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Barriers to Hospital Food Waste: A Pilot Exploratory Study

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BARRIERS TO HOSPITAL FOOD WASTE: A PILOT EXPLORATORY STUDY

by

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ABSTRACT

Food waste is an ever-growing problem in this country and hospitals are large producers of food waste. Food is something that is beneficial to everyone on the planet, but when wasted, it creates added methane gas production which contributes to the greenhouse gas effect. There is a paucity in the literature concerning industry specific food waste disposal processes. To add knowledge about food waste in Maine, a 24-question survey was used to ask healthcare organizations nutritional and environmental personnel about, food disposal, reuse, and environmental sustainability efforts. The data was analyzed using descriptive statistics. The response rate was low, however the data provided some insight into food waste in healthcare institutions. With a better understanding, new efforts can focus to food waste reduction, circular economy support, and environmental sustainability.

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CHAPTER I: LITERATURE REVIEW

Introduction

Food waste and loss is a widespread problem with implications that span from hunger to global warming. The term "food waste" used throughout this paper follows the definition of the Food and Agriculture Organization ([FAO], 2014, paragraph 1]) as "the removal of food from the supply chain which is fit for consumption, or which has spoiled or expired, mainly caused by economic behavior, poor stock management or neglect". In addition, the FAO defines "food loss" as "food that is lost in the production and distribution segments of the food supply chain and is mainly caused by the functioning of the food production and supply system or its institutional or legal framework (FAO, 2014, paragraph 1). "Roughly one third of the food produced in the world for human consumption every year — approximately 1.3 billion tons — gets lost or wasted (FAO, 2019; paragraph 1)". Given the global population of 7.6 billion people, that figure equates to every person wasting 341 pounds of food every year. Food loss and waste are adding to the cumulative effect of climate change through an inefficient use of valuable resources, including water, land, energy, labor and capital (Agriculture Organization of the United Nations [AOUN], 2014).

The relationship between food waste and climate change, begins with the relationship between the sun's rays and earth's atmosphere. The rays of the sun penetrate the earth's atmosphere and deflect off of the surface of the earth and exit into space. Some of the heat is kept inside the earth's atmosphere because it is trapped by greenhouse gas (GHG). This normal heating of the earth's atmosphere is needed to

support human, animal and plant life. However, increases in GHG results in the radiant heat being trapped in the environment which leads to the earth surface and atmosphere warming.

The potential of greenhouse gases (GHG) to cause warming is defined by global warming potential (GWP; United States Environmental Protection Agency [EPA], 2018). GWP is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide, which is normally measured over 100 years (CO_2; EPA, 2018). One ton of CO_2 is the equivalent of 1 GWP.).

There are several types of GHGs, however, the two main gasses produced with food waste are carbon dioxide (CO_2) and methane (CH_4). Methane (CH_4) is estimated to have a GWP of 28–36 over 100 years (EPA, 2018). Methane emitted today lasts about a decade on average, which is much less time than CO_2, however it absorbs more energy than CO_2 (EPA, 2018). Because of this, methane has a higher potential to accelerate global warming and climate change. Although carbon dioxide is the most prevalent greenhouse gas (accounting for 81% of emissions), methane is much more potent. In fact, over a 20-year period, it traps 84 times more heat than CO_2 (Krupp, 2018).

Methane is produced when organic compounds break down (i.e., food in landfills) and from livestock over the course of their lives. To control methane emissions, an analysis of where food is wasted is needed This literature review will outline where food is wasted, with a specific focus on hospitals, as well as explain what factors contribute to food waste and potential solutions to this problem.

Food Waste and Efforts to Reduce

The Food Supply Chain

The potential for food waste essentially begins when food is produced. Food can either be wasted or recovered (see Figure 1). Garrone, Melacini, and Perego (2014), illustrated the food production model and how food waste management can be implemented. As defined by the article, food availability is the amount of food produced throughout the food supply chain. Surplus food can be recovered and used in a variety of ways. Four main management goals were considered: feeding humans, feeding animals, waste recovery, and waste disposal (Garrone et al., 2014). From this framework, the food supply chain was reevaluated to look at where and how food is wasted. In order to describe the condition of the food, Gustavsson Otterdijk, and Meybeck (2011) defined food surplus versus food waste. *Food surplus* is the edible food that is produced, manufactured, retailed or served, but for various reasons is not sold to or consumed by the intended customer. *Food waste*, on the other hand, is food that is no longer suitable for human consumption, for example, food that has expired or has grown mold. The transition from surplus food to food waste is also dependent on the food's degree of recoverability. A surplus food's recoverability for human consumption is dependent on where it exists in the food supply chain and the kind of product it is (Parfitt & Barthel, 2010). Garrone (et al., 2014) uses the example of unharvested grains which although healthy, are less recoverable because they need to be physically altered in order to be consumed. This example was compared to a packaged product that is not sold because the box is dented which has a much higher degree of recovery due to it already being ready to eat. This technique of breaking down the food supply chain and reevaluating where food waste physically occurs has far reaching implications. This research can be

utilized by many organizations for decreasing food waste and better managing the waste that is produced in a more efficient manner.

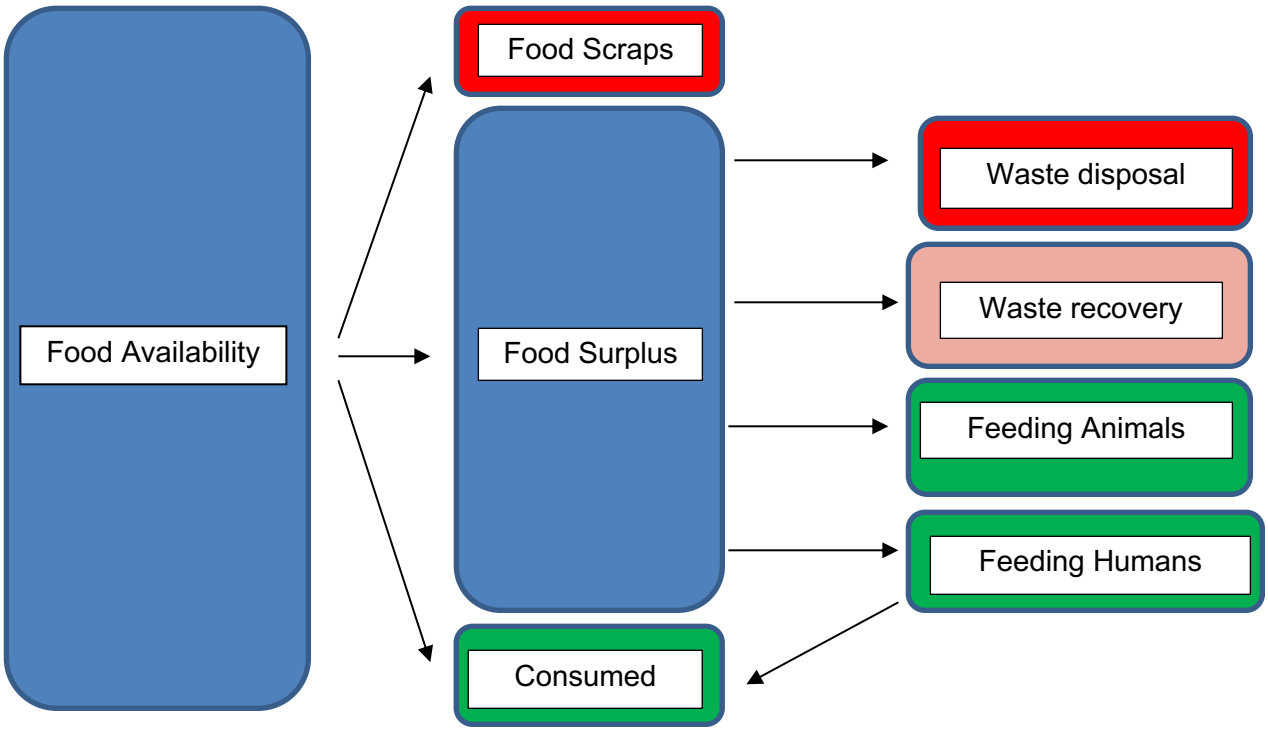

Figure 1: Model adapted from *Opening the Black Box of Food Waste Reduction* (Garrone et al., 2014)

Household/Residential Food Waste

Pedersen, Land, B, and Kjærgård (2015) examined different forms of promotion and sustainability developed in Denmark to face the food waste crisis. The article divided its information into two categories: private households and retail. The main motivator for a household to decrease food waste is to save both time and money (European Environment Agency [EEA], 2014). In Denmark, a large number of organizations representing consumers, agriculture, industry and food movements have initiated a study identifying the behavior of Danish households in respect to food waste (Pedersen et al.,

2015). To combat this, many organizations that represent consumers have put together information on the importance of eliminating food waste. One such organization titled *Stop Wasting Food* distributes information to highlight the benefits associated with meal planning, which in the long term, is associated with better outcomes both financially and in terms of decreasing food waste (Stop Wasting Food, 2019). The organization also publishes cookbooks on what people can do with their leftovers to reduce waste (Pedersen et al., 2015). Another organization titled *Waste & Resources Action Programme* (WRAP) works together with industry, local authorities, and retailers on raising awareness of the necessity to reduce food waste (WRAP, 2019). WRAP has a five-year plan "Resource revolution creating the future" that involves recruiting and outlining how businesses, organizations and consumers can be part of a more educated approach to using materials including food to decrease unnecessary waste (WRAP, 2019). The World Watch Institute of Europe argues that efforts such as WRAP and Stop Wasting Food have helped cut food waste by 21% since 2007 (Pedersen et al., 2015). However, challenges of decreasing food waste at the household level can be found because constant motivation is critical to sustainability. Raising awareness about the benefits of healthy food habits is critical (e.g., cost and time saving) to turn the practice of food waste reduction into a habit

Retail Food Waste

Food waste at the retail level utilizes a variety of strategies—different than those used at the household level—for managing food waste. The most popular strategies include separating out food that is about to expire and marking it down to a lower cost, selling "ugly fruits" at a discounted cost and changing the quantities of how things are

packaged while selling everything at the same price. “Ugly/imperfect fruit” is food that has the same nutritional value as more perfect variations but are mismatched in some way. Examples include bent cucumbers, or apples and carrots of different sizes. Supermarkets have found an increased purchase of these items if they are sold at a discounted price (Dung Thi, Kumar & Lin, 2015). This phenomenon is more so seen in industrialized countries where there is a higher standard of aesthetic standards of food products (Dung Thi et al., 2015).

Beyond discounting prices and changing how food is packaged for the primary consumer, there is still more that can be done to increase supply chain efficiency and reduce food waste. The Danish Food Bank is a nonprofit organization that works to combat food waste by collecting food that is approaching the date of expiration from supermarkets and distributes the surplus food — fresh or cooked — to volunteer organizations that support the homeless, crisis centers, and to other socially disadvantaged people (Danish Food Bank, 2019). Another example of redistribution is utilized by the Salling Group, the largest retail company in Denmark, and Dan Church Aid, a non-profit organization (Pedersen et al., 2015). These two organizations opened a social supermarket named Refood where the oversupply from supermarkets is sold at 50-70% below the standard retail price. Any surplus from these sales is donated to Dan Church Aid to fight hunger in third world countries (Dan Church Aid, 2019).

Food Waste in Industrial versus Developing Countries

Industrialized and developing countries discard roughly the same quantities of food — respectively 670 and 630 million tons (FAO, 2019). However only about 1/7 of the global population lives in industrialized countries (Shah, 2013) which means there is

a disproportionately high amount of food being wasted in industrialized versus developing countries. In comparison, industrialized countries also dissipate a higher volume of carbon dioxide emissions every year. Figure 2 compares the carbon dioxide emissions from different regions of the world.

Nellemann and MacDevette, (2009) reported that a percentage ranging between 25%-50% of food produced is wasted through the supply chain. This includes harvesting, collection, processing, and distribution of any food product being sold. However different countries report different amounts of food being wasted at different points in the supply chain. In developing countries more than 40% of food losses occur at the postharvest and processing stages while in industrialized countries about 40% of losses occur at the retail and consumer level (Gustavsson, et al., 2011). These studies show that in order to combat food waste on a global scale, different strategies are needed for different countries, and these differences mainly come from an organizational standpoint. In developing countries, food waste is, as aforementioned, produced mainly after consumer purchasing. Girotto, Alibardi, and Cossu (2015) found that food waste in medium to high income countries related mainly to consumer behavior or lack of coordination between different parts of the supply chain. Quested and Johnson (2009) identified other consumer behaviors that most directly led to food waste such as overbuying, poor food storage, excessive preparation losses, inability to use by-products, poor cooking/holding techniques, shortage of labor and equipment, excessive portion sizes, inability of the eater to remove all edible material, inappropriate purchasing, and bad storage conditions. There is also some confusion for the consumer between ‘best before’ dates and ‘use by’ dates which adds to the waste (Girotto et al., 2015). In industrialized countries food is held to a

certain standard of quality. If food does not meet that quality, it sometimes goes unused such as the previous example of "ugly fruit" demonstrates (Graham-Rowe, Jessop, Sparks, 2014).

On a household level, consumer behavior may produce a huge impact on food waste (FW) generation (Girotto et al., 2015). In industrialized countries, FW prevention should focus on the consumers behaviors at the household level (Papargyropoulou, Lozano, Steinberger, Wright & Ujang, 2014). Several studies found the convenience in sorting, storage space at home, availability or sorting facilities, access to a curbside collection system and distance to collection points are important influential factors that can increase the recycling rate (Bernstad &Jansen, 2011).

On the other hand, the causes of food losses in low income countries are mainly linked to financial, managerial, and technical limitations in harvesting techniques, lack of storage and cooling facilities in difficult climates, infrastructure, and packaging and marketing systems (Girotto et al., 2015). Prevention in these countries should focus increasingly on the retail and distribution system rather than consumer behavior (Nahman & de Lange, 2013). Prevention in both developing and industrialized countries can be achieved by either attempting to reduce food losses and, thereby, decreasing the demand for food production, or reducing food losses by diverting excess product that is still safe for consumption to other consumers (Girotto et al., 2015).

Figure 2: CO2 Emissions from Industrialized and Developing Regions (FAO, 2018)

Region	Industrialization Progress	CO2 Emissions/year
North America and Oceania	Industrialized	860 kg
Industrialized Asia	Industrialized	810 kg
Europe	Industrialized	680 kg
Latin America	Developing and Industrialized	540 kg
North Africa, Western Asia, and Central Asia	Developing	350 kg
South and Southeast Asia	Developing	350 kg
Sub Saharan Africa	Developing	210 kg

Another consideration when comparing food waste from industrial versus developing countries is the carbon intensities of the food that is grown. The carbon intensity of food is defined as the total GHG emitted from growing, rearing, farming, processing, transporting, storing, cooking and disposing of the food (FAO, 2018). For example, vegetable production in Europe is more carbon intensive than vegetable production in industrialized southeast Asia as Europe uses more carbon intensive means of production such as artificially heated greenhouses (FAO, 2018). On the other hand, cereal production in Asia is more carbon intensive than cereal production in Europe due to the difference in type of cereal grown: rice on average has higher impact factors than wheat. Specifically, rice is a methane emitting crop because of the decomposition of organic matter in paddy fields (EPA, 2019).

Meat is also an important consideration in the discussion of climate change. Although meat is proportionally not a huge contributor to food waste (it makes up about 5% of global waste) (FAO, 2018), the production of consumable meat has a huge impact on climate change, contributing to over 20% of the carbon footprint of total food waste (FAO, 2018). The impact is due to several reasons. The total carbon footprint (total carbon emissions) of meat production includes the emissions from producing a kilogram of meat, the emissions related to feeding the animals, and emissions from manure management (Petersen & Rohrer, 2019). Overall, the total carbon foot print of global food waste is 4.4 giga tons of CO2 emissions per year. To put this into perspective, if food waste was its own country, it would have the third highest rate of CO2 emissions from food (FAO, 2019). To efficiently reduce GHG production, efforts within the food industry should focus on rice and meat.

The Role of Packaging in Food Waste

Williams, Wikström, Otterbring, Löfgren, and Gustafsson (2009) conducted a study on the effect of packaging on food waste and found that 20-25% of food waste can be related to packaging. About 15% of consumers in the study reported that the packaging was important cause for food waste, and 30% of consumers stated that too large packages are one important cause for food waste. In this study, the consumers were divided into two groups, the blue group and the green group. Consumers in the green group had more background information on living a green lifestyle and minimizing food waste while the blue group was more reflective of a standard household. After studying waste habits over one week they found that packaging aspects that caused food waste were found both at the time of purchasing the food and using packaging at home. The

following reasons were frequently mentioned in regard to the shopping occasion: buying too much, offers to take three and pay for two, multi-packs (Cox & Downing, 2009).

In the analysis of the differences between the green and blue groups, the environmental commitment and/or the environmental education of the green group makes a difference (Williams et al., 2011). The green group wasted half the amount of prepared food as compared to the blue group. This study highlights the effect that education can have on waste habits and its potential for changing food waste habits on a global scale. However, the study also highlighted an important point to take into consideration when it comes to food waste. The directive and business communications show the consumer that it is the packaging itself we should care about. There are no such directives for reducing food waste which signals that this is less important than packaging waste (Geyer-Alle'ly & Zacarias-Farah, 2003). Many participants in the green group indicated that they believed that no packaging at all for their food would improve waste. However, packaging does serve a purpose. It helps to keep food contained and protected from bacteria. It also can elongate the time that food can be eaten. The view of packaging as being something bad which has to be minimized has hidden the more important focus on packaging optimization for a more comprehensive environmental approach (Williams et al., 2011) Packaging is a part of food waste in the modern world that will not be eliminated, but steps need to be taken for packaging to be used more efficiently and be produced more environmentally friendly. Most people do see packaging waste as an issue, however if this information is not paired with information regarding food waste, the issue will remain unaddressed.

Hospital Food Waste

Food wasted by consumers and at institutions that serve food –including hospitals –have a higher accumulated environmental impact than food wasted in the distribution chain and is therefore even more important to reduce (Williams & Walton, 2011) Currently, hospitals are experimenting with different strategies to reduce their own food waste. The main strategy currently being tested by hospitals is controlling how food is served.

Waste Prevention: Serving Styles

Curbing food waste in hospitals takes different strategies depending on the organization. A popular strategy discussed to reduce food waste in hospitals is to reinvent the way in which food is provided, which can include bulk (buffet) style trolley food service, or room-service style serving to patients. According to Williams and Walton (2011) and Ofei, Holst, Rasmussen, and Mikkelsen (2014) these strategies benefit patients and reduce food waste. Bulk/trolley service styles entail a trolley or cart of food being brought up to the unit. Food options are offered to patients and they are able to visually see what options look appetizing to them. Room service can be done in a variety of ways. One way is to have a set menu of food items available for selection each day (for example, two options of an entrée). The second style is more open and involves a complete list of all food options in a hospital that the patient can choose from. Bulk and room-service style serving models control portion sizes, maintain food temperatures, and improve the appearance of the food being served. Dias-Ferreira, Santos, and Oliveira (2015) examined portion size as a problem within healthcare facilities and found that the most food wasted was generated by the main course and suggested offering patients two

different portion sizes to choose from to help reduce the amount of food uneaten. Globally, the one-size-fits-all portion size is the most common way to distribute food within hospitals, but this method leads to higher amounts of food waste due to the fact that everyone is given the same portion size whether they have a decreased appetite or not. For example, older adults, patients who recently underwent surgery, and patients that feel ill may have smaller appetites and should not be given the same amount of food as a patient with a standard or larger appetite; patients should be able to make decisions concerning the amount of food they think they can consume. Allowing patients to choose from two different portions sizes, food waste in hospitals could potentially be reduced by at least 30% at the individual level (Dias-Ferreira et al., 2015).

Waste prevention: portion size control

Both food delivery models (i.e., bulk and room service) have been shown to reduce waste and improve patient satisfaction because the patient can choose what they want, how much they want, and when they want it. Eliminating fixed meal times for patients could be beneficial in making sure patients are given food when they are actually hungry; therefore, minimizing the amount of food uneaten. In fact, room service can influence patients to eat more of what they order due to better portion sizes, temperatures, and appetizing appearance at the time that they are hungry. However, Williams and Walton (2011) explain that both strategies risk patients' "under-ordering". That is an undernourished patient may not order enough food or as frequently. This can result in patients not consuming enough nutrients for metabolism and proper healing. Ofei et al. (2014) disproved this concern for undernourished patients not being able to consume enough food by exploring the use of trolley food service in which patients can choose

their meals right from the food trolley. More than 65% of hospitals in Denmark since 2003 have incorporated the trolley meal service method. Trolley food service has been found to improve patients' food intake while simultaneously reducing food waste since it allows for a more customizable, individualized approach (Ofei et al., 2014). Trolley meal and bulk service has been very favorable due to higher patient satisfaction and food/energy intake because it gives the patient control of their portion sizes and meal items. With the leftover food on the trolley, the staff of the hospital involved suggested the idea of allowing patients' family members to be able to buy the leftover food. This enables them to be able to have a meal with their loved one in the hospital. Other staff members of the hospital would be able to buy the extra food as well, furthering the reduction of food waste while increasing profit (Williams & Walton, 2011).

Food Waste: Solutions to Promote A Circular Economy

Anaerobic Digestion

Another way to reduce food waste that is growing in popularity is called anaerobic digestion. Anaerobic digestion is the process in which unused food is broken down into methane which is collected and converted into reusable energy (Bernstad & Johnson, 2011; eXtension, 2018). Food from different sites is collected and transported to digestion facilities and put into a large container called a digester which breaks down the food through anaerobic digestion and releases methane as a by-product.

Anaerobic digestion is broken down into 4 steps: hydrolysis, fermentation/acidogenesis, acetogenesis, and methanogenesis (Anaerobic Digestion and Bioresources Association [ABDA], 2019). In the first step of hydrolysis, the large polymers that make up food (protein, fat, and carbohydrates) are broken down into amino

acids, fatty acids, and simple sugars (eXtension, 2018; ADBA, 2019). The next step, fermentation, breaks down the products of hydrolysis further using acidogenic microorganisms. The bacteria create an acidic environment in the digester while creating ammonia, hydrogen gas, carbon dioxide, hydrogen sulfide, shorter fatty acids, carbonic acids, alcohols, as well as trace amounts of other byproducts (ADBA, 2019; eXtension, 2018). The third step of anaerobic digestion breaks down the products of fermentation even further. In acetogenesis, acetogens catabolize many of the products created in acidogenesis into acetic acid, CO_2 and H_2, which are used by methanogens to create methane (ADBA, 2019; eXtension, 2018). The final stage of anaerobic digestion, methanogenesis, uses the byproducts from acetogenesis and converts those into methane. The main mechanism to releasing methane in methanogenesis is the path involving acetic acid. This path creates methane and CO_2, the two main products of anaerobic digestion (eXtension, 2018).

Bernstad and Jansen (2011) found in their study *A Life cycle approach to the management of household food waste—A Swedish full-scale case study* found when comparing different waste programs that anerobic digestion had the lowest negative impact when comparing AD, composting, and incineration. The waste products from AD has many uses. The biogas (end product of AD: gaseous methane) can be used to produce electricity, heat, fuel for cars or be injected into the gas grid (ADBA, 2019).

Anaerobic digestion is difficult to do on site for most facilities including hospitals. However, resources are available in which waste management stock facilities with the necessary supplies for anaerobic digestion (i.e., large shipping container bins)

can collect waste from various sites for digestion. A company can collect designated food waste bins and transport them to a facility with an anaerobic digester.

Composting

In contrast to anaerobic digestion, composting relies on aerobic digestion to break down food waste. During composting, microorganisms such as bacteria and fungi break down complex organic compounds into simpler substances and produce carbon dioxide, water, minerals, and stabilized organic matter (compost) (NC State, 2018). The process produces heat, which can destroy pathogens and weed seeds (NC State, 2018). Composting can be done on a small household scale, or a large scale. This section will specifically go over large-scale composting (LSC) techniques.

There are two main forms of LSC: windrows and in-vessel composting. (EPA, 2016; FAO, 2003). With wind row composting, waste is laid out in rows that are agitated or turned on a regular basis to increase aeration of the waste. This, in turn, encourages organic breakdown of food waste (EPA, 2016; FAO, 2003). There are many different forms of windrows. In each kind, the variables (i.e the amount of agitation, the method of agitation) is manipulated to meet the needs of the environment.

The other form of composting, in-vessel composting, is a method of composting that involves composting materials within a building, container or vessel (EPA, 2016; FAO, 2003). In-vessel methods rely on a variety of forced aeration and mechanical turning techniques to accelerate the composting process (FAO, 2003). Many methods combine techniques from the wind-row and aerated pile methods in an attempt to maximize the benefits from the organic material. There are many different kinds of in-vessel composting. Some examples are bin composting, rectangular agitated beds, silo

composting, rotating drums, and transportable container composting. Each method mainly manipulates the variable of size needed for composting.

Conclusion

Food waste is an issue that affects everyone and even small steps towards reducing food waste could make a massive difference. Food waste generated by hospitals are generally overlooked yet produce a large portion of commercial food waste. This thesis aims to collect data about hospital food waste. By gathering and analyzing data related to hospital food waste, there may be a better understanding of industry practices, which could provide insight to solutions leading to environmentally friendly practices and a circular food economy.

CHAPTER II: METHODS

Study Aims

To evaluate food waste in healthcare facilities across Maine, a pilot study using a quantitative design was conducted. The study was used to evaluate professionals in the nutrition sector of facilities and evaluate what they knew about food waste and how they managed food waste from their facility. The aim of this study was to:

1. Assess the region and categorize the different types of healthcare facilities across the state of Maine
2. Assess where food is being wasted in those facilities
3. Assess how the food waste in managed
4. Assess perceived barriers to composting and anaerobic digestion in healthcare facilities
5. Evaluate data collected in order to identify a baseline for perceived barriers to efficient disposal of food waste (composting and anaerobic digestion)

Internal Review Board

The internal review board (IRB) of the University of Maine (UMaine) approved this study based on the process of calling nutritional directors of healthcare facilities and sending a survey to them. A copy of the consent form (See Appendix A) was sent out to participants as well. Risks of the study were limited and only included time and inconvenience to the participant. There were no direct benefits to participants, however,

they were made aware of the importance of this research in learning more about food waste in Maine healthcare facilities.

Study Preparation

The targeted audience for this study were employees who were involved with preparing, ordering/supplying, and discarding of food. That is nutritional and environmental directors of different healthcare facilities (HCF) across Maine. Overall, Maine has about 140 healthcare facilities. 100 of those include nursing homes and rehabilitation facilities. Forty of them are hospitals of various acuity and size ranging from 25 beds to 637 beds.

Overall, 48 people were contacted by phone. Of the 48, 14 were given a verbal script (see Appendix B) and then they provided email addresses. The rest had a message outlining the study with a verbal script. The email collection processes were conducted over 1.5 months. Emails were collected over a time period of 1.5 months.

Once the email collection process ended, the survey (see Appendix C) was prepared for distribution using Qualtrics. Qualtrics is a software used to set up surveys, distribute them anonymously, collect data, and analyze it using different functions. The email addresses were entered in Qualtrics for an email with a copy of the consent form (see Appendix B) was sent with a link to the survey using Qualtrics. The data collected was anonymous with no link to person or healthcare institution. Data was collected over two weeks. After the end of the two weeks, 7 responses were obtained and 5 or them we're complete.

Study Procedure and Data Collection

The following section outlines the questions asked in the survey. A copy of the survey can be found in Appendix C. There are 24 questions in the survey, most of which are in a single answer multiple choice format. Other question formats used include select all the apply, yes/no, and a Likert-like scale.

Question one asked "How many staffed beds do you have in this hospital institution?". It was set up as a multiple-choice question with answers ranging from 0-25 to over 500 bed. This is an important starting point in order to frame how big an institution is. Question two, also multiple choice, asked the participant to identify what kind of HCF they worked at. Answers included acute care, critical access, or specialty (e.g., psychiatric, trauma, pediatric).

The third question was also a single answer multiple choice question that asked when the HCF was built. The years ranged from before 1940 to 1990 or after. Question four asked whether the hospital had been updated since it was built. This question had a yes or no format. If the participant answered yes, the survey brought them to question five If not, the survey skipped question five and brought them straight to question six. Question five asked if the kitchen had been part of the HCF that had been updated since it was built. This was also a yes or now format.

The purpose of question six was to identify what role the participant had in their HCF. The question was a single answer multiple choice with answers as follows: nutritional director, nutritional/environmental services, nutritional manager, or other. Question seven followed up by asking the participant how long they have been employed

in their position. Answers followed a single choice multiple answer format with responses ranging from 0-5 years to 20+ years.

Question eight identified whether or not the participant had any formal education related to food science. It was a yes or no format. If the participant answered no, the survey would skip question nine. If they answered yes, question nine was answered. Question nine asked the participant to identify their educational preparation in the food industry. The answer format was select all that apply. Selections included: Clinical dietitian, Chef, Culinary School, Undergraduate degree in food science/nutrition, or Environmental.

Question ten used a Likert-like scale. The question asked how meals were prepared in case he HCF. The options were premade outside of the facility or made from scratch. All answers would bring the participant to the second part of the question: what is the percentage of meals prepared this way on a daily basis?

Answers for this followed a single answer multiple choice format that ranged from less than half to all the meals. The next question, question 11, addressed food service. The question was yes or no. If the participant answered no, the next question was skipped. If participants answered yes, they were directed to question 12. which asked what kind of food service is offered at the HCF and offered custom order or set menu as the options.

Question 13 asked how food was transported to the floor by specifically addressing whether or not nutritional staff brought trays up from the kitchen. This was answered using a yes or no format. The follow up question to that, question 14, asked it

nutritional service department personnel removed trays from patients' rooms when they were done with their meals. This was also set up as a yes or no question.

The following series of questions, starting at question 15, start to address food waste. The first question asked how they discard waste from patient trays in a select all that apply format. Options include:

- Garbage disposal
- Trash receptacle
- Composting
- Anaerobic digestion
- Farm animals

Question 16 followed up by asking the participant what ways they are limiting food waste, this was also select all that apply. Options include:

- Donations
- Food Pantry
- Repurposing food (ex. Bread into croutons/Overripe strawberries into dessert)
- Given to staff with pigs, chickens, etc.

After those, the survey asked if the HCF has a cafeteria for visitors and staff in question 17. A ye/no question was asked. If no was selected, the next question was skipped and if yes was selected the next question was answered.

Question 18, answered only if the participant selected yes, asked how waste from the cafeteria was disposed of. It had a select all that apply format with options that included:

- Garbage disposal
- Trash receptacle
- Composting
- Anaerobic digestion
- Farm animals

Question 19 addressed the HCFs procedure for discarding prepackaged food that was not sold or the shelf life expired. It followed a select all that apply format with options:

- Garbage disposal
- Trash receptacle
- Composting
- Anaerobic digestion
- Farm animals
- Offered to staff
- Donate

The following question, number 20, was similar but asked what the procedure for food on the unit that was not eaten and whose shelf life expired is disposed of. This answer had identical options to the previous question.

Question 21 asked the participant whether a composting or anaerobic digestion program exists at their HCF. The answers were in a yes/no format. If no was chosen, the survey went chronologically to question 22. If yes was chosen, the survey skipped to question 24. If the participants said no, which the majority of them did, question 22 followed up by asking if participants would ever consider an anaerobic digestion or composting program at their HCF.

Question 22 followed a yes/no format. For either answer, the participant was directed to question 23 which asked them to identify barriers to starting an AD or a composting program at their facility. This followed a select all that apply format with options as followed:

- Someone to run the program
- Time to set up the program
- Space for the holding containers
- Cost of the service
- Odor of the food
- The weight of the totes once filled

The last question, question 24 asked the participant if their facility had isolation patients did they treat the food waste from these individuals different than those patients who were not under isolation precautions? The answer followed a yes/no format.

Results

Overall, seven responses were recorded. Of those 7, only 5 of them were complete. For question one, 33% stated their hospital had 26-50 beds while the other 66% had 51-100 beds. The majority of participants (50%) stated they were employed at a critical access hospital. Twenty-five percent worked at an acute care facility, and the other 25% worked at a specialty hospital. The time period for when the HCFs were built was mixed with 33% of participants documenting before 1940, 33% documenting 1970-1989, and the last 33% documenting 1990 or after. Every responder stated their facility had been updated since it was built, however only 83.33% stated that the kitchen had been a part of the update.

For employment, 50% of respondents answered their job title was nutritional director, 16.75% stated their title was the nutritional/environmental director, and 33.3% stated other. Everyone has held their position for more than 5 years. The majority of participants (80%) had held their position for 10-20+ years. Education was highly documented with 66.6% of participants stating they did have formal education related to food science. Careers backgrounds were mixed with 40% of people with a culinary background as a chef, 20% went to culinary school, and 40% had an undergraduate degree in food science.

Participants reported that 83.3% of the meals were prepared by kitchen staff while 16.7% were premade outside of the facility. Of the meals prepared by kitchen staff, the majority of respondents (60%) reported that more than half of the meals were made from scratch. Only one respondent stated their food was premade outside of the facility in which half of the meals were prepared that way.

The majority of participants (66.7%) stated that their facility had room service. Of the facilities with room service, 25% were custom order and 75% had a set menu. Fifty percent of respondents had nutritional staff bring trays up to the floors and 50% did not. After meals were eaten, 33.3% stated that nutritional staff then retrieved the trays from the floor which left 66.7% of facilities who had other staff gather trays. Appendix D shows a breakdown of food waste from patient trays. In order to limit food waste, 36.6% repurposed food from other meals, 27.3% was given to farm animals, 18.2% was donated, and the last 18.2% was given to a food pantry.

The majority of facilities (83.3%) did have a cafeteria for visitors and staff while. Appendix E shows a breakdown of food waste from cafeterias. For food on the floor that expired, 33.3% was put in the garbage disposal, 22.22% was put in the trash receptacle, 22.22% was offered to staff, 11.11% was donated, and 11.11% was composted. The majority of facilities (85.7%) did not compost or anaerobically digest while only composted 14.29%. Of the participants who said they did not have a composting/AD program, 50% said they would consider it and 50% said they would not. Appendix F has a graph that breaks down the different perceived barriers. Only 28.6% respondents reported no isolation patients at their facility. Of the facilities with isolation patients, 57.14% did not treat their food differently.

Discussion

The data collected from the survey was minimal, however, there were some interesting outcomes. Such as, with the amount of staffed beds reported in question one, it can be inferred that the majority of responders were employed at a larger scale hospital rather than a rehabilitation/skilled nursing facility. This makes sense as the majority of facilities contacted were not skilled nursing/rehabilitation facilities. The time period for when facilities were built was split into thirds, however not all kitchens were remodeled in an update. The kitchens that were not updated could potentially have outdated appliances which would make preparing food for large groups of people difficult.

With question 6, there was a lot of participants who reported that they were neither the nutritional director/manager or the environmental director. It would be interesting to find the position held and what job roles were required. Another thing was that no matter the position, most respondents worked in their position for over 10 years

which is substantial. The difference in experience would absolutely affect knowledge of food preparation and waste. Those people would also have a better understanding of facility specific issues they may have when implementing a composting of anaerobic digestion program.

Most respondents worked as a chef and the majority of the food was made from scratch across the board. With prepackaged food, there is usually a lack of understanding of how to save leftover food to repurpose in other dishes. The data collected showed that most respondents had a background and education in food science. This would impact how food is prepared and how scraps are dealt with. In fact, most respondents stated that the main way they limited food waste was by repurposing food in other dishes.

Composting does exist in healthcare facilities, about 25% of respondents stated composting was used as a way to discard food waste from the cafeteria, unit floors, and patient trays. This was unknown prior to this study and more information regarding what is being composted should be gathered. For the facilities that did not compost, half of the respondents said they would not consider starting a program and listed their perceived barriers. See Appendix F for a breakdown of the different perceived barriers. Overall, the data, although minimal, was able to shed some light onto how food is handled in healthcare facilities.

CHAPTER III: STUDY REFLECTION

Limitations

There were several limitations to this study. The main issue was the lack in participation. A reason for this was the short amount of time from IRB approval to contact the HCFs and obtain an email address from the nutritional director. Calling participants in a list is inefficient and resulted in many missed opportunities as there was no efficient way to check up on the people who did not pick up the first time around. The contacts who did pick up were often times rushed and did not have time to listen to information regarding a study. There was also a lack of diversity in respondents in that the majority of HCFs contacted were hospitals rather than skilled nursing/rehabilitation facilities.

Another potential cause for the low response rate could be due to not being from the area and being an undergraduate student. Because of my position, I have little to no professional connections outside of the University. Because of that, there was no name familiarity connection when I sent my email which probably made it easily ignored. And finally, people may not consider food waste to be as problematic as it is, especially in an environment such as a hospital where everything is one time use and discarded.

For those who did start the survey but did not finish, one reason may be a lack of education of what AD/composting programs entail. The survey included no information regarding AD, and while composting is more widely understood, large scale composting may not be. This lack of understanding may have contributed to unanswered questions.

The survey could have been modified slightly at question 2 to include long term care/rehabilitation facilities.

The questions asked in the survey could have also been altered. The survey used was very broad. To get more detailed information, a different data collection survey should be used. For example, composting was listed as a method of food waste used by one HCF. to learn more, the survey could be modified to only encompass composting, what is being composting, how the facility manages it, what have they found successful or not and so on.

It would also be interesting to see if there is a correlation between an employee's education background and food waste. If a person is more skilled in reusing, storing, and prepping food, there may be less overall food waste. Another interesting direction could be quantifying food waste by weight from patient trays, cafeterias, and food on the floors. More direct questions should have been asked about where food is being sourced as well. Local versus food that is shipped in could affect the amount of food spoiled before it is even prepared for a meal.

Future Directions

This study is the first step in a longer process. The data used will help to identify barriers to efficient food waste disposal at HCF. The main purpose is to have data on food waste in a very specific institution: hospitals and healthcare facilities. Using this data, a similar study can collect more information. Once more data is amassed, different potential solutions can be addressed to hospitals. Implementation of composting or AD programs can be considered, and the results of those programs can be studied. This has

many future implications regarding how food is disposed of at HCFs on a large scale. A more successful study may be accomplished with a reward for completing the survey.

Conclusion.

Food waste is a multidimensional problem. This study was a limited start in understanding the different facets that make up food waste in healthcare facilities, as well as demonstrated how different factors in facilities such as cafeterias and room service can compound the problem. This study and the findings touched upon the importance of a solid understanding in food science that can impact how food is used in the HCF. Indeed, food has an important job in HCF, but when it is wasted it can contribute to the sickness of the world. Food waste needs to be curbed on a global scale Looking for industry specific solutions could lead to a future with less food waste.

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APPENDICES

APPENDIX A

CONSENT FORM

You will be asked to respond to a confidential electronic survey for a research study being conducted by Jen Goulding (undergraduate student) and Dr. Debbie Saber (Assistant Professor) in the School of Nursing. The purpose of the research is to collect some data about food waste and food waste practices in your healthcare institution. You must be at least 18 years of age to participate. This is the Phase II of a multiple phase study.

What Will You Be Asked to Do?

If you decide to participate, you will be asked to:

1. Read 25 survey questions and answer them using the responses provided. The survey will take approximately 15 minutes to complete.

Risks:

Except for your time and inconvenience, there are no risks to you from participating in this study.

Benefit:

While this study will have no direct benefit to you, this research may help us learn more about food waste in Maine hospitals

Confidentiality:

This is a confidentially distributed electronic survey and your name will not be on any of the data. Demographic data may identify participants; however, responses will be kept confidential and will be reported in aggregate form only. Your name or other identifying information will not be reported in any publications. The data will be kept indefinitely.

Voluntary:

Participation is voluntary. If you choose to take part in this study, you may stop at any time. You may skip any questions you do not wish to answer.

Contact Information:

If you have any questions about this study, please contact me (Dr. Saber) at (207-581-2553/Deborah.saber@maine.edu). If you have any questions about your rights as a research participant, please contact the Office of Research Compliance, University of Maine 207/581-2657 (or e-mail umric@maine.edu).

Your participation signifies consent to participate in this research project.

Thank you so much for your time!

APPENDIX B

Phone call script to obtain email address and recruit

Good Morning or Afternoon,

First, thank you for speaking with me. My name is Jen Goulding or Dr. Debbie Saber. I am an undergraduate nursing student or Assistant professor in nursing at the University of Maine. I am working with Jen Goulding (or I am working with Dr. Saber). We obtained your phone number from the healthcare institution directory and would like to confirm or obtain your email address. We are conducting Phase II of a multiple phase study concerning food waste and food waste diversion (such as composting) in healthcare institutions because we know that approximately 40% of all food is wasted in the United States. However, there is little known about the food waste in different industries such as health care.

During Phase I, we asked a few healthcare industry experts to help us create a healthcare food waste survey. During this Phase II, we will ask you to complete the 25-question survey to better understand Maine healthcare institution food waste and food Disposal.

If you would like to participate in this survey, we will send you an email with a consent form to read and an electronic survey link to the survey. The confidential survey consists of 24short answer and multiple-choice questions and will take approximately 15 minutes to complete.

Your participation is voluntary. If you choose to take part in this study, you may stop at any time. You may skip any questions you do not wish to answer. The data will be reported as aggregate and no data will be linked to you or your institution.

Your participation will serve as the consent to participate

Will you be willing to you provide your email address?

Thank you so very much for your consideration!

Jen or Debbie

APPENDIX C

Barriers to Hospital Food Waste: An Exploratory Study Survey
Bold indicates skip logic for survey flow

Q1 How many staffed beds are in your hospital?

○ 0-25

○ 26-50

○ 51-100

○ 101-250

○ 251-500

○ Over 500

Q2 What type of hospital?

○ Acute Care

○ Critical Access

○ Specialty Hospital

Q3 When was your hospital built?

○ Before 1940

○ 1941-1969

○ 1970-1989

○ 1990 or after

Q4 Has your hospital been updated since it was built?

○ No

○ Yes

Skip To: Q6 If Has your hospital been updated since it was built? = No

Q5 Was the kitchen of your facility updated/remodeled during the update of the facility?

○ Yes

○ No

Q6 What is your position in the hospital?

○ Nutritional Director

○ Nutritional Director/Environmental Service

○ Nutritional Manager

○ Other

Q7 How many years have you worked in your profession?

○ 0-5

○ 6-10

○ 11-20

○ Over 20

Q8 Do you have any formal education relating to food science?

○ No

○ Yes

Skip To: Q10 If Do you have any formal education relating to food science? = No

Q9 What is your educational preparation in the food industry? (select all that apply)

☐ Clinical dietitian

☐ Chef

☐ Culinary school

☐ Undergraduate degree in food science/nutrition

☐ Environmental science

Q10 How are meals prepared in your institution?

○ Kitchen staff

○ Pre-made outside of facility

Skip To: Q25 If How are meals prepared in your institution? = Kitchen staff
Skip To: Q26 If How are meals prepared in your institution? = Pre-made outside of facility

Q25 Made from scratch

○ Small amount

○ Less than half

○ Half the meals

○ More than half

○ All the meals

Skip To: Q11 If Made from scratch = Less than half
Skip To: Q11 If Made from scratch = Half the meals
Skip To: Q11 If Made from scratch = More than half
Skip To: Q11 If Made from scratch = All the meals
Skip To: Q11 If Made from scratch = Small amount

Q26 Pre-made outside of facility

○ Small amount

○ Less than half

○ Half the meals

○ More than half

○ All the meals

Q11 Do you have room service?

○ No

○ Yes

Skip To: Q13 If Do you have room service? = No

Q12 What type of room service is offered at your facility?

○ Custom order

○ Set menu

Q13 Do nutritional staff bring trays to the units/floors?

○ Yes

○ No

Q14 Do nutritional service department personnel remove food trays from patient care rooms after meals?

○ Yes

○ No

Q15 How do you dispose of food waste from patient trays? (select all that apply)

☐ Garbage disposal

☐ Trash receptacle

☐ Composting

☐ Anaerobic digestion

☐ Farm animals

Q16 What ways are you limiting food waste (such as donations, food pantry)? (select all that apply)

☐ Donations

☐ Food pantry

☐ Repurposing food (such as bread into croutons or using overripe strawberries in dessert)

☐ Given to staff with pigs, chickens, etc.

Q17 Do you have a cafeteria for visitors and staff?

○ No

○ Yes

Skip To: Q20 If Do you have a cafeteria for visitors and staff? = No

Q18 How do you dispose of food waste from the cafeteria/visitors/staff meals? (select all that apply)

☐ Garbage disposal

☐ Trash receptacle

☐ Composting

☐ Anaerobic digestion

☐ Farm animals

Q19 What is the procedure for discarding prepackaged cafeteria food that is not sold or the shelf life expires? (select all that apply)

☐ Garbage disposal

☐ Trash receptacle

☐ Composting

☐ Anaerobic digestion

☐ Farm animals

☐ Offered to staff

☐ Donation

Q20 What is the procedure for discarding prepackaged patient food on unit floors that expires? (Select all that apply)

☐ Garbage disposal

☐ Trash receptacle

☐ Composting

☐ Anaerobic digestion

☐ Farm animals

☐ Offered to staff

☐ Donation

Q21 Does your facility compost/anaerobically digest food waste?

○ No

○ Yes

Skip To: Q24 If Does your facility compost/anaerobically digest food waste? = Yes

Q22 Would you ever consider anaerobic digestion/composting at your facility?

○ Yes

○ No

Q23 What do you see as barriers to starting a composting or an anaerobic digestion program in your facility? (select all that apply)

☐ Someone to run the program

☐ Time to set up the program

☐ Space for the holding containers

☐ Cost of the service

☐ Odor of the food

☐ The weight of the totes once filled

Q24 If your facility has isolation patients, do you treat the food waste from these individuals different from those patients who are not in isolation?

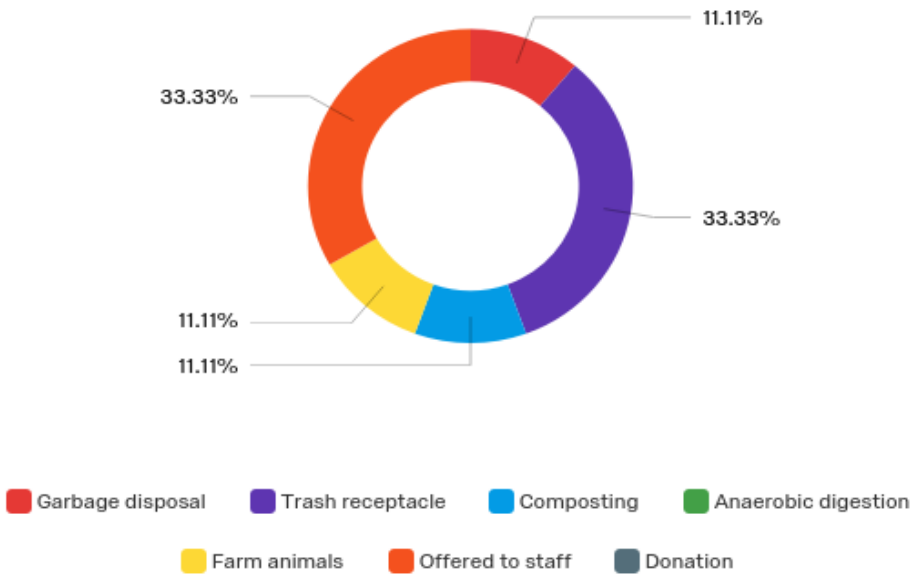
○ Yes

○ No

○ No isolation patients stay at this facility

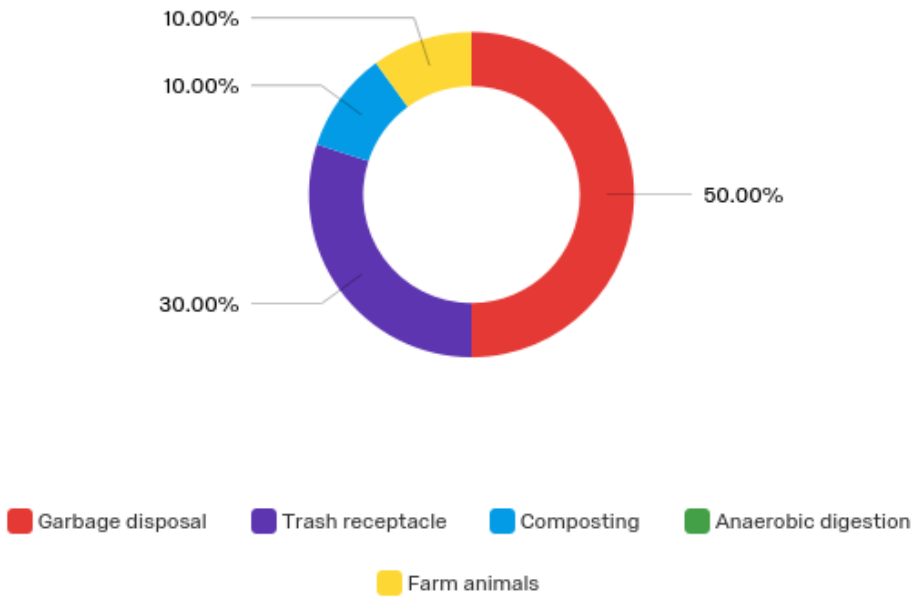
APPENDIX D: QUESTION 19

What is the procedure for discarding prepackaged cafeteria food that is not sold or the shelf life expires? (select all that apply)



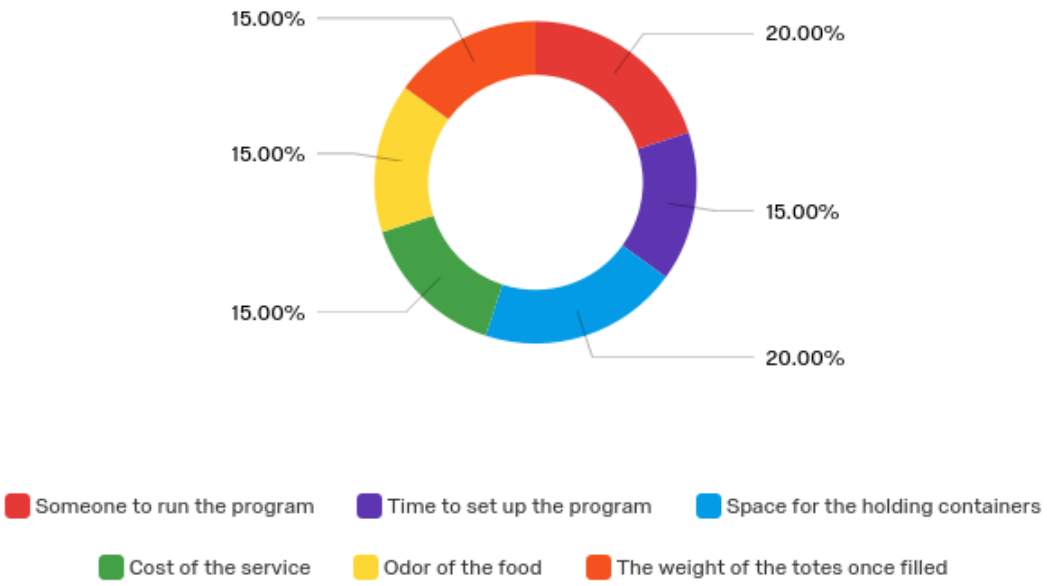
APPENDIX E: QUESTION 15

How do you dispose of food waste from patient trays? (select all that apply)



Appendix F: Question 23

What do you see as barriers to starting a composting or an anaerobic digestion program in your facility? (select all that apply)



AUTHOR'S BIOGRAPHY

Jennifer was raised in Groton, Massachusetts. Her childhood was spent skiing mountains all across New England, her favorite being in Maine. Because of that, Jennifer chose to pursue nursing in snowy Maine. During her college career, she began the fiber arts club with her fellow freshman roommates and neighbor which lasted a couple of years. She worked in the tutoring center and helped support her fellow students in chemistry and anatomy and physiology. Many of the students she worked with were fellow nursing students and she truly enjoyed her experience as a tutor. She was also a part of Operation Hearts, Orono Student Nurse's Association, Gift of Life, and Nursing Honors Society Sigma Theta Tau. She is incredibly excited to begin her nursing career at Dartmouth-Hitchcock Medical Center as a perioperative nurse after graduation and cannot wait to see what else lies in her future!