiency in the short run for healthcare professionals to simply dispose of items instead of reusing them (Hasija, 2022).

Waste Removal Access

A different roadblock that is important to discuss is the access to proper disposal methods such as combustors. According to a map of the combustors provided by the EPA, the facility closest to Missoula is in Spokane, Washington (EPA Website). Spokane is a three hour drive from Missoula and even more for the rest of the state. Biohazardous medical waste requires incineration to be deemed safely disposed of, so there is a requirement for much of the waste to be taken to the combustors. However, if there are no combustors nearby, the medical waste needs to be sent to the other locations. By doing this, we are utilizing forms of transportation that are negatively affecting the environment as well. Combustors are expensive to build, so it is easier for both states and the federal government to ship waste to the already established locations. There are many roadblocks to a successful medical waste reduction plan, but financial gain, undereducation, and lack of access are some of the largest components.

Recycling is often promoted as a means of reducing waste; however most plastics used in these facilities are hard or impossible to recycle. This is because many plastics are composed of different polymers that melt and break down at different temperatures and times, meaning it is basically impossible for plastic packaging to break down at similar times (Tyler Packaging, 2021). Prescription pill bottles, for example, are technically made of a recyclable plastic but because of their small size are often passed off to the landfill (Steele, 2019). It is the World Health Organization's recommendation to cut down on this waste by turning to biodegradable

packaging instead of regular plastic packaging, but this practice has not yet been widely adopted (WHO, 2022). Low-income countries do not hold the capability or money to properly reduce and focus on medical waste (OHCHR, 2011).

Increased Utilization of Care

As previously mentioned, demand for healthcare services and utilization of resources is an important driver of medical waste. Of course, we know that medical waste did not start and end with the recent COVID pandemic, but it is true that much more research seems to be put out after the fact. Before COVID, we were still creating 4.7 billion tons of medical waste (33 pounds per bed per day), but we have found that it has become much easier to put the medical waste phenomenon into a global perspective now with the pandemic still occurring. COVID is not the main cause of the stunning amount of waste we produce, it is only a factor.

With the beginning of the COVID-19 pandemic, there was an obvious push to create a vaccine and treat those who were sick. As one can assume, this led to an extreme increase in medical waste. As of February, 2022, Kayleigh Bateman writes “eight billion vaccine doses have generated an additional 144,000 tonnes of waste” (Bateman, 2022). Additionally, just within the UN, an excess in PPE was shipped around, creating upwards of 87,000 tons of extra medical waste (Bateman, 2022). Generally, many countries' medical waste percentages have increased by about 15-20%. And it is not just the vaccines themselves that create this waste. For example, during this massive push for vaccines, there is also a need for disinfectant. The packaging for this disinfectant is considered medical waste and it was discovered that about 10L/day for 1000 people/dose is required (Hasija, 2022). This example demonstrates how resources can be used

for necessary and lifesaving reasons but can still contribute to waste. WHO Technical Officer Maggie Montgomery told Reuters: "We found that COVID-19 has increased healthcare waste loads in facilities to up to 10 times" (Bateman, 2022). Disposable and single use devices were seen as safer and often necessary in the beginning of the pandemic.

Medical Liability

Healthcare providers fight multiple battles throughout the day, one of them being liability for the care they provide. Many times, healthcare providers may overtreat a patient to ensure that there is no missed diagnosis or course of action missed. Even if it is as simple as bringing multiple syringes/pieces of equipment into the room, it all becomes waste. For example, in our interviews with subject matter experts, we learned that if there is a call to a room, nurses and other staff will often bring multiples of different treatment options and then throw away the unused single-use items after. Overtreatment may be linked to healthcare providers fighting liability and assigning more exams/tests to patients (Nunn et al., 2020).

In order to find a way around the staggering amount of medical waste produced each day, we also need to find how to overcome the ease that non-biodegradable medical supply packaging provides. Additionally, the COVID-19 pandemic has increased the amount of medical waste that is being used creating more of an impact on the environment. The pandemic produces more dangerous medical waste in lower-income countries creating a higher risk for injury and infectious disease. To improve medical waste management across the world more studies have been published to help reduce it.

Solutions & Recommendations:

Through our findings we have developed several different solutions to mitigate medical waste. During our research we have found that making small changes make a big impact. Medical waste is clearly a large global issue however, it would be difficult to tackle it in its entirety. Therefore, our group chose to create a smaller scale project that can be applied globally. Education is the solution that has brought forth the most success according to our research. According to the World Health Organization they have found that higher income-countries such as the United States and The United Kingdom have found that proper education can aid in the reduction of medical waste (WHO, 2022). This is because high income countries have more money at their disposal to put towards educating hospitals and healthcare professionals. Educating healthcare professionals and the public about different types of medical waste and how its generated along with the potential risks associated with improper disposal will only benefit the environment in the future. The World Health organization also highly suggests an increase in attention and diligence for proper management of waste (WHO, 2022).

While education will be the biggest factor within our proposed project there are many other different solutions that we have found. The second solution to the medical waste problem is to reuse and reduce the number of single-use materials medical facilities use. This might include developing safe and clean strategies to sanitize and clean materials that have been previously used (Rutala, W & Webber, D). In a study done by Rutala & Webber, they found that as long as equipment is properly sanitized and disinfected it can be reused. This method of sanitization and reducing the amount of single use items will effectively help the management of medical waste within medical facilities.

Another key finding from our research was the importance of fostering connections within our community. Building strong local networks can help reduce waste by enabling organizations to connect with each other and share best practices. Through interviews with several experts in the field of medical waste management, we gained valuable insights into the successful strategies that they have used. By promoting these connections within our community, we can increase awareness of the harmful effects of improper medical waste disposal and work together to effectively reduce medical waste.

Summary of Findings & Proposed Intervention

In conclusion, our research has shown that opportunities for our group to make an impact include education, reusing single use material, reducing single use material and fostering connections within the community. By holding an educational event engaging the community with how to properly dispose of medical waste, it is possible to increase awareness about medical waste and promote better practices for managing it. Collaboration with other organizations and stakeholders within the community to develop an educational event will also help increase awareness about medical waste, while also allowing the community to continue collaboration after the event is done.

The goals of this project include: 1) increasing education of medical waste, 2) increasing awareness of the issue, and 3) fostering connections between sustainability organizations and directors of medical equipment and waste at local medical facilities. By adopting more efficient and environmentally friendly practices within the community, such as implementing green cleaning programs and reducing the single-use medical supply chain, and educating the

community, we can reduce the amount of medical waste created. With that being said we propose an educational day to spread awareness and education around medical waste.

Methods:

Our approach to the development and implementation of a medical waste day required collaborative efforts within our group and the broader community. This was done in 5 steps: finding partners with like minded interests, creating a preliminary survey to assess local need, organizing the event, hosting the event, and evaluating the impact of the event.

Finding like minded partners to collaborate with on the medical waste day were done using numerous methods, such as reaching out through email, personal interview, and zoom meetings. During these meetings we asked the interviewee if there is any organization/interview they believe we should also collaborate with. By doing this we were able to develop a complete overview of necessary individuals and organizations in the missoula community.

After building numerous connections amongst the local community we developed a preliminary survey. Prior to this survey an IRB proposal to gather data from survey responses was filed. This survey was distributed through email and responses were collected from email replies. The survey entailed questions about where Missoula can improve upon in handling of medical waste, what organizations should be more involved in reducing medical waste, and other various questions about medical waste education.

The third step of this project was organizing the event. The event was hosted at the Missoula public library. Attendees of the event included Providence Health, Skaggs school of Pharmacy, and a booth created by us, the program coordinators. We advertised this event to the general public, through flyers placed around the University of Montana Campus and in the library. We also provided incentive for attending the event which included extra credit for the surgical tech program and four \$25 REI gift cards.

At the actual event we formed a small series of tables hosted by some of the local organizations listed prior. The event was hosted from the late morning to early afternoon and was open to guests throughout the entire period of the day. The prize drawing was done after the event using a randomizer for equal opportunity, and the winners were contacted through email.

Following the event we assessed impact using a survey. This survey was administered via Qualtrics forms and assessed individual takeaways from the event including: if any new connections between organizations were fostered, and if any healthcare organizations implemented any change, what individuals learned most about in the event, where individuals would like to see more information if the event was hosted again, and what individuals thought was the most important type of medical waste.

Timeline:

- January- early February: We reached out to groups from both the sustainability end and the healthcare end to determine if they would be willing to partner with us for our Medical Waste Day. This may look like actually tabling the event, providing an

award/service to give away, or even just giving advice. Additionally, we started the process of printing posters to gain awareness for our Medical Waste Day. At the beginning of January, we also scout our event space. We will reserve the Blackfeet Communication Room of the Montana Public Library. Finally, we submitted our IRB for the surveys reflecting on Medical Waste Day.

- February-March: During this period of time, we finalized our event schedule. We sought concrete answers from the organizations we reached out to.
- March: While finalizing our event schedule, last minute cancellations required us to fill in gaps. Our group created a table with general information about medical waste. This table showed us another way of showing how passionate we were in planning this Medical Waste Day.
- April 15th: Our event was held April 15th, from 10- 11:30 in the Blackfoot Communications room of the Missoula Public Library. In attendance we had Providence Health, UM Pharmacy, and our group at tables. We had good attendance by the public. We encouraged participants to respond to our survey to understand the impact we made and what they learned from the information given.
- Late April: We compiled our data into graphs in order to understand what impact we made on the participants. We wanted to understand what they felt went well in the event and what could be improved. We also reached out to thank our partners. We also presented our findings at UMCUR.

Results:

For the medical waste day event three subject matter experts were able to set up tables to

present their knowledge about the matter of medical waste. Sarah Johnson from Providence set up her table to explain the waste streams within our local hospitals and also the streams of waste that come from bedside nursing. Hayley Blackburn from the University of Montana School of Pharmacy was also able to create a table based on the education of waste from pharmaceuticals and different ways to help combat those waste streams within the local Missoula Community. Lastly, our capstone group had an educational table that had globally directed information from our initial literature review, providing the participants with background information on the issues of medical waste.

In terms of participants that came to the event we had in total 12 student participants that were in attendance. All 12 participants stayed for the entirety of the event, and were all engaged in the conversations around medical waste. At the end of the event we asked the participants to fill out a survey to better understand the impact that education has on individuals. Our previous research had shown that education was the best way to understand and mitigate medical waste and through the survey we were able to determine that statement was correct.

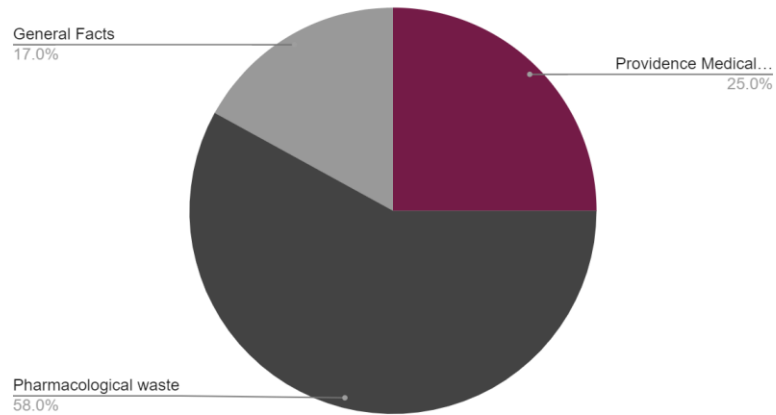
The survey was set up to better understand what the students and the public had previous knowledge on before the event and then after the event. As you can see looking at the graph below three of the topics were fully understood after the event, those topics include single use devices, plastic waste, and Biohazardous waste. The topic on prescription containers also resulted in seven students understanding the topic better.

Pre event and Post event Understanding



While this survey was created to determine the understanding of the participants, we also created this poll to see what students might want to see in the future as the medical waste day could become a yearly event. Most students selected the option for No additional information needed, which shows how educational the event truly was.

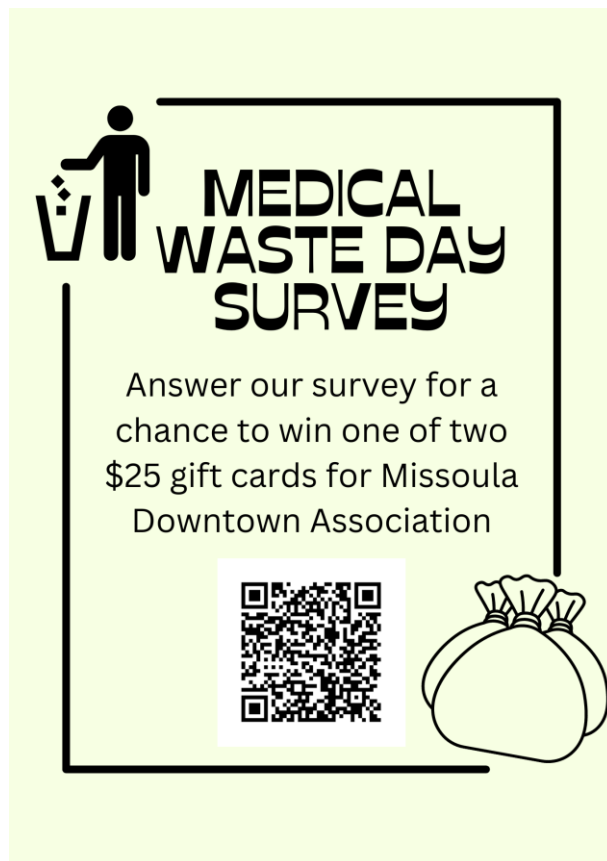
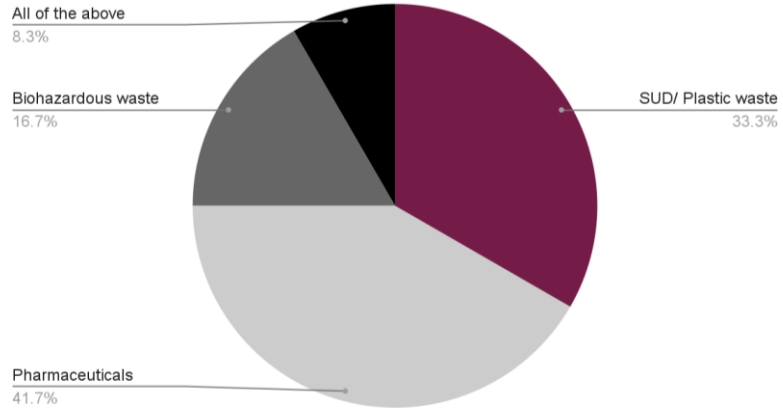
What Table and/or Information Did You Find Most Helpful?



The survey also looked at what information the participants found helpful. A majority of the students found that information about pharmacological waste was interesting and helpful. Hayley Blackburn covered a lot of information on pharmacological waste within the Missoula

community and also provided many different resources for waste reduction in Missoula.

What table and/or information did you find most helpful?



Above is the QR code that we had the student participants use to take the survey. The survey took no more than 5 minutes and was taken after the students had visited all of the tables.

Discussion:

Medical waste is a global issue and needs interdisciplinary solutions. We found that the most effective solutions are simple solutions. Our research highlighted that education would be most beneficial for creating a feasible solution. We had to come to terms with the fact that medical waste is a global issue and the scale of it means that there isn't one perfect solution but that education is an important place to start. We found that medical waste created locally has global impacts. This meant that local education would help to create a global solution. We interviewed medical care providers and Missoula businesses centered around sustainability to learn the present state of medical waste disposal in Missoula. We found that there is a desire for change and increased sustainability but a lack of awareness about this issue by many. For our event we also wanted to foster connections throughout the Missoula community and to our event we invited those we had previously interviewed as well as the Missoula general public and students of the University of Montana. This is one of the strengths of our project because it allowed for a multidisciplinary approach to the problem. From our event we found that there is interest from the Missoula community for improvement. The medical centers specifically are striving for a more sustainable future and felt that a lack of knowledge was also holding them back. We also found that the participants of this event responded most to the consequences that medical waste creates that impacted them directly. Some limitations we encountered was a limited response from the Missoula community as this is not a topic everyone is interested in.

To improve this event we would recommend hosting this type of event in conjunction with other sustainability groups in order to garner more attention and interest. While people were interested once they started learning about the issue the topic didn't garner much interest initially because the majority of the Missoula community did not know medical waste is an issue. In

order to emphasize the scale of this issue, in the future we would recommend emphasizing the global consequences of this issue. Our team would also recommend trying to include this event with an already established sustainability education day in order to reach the most people possible.

Conclusion:

In conclusion, the team determined that medical waste is a prevalent issue in today's society, both locally and globally. This is because of the immense amount of medical waste that is produced by every place that deals with medicine. This could be a hospital, a walk-in clinic, or even a house. Because of the scale of the issue, the team immediately knew that it was worth putting full scale efforts against. Through extensive research, it became clear that the most effective way to bring about any change was through education. While the team knew that it was impossible to reach everyone globally, making connections locally quickly identified itself as a main cause.

Educating and reaching people were the main reasons for Medical Waste Day. The goal was to foster connections between sustainability and medical groups, as well as the organizations and the public. In this way, education was at the forefront of every step taken, and would continue to be so if Medical Waste Day took place in the future.

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