Pūhau ana te rā: Tailwinds

Abstract

This research project explored solutions for food waste reduction and mitigation across Te Whatu Ora / New Zealand Public Hospital systems. Directly relating and supporting Sustainable Development Goal (SDG) 12.3, to halve global food waste at consumer and retail levels by 2030. This research was done by analysing appropriate literature exploring food and organic waste management strategies in national and international hospital service sectors and systems, further using the Food Recovery Hierarchy as a framework, which ranks the effects of these strategies when looking at them financially, environmentally and socially. Furthermore, this research looks at the barriers and enablers of the suggested organic waste management strategies. A food waste audit was conducted at Dunedin Public Hospital to assess and quantify the current organic waste within the system. The audit method was developed using the Food Loss and Waste Protocol Waste Composition Analysis Guide. The key questions of this study are: How do we prevent organic waste in the first place (preparation strategies)? What can we do with the organic waste produced to prevent it from going to landfills? What items in the food system are the most wasted? How much Greenhouse gas (GHG) is produced by this organic waste going to landfill? Organic waste produces methane, occupies land mass and has the potential for groundwater contamination. Ten per cent of total global GHG Emissions come from food waste, 22% of which is occurring at the consumption level. The key impact of this research is to mitigate organic waste going to landfills to reduce further climate change, thus benefiting environmentally, socially and economically.

Introduction

Hospitals typically have a variety of food services, from cafes and retail to kitchen and service, all catering to a large number of patients. Thus, there is high potential for food waste, which provides us with a unique position of solving this large-scale issue, saving the hospital money and enabling better nutrition. Moreover, reducing landfill quantities and benefiting carbon reduction targets such as Sustainable Development Goal (SDG) 12.3 to "halve global food waste at consumer and retail levels by 2030" (UN, 2015). This article will firstly outline the large issue of food waste at consumption level. Secondly, the method of the study will be detailed, followed thirdly, by the results of the study. Fourth, the article will have a discussion of the economic factors, environmental factors and barriers. The final section before the conclusion contains the recommendations including a section for prevention and then post waste solutions.

There are vast economic losses with food waste in the hospital context. According to Carino et al, 2020, several studies estimated the economic cost of this food waste ranged from NZD$1.7 to NZD$4.4 for plate waste per patient/day. The average plate waste to create this economic loss was 447g/patient/day, generally being 20-30% of the total waste (Carino S. , Porter, Malekpour, & Collins, 2020). Food sectors could see a 14-fold return on investment if they introduce food waste reduction measures (NZ Food Waste Champions 12.3, 2023). Furthermore, reducing food waste benefits socially, with one in nine people undernourished globally, and redistributing food through food rescue charities significantly assists people who face food insecurity (FAO UN, 2020). According to the FAO, in 2011, one-third of food produced for human consumption is lost or wasted, amounting to 1.3 billion tonnes of food waste every year globally (FAO UN, 2011). In 2021, it was estimated that global food waste rose to 40% of food produced for human consumption, amounting to 2.5 billion tonnes of food waste per year (WWF UK, 2021). The environmental effects of this food waste occurs at landfill where it produces methane which is 25x more potent than CO_2, occupies land mass and has the potential for groundwater contamination. Moreover, wasting food at the consumption level wastes emissions, energy, water, money and labour from the production and preparation levels as it moves through the supply chain. Reducing food waste is ranked as the third-best global solution for addressing climate change, this is because of the resources wasted as well as emissions produced and production and landfill (Project Drawdown, 2021). For every tonne of food sent to a landfill in Aotearoa, around 0.6 tonnes of CO_2 equivalent (CO_2e) are released, based on 2020 calculations (Ministry for the Environment, 2022). With 10% of total global Greenhouse Gas Emissions coming from food waste (4.4 gigatonnes of CO_2 equivalent every year), 22% of which is occurring at the consumption level, the key impact of this research is to mitigate and prevent organic waste going to landfill to reduce further climate change, thus creating a benefit

environmentally, socially and economically (Ministry for the Environment, 2022). Due to the nature of hospitals with their various catering services, there are multiple opportunities for different food waste prevention methods and reduction initiatives. This further relates to SDG Goal 12, with target 5 being to "Substantially reduce waste generation through prevention, reduction, recycling and reuse, by 2030" (UN, 2015).

Some barriers to reducing food waste may be available funding, lack of resources, physical space and attitudes towards motivation and awareness (Cook, Goodwin, Porter, & Collins, 2022).

Method:

Audits of the food waste were conducted. Due to the nature of the hospital and its time schedule, the audits only included plate waste (what is left on the plate after a patient has eaten). It included breakfast, lunch and dinner waste over a two-week period, covering a complete bi-weekly menu rotation. The aim of this audit was to measure the organic/food waste generated in the wards and post-ward waste (plate waste) at the Dunedin Public Hospital. A waste composition analysis was undertaken, which is a process of manually separating, weighing and categorising waste. Results can be used to determine both total amounts of food loss and waste and to categorise the different types of foods that have been discarded (e.g. carbs, vegetables, meat), or to distinguish between food and inedible parts. The food was divided into as precise a category as possible (e.g. peas, beans, carrots) as this enabled the categories to be grouped further in the analysis of the data, whereas the categories could not be broken down further once the audit was completed. Both edible and inedible components of food are in scope because inedible parts of food (e.g. bones, corn husks, grape marc) contribute to the environmental harms associated with food waste (e.g. methane release upon decomposition) and opportunities exist for better utilisation of this waste stream. In addition, there is considerable cultural, demographic, and individual variation around what is considered inedible (e.g. different practices relating to potato skins, apple cores, kiwifruit skins, fish heads, etc) (Teigiserova, Hamelin, & Thomsen, 2020).

The chosen protocol was developed using the Food Loss and Waste Protocol: Waste Composition Analysis Guide and was selected due to its high recognition. The audit process initially involved a discussion of logistics with the kitchen manager such as understanding kitchen layout and meal preparation and post-meal cleaning, and a further area for the auditor to set up, and time of audit (days and times). Following this, asking the kitchen staff about how many patients/customers attend each meal, frequency of bin filling, and weekday/weekend variation. The auditor will set up on the conveyor belt where the plate waste is usually binned. There will be multiple buckets for collecting

all the different categories of food. The food will be scraped off the plate into the buckets as accurately as possible.

An ethics report was conducted and sent to the institute which was signed off for the following data to be presented in this journal article as well as sent to the retrospective staff overseeing the study at the Dunedin Public Hospital and New Dunedin Hospital to analyse and act accordingly with.

Results:

Date	Breakfast Total (Kg)	Lunch Total (Kg)	Dinner Total (Kg)	Day total (Kgs)	Plate waste per plate (g)	Total average plate waste per patient (g)
Day 1	21.04	30.66	46.22	97.92	129.524	388.571
Day 2	19.64	26.18	9.46	55.28	64.056	192.167
Day 3	53.94	28.22	8.58	90.74	109.457	328.372
Day 4	30.62	47	30.72	108.34	138.897	416.692
Day 5	33.3	21.62	41.16	96.08	135.515	406.544
Day 6	28.82	43.02	29.28	101.12	140.641	421.919
Day 7	24.69	38.1	32.08	94.87	134.377	403.13
Day 8	23.5	53.34	43.96	120.8	155.271	465.811
Day 9	28.3	31.74	47.08	107.12	133.911	401.711
Day 10	33.52	30.28	41.78	105.58	141.528	424.584
Day 11	27.02	38.08	41.86	106.96	136.603	409.808
Day 12	23.08	32.08	33.86	89.02	115.611	346.831
Day 13	30.04	43.96	8.1	82.1	114.028	342.083
Day 14	28.26	31.34	46.62	106.22	154.165	462.496
Totals	405.77	495.62	460.76	1362.15	1803.571	5410.709
Average (daily)	28.98	35.4	32.91	97.31	128.826	383.153

Figure 1: Raw data of the plate waste audit

Average total Kgs: **97kgs**

Average per patient/ breakfast : **122g**

Average per patient / lunch : **133g**

Average per patient / dinner : **128g**
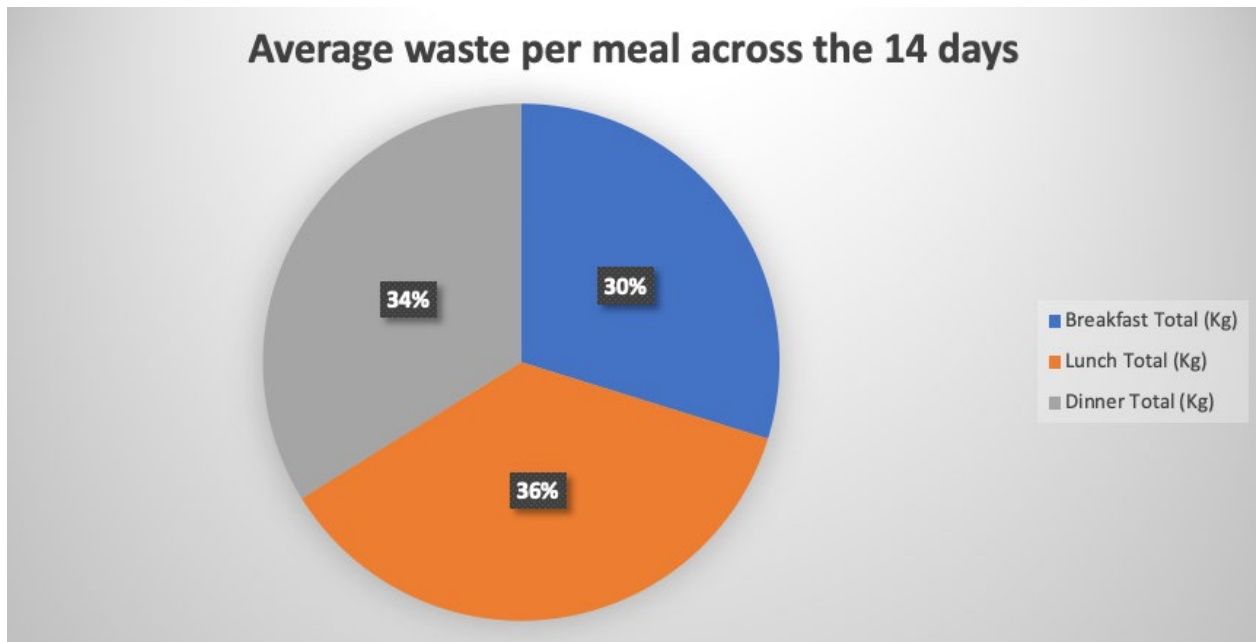
Average per patient / per day : **383g**

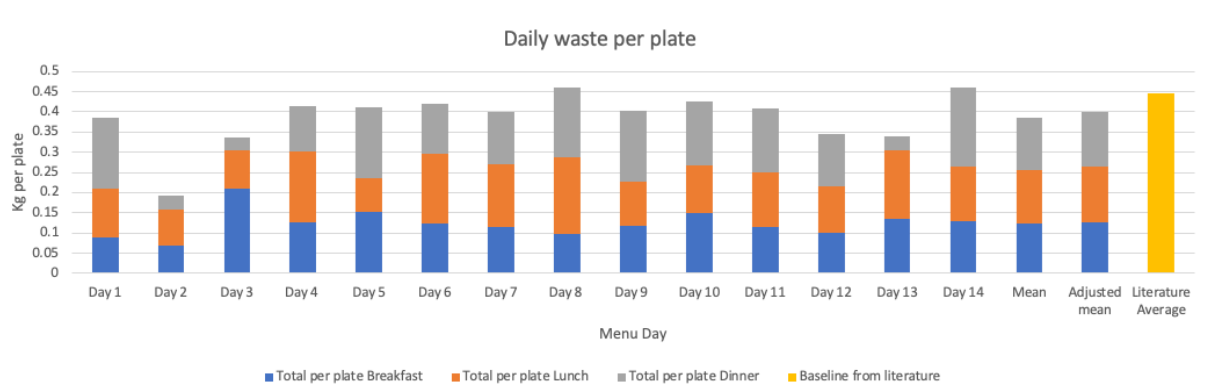Figure 2: Average waste per meal .

Figure 3 : Daily waste per plate categorised by breakfast, lunch and dinner.

Figure 3 depicts the daily breakdown of breakfast, lunch and dinner waste, followed by the daily Dunedin Public Hospitals food waste mean. The adjusted mean is due to the anomaly of Day 2. Day 2 had an exceptionally low dinner waste and was the lowest day overall. I have treated this as an outlier. The reason for this outlier is unknown, but could be due to many reasons such as waste may have been disposed of prior to auditors arrival.

The right-hand column of Figure 3 is the Literature Average, this compares the Dunedin Public Hospitals food waste levels with that found of hospitals internationally in the literature. The literature average was 447g per person per day compared with the Dunedin Hospital mean of 383g per patient per day. However, the single biggest day for the Dunedin Public hospital exceeded the international average by 20g.
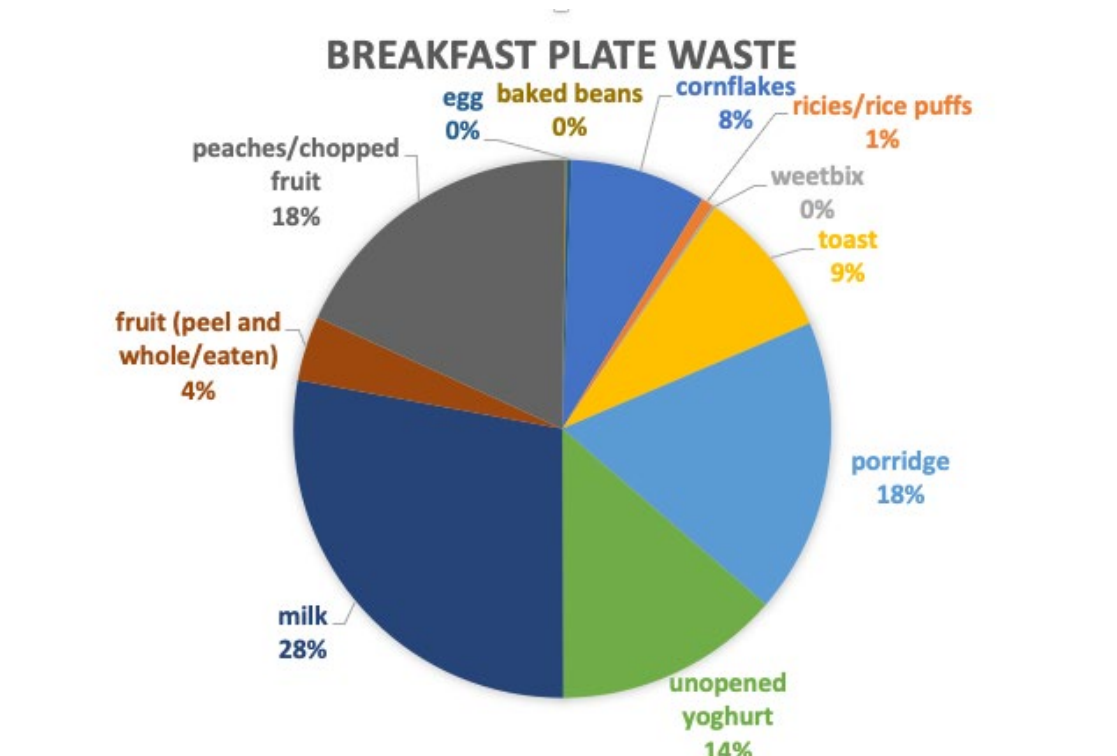
BREAKFAST PLATE WASTE

Figure 4. Breakfast plate waste, across two weeks

Breakfast: 405.77kgs across the two weeks

Total per patients per day for breakfast was 122 grams

The highest wasted food for breakfast was milk at 28% which totalled 114kg over the two weeks, followed by porridge and chopped fruit both at 18%, weighing a total of 73kg, fourth largest waste was unopened yogurts at 14%, weighing 55kg. However, if we were to group the categories into dairy, carbohydrates and fruit, dairy would be the most at 42%, followed by carbs at 36% and fruit only 22%.
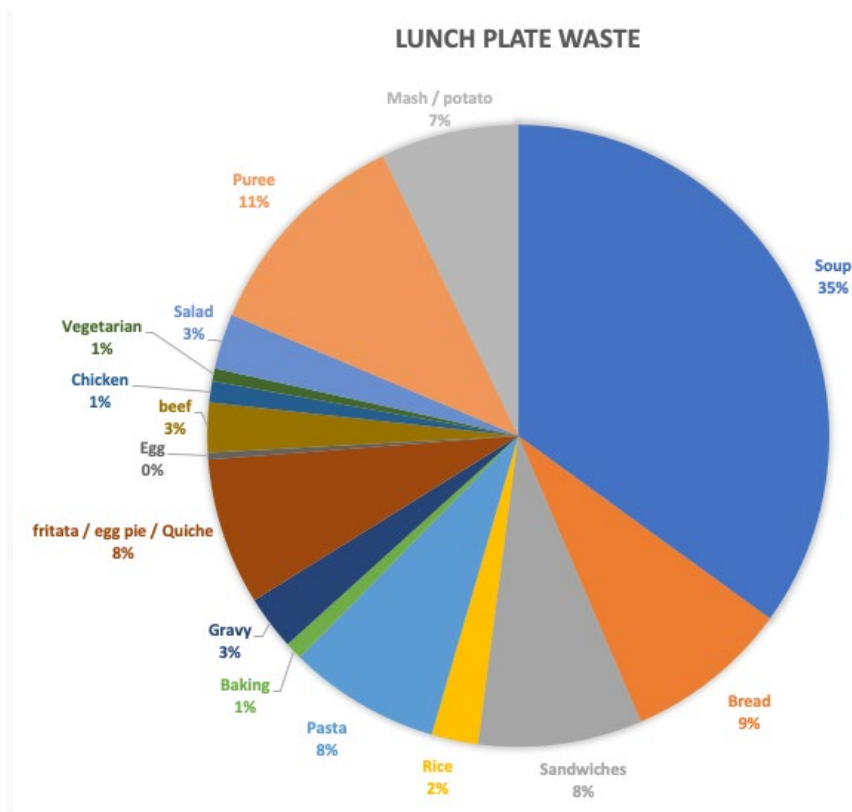
Figure 5. Lunch plate waste, across two weeks

Lunch: 495.62kgs across the two weeks

Total per patients per day for lunch was 133 grams

The highest wasted food for lunch was soup at 35% which weighed a total of 154kg across the two weeks, this was followed by purée at 11%, weighing 51kg, third was bread at 9% which was served with the soup and weighed 38kg, and fourth was equally sandwiches, pasta and frittata at 8% at around 35kg. However, if we were to group the categories into soup, mains (meat or eggs) and carbohydrates, soup would still be first at 35%, however, carbs would then equal 34% with mashed potato, pasta, rice, sandwiches and bread. Mains equalled 13%, with the meats and eggs.
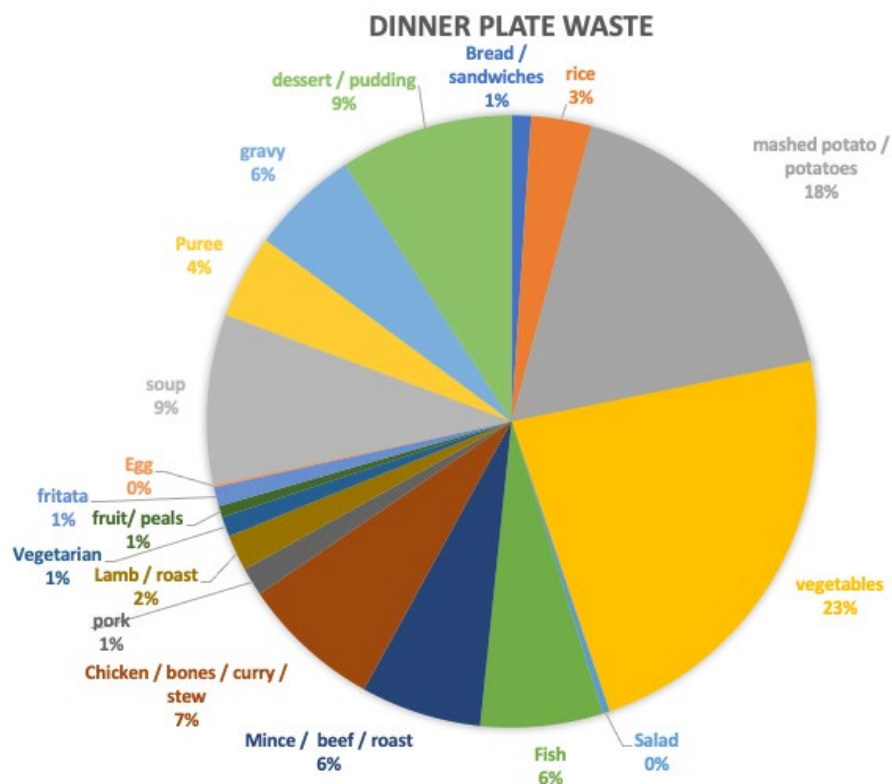
DINNER PLATE WASTE

Figure 6. Dinner plate waste, across two weeks

Dinner: 460.76kgs across the two weeks

Total per patients per day was 128 grams

The most wasted food at dinner was in fact meat, when all the different categories are added up this equals 24%, this weighed a total of 109kg across the two weeks. Close second to meat was vegetables at 23%, weighing 105kg. Third most wasted at dinner was mashed potatoes at 18%, weighing 81kg, however if this was put as a carbohydrate category it would equal 22% with bread, sandwiches and rice included. Fourth was equal at 9% for dessert and soup at around 42kg.

Discussion:

The approach this research will use was developed by the United Nations Environment Programme FAO, namely the 'Target, Measure, Act' approach. This approach, as the name suggests, is to set formal food waste reduction goals in line with SDG 12.3 (Target), regularly measure food waste, to get the waste baseline and further understand where it is occurring and what causes it (Measure) and put actions into place to reduce food waste by scoping what interventions are appropriate (Act). This approach has proven to be successful in reducing food waste in the United Kingdom, reducing

food waste per capita by 27% over 11 years, meaning they are the first in the world to have advanced more than halfway towards SDG 12.3 (FAO UN, 2020).
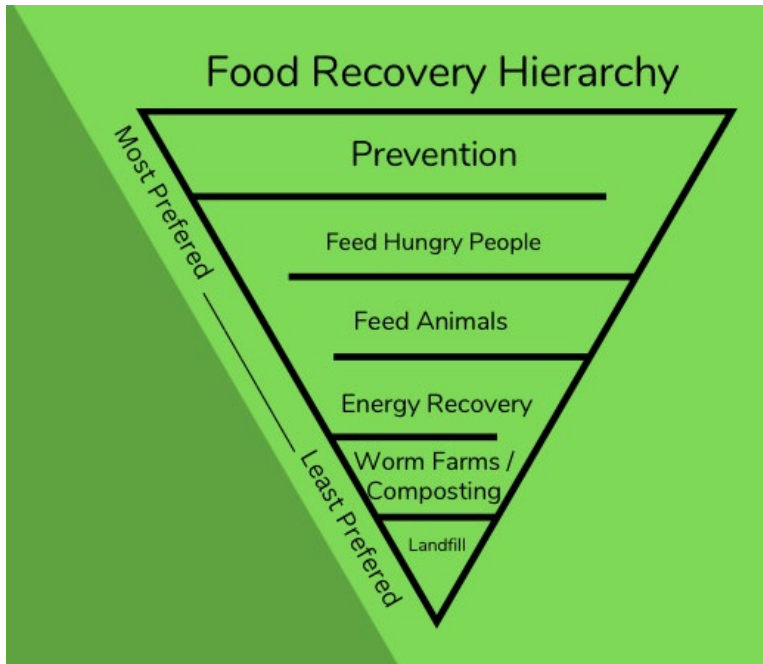

Figure 7. Modified version of The EPA's Food Recovery Hierarchy

Furthering this, we will be incorporating the Food Recovery Hierarchy, modified by Teigiserova, Hamelin, & Thomsen and Moshtaghia et al, as a framework to guide this project, firstly to prevent waste and secondly to keep materials in circulation for as long as possible in their highest valued form (Office of the Prime Minister's Chief Science Advisor, 2022). The Food Recovery Hierarchy is a modified version of the standard Waste Management Hierarchy. Both of these hierarchies ultimately aim to create a circular economy by closing the linear take-make-use-waste system to loop the use of materials enabling a regenerative and sustainable system without the incorporation of waste (Teigiserova, Hamelin, & Thomsen, 2020)

Long before the development of the food recovery hierarchy and circular economy frameworks, sustainable and regenerative relationships with te taiao have been central to te ao Māori, providing insights that are pertinent to combatting food waste in Aotearoa. A relational, holistic, and intergenerational view of environmental stewardship and insights from mātauranga Māori will be embraced throughout the project (Office of the Prime Minister's Chief Science Advisor, 2022).

When analysing the Food Recovery Hierarchy the most important measure is to prevent food waste in the first place (EPA, 2022). This can firstly be done by understanding the reasons for food waste. Barriers to adequate food intake are multifaceted and complex and require multiple interventions. According to Cook, Goodwin, Porter, & Collins, 2022 and Williams & Walton, 2011, there are three key components that deter inadequate food intake and thus food waste prevention, firstly, patient-

related factors, second, the food service model and third, the hospital environment (Cook, Goodwin, Porter, & Collins, 2022) (Williams & Walton, 2011). Patient-related factors include their health status and length of stay, patient appetite, expectation and satisfaction of food quality and quantity, the meals' appearance, portion size and taste, and the variety of choices on the menu. Foodservice model includes the inability to provide certain therapeutic diets, the inability to forecast expected meal numbers, food service type and kitchen design, large gaps of time between food ordering and consumption, the continual provision of excess or incorrect items, poor food quality, and limited menu choices. Hospital environment factors include service interruptions, inappropriate meal times and unpleasant patient surroundings. According to these studies, the most common reasons for inadequate food intake are first, loss of appetite (40-50%), secondly, meal quality (27%), and third, portion size too large (19%) (Cook, Goodwin, Porter, & Collins, 2022) (Williams & Walton, 2011).

Current state:

Over the Otago region, it was recorded in 2020 that organic waste accounted for 55.3% of total kerbside waste, with 32.9% (16,827 tonnes) of that being kitchen waste (Wilson, Eve, Middleton, Bould, & Van Gool, 2022). The current Dunedin Public Hospital only has a landfill stream for food waste. The New District Hospital plans on implementing a food and green waste stream.

Economic factors:

According to Carino et al, 2020, several international studies estimated the economic cost of this food waste ranged from NZD$1.7 to NZD$4.4 for plate waste per patient/day, this equates to NZD$90,960 to NZD$342,449 lost per year. The average plate waste from this literature created an economic loss of 447g/patient/day, generally being 20-30% of the total waste (Carino, Porter, Malekpour, & Collins, 2020). Based on this study from Carino, et al, 2020, using the Dunedin Public Hospital figure of 383g, the cost of food waste per patient/day would be in the middle of the literature range of NZD$1.7 - NZD$4.4. This figure multiplied by 260 patients over a year would equate to a loss of NZD$300,000 each year to food waste. Furthermore, a Portuguese case study found 0.5% of the Portuguese health budget is thrown away as hospital food waste, that being 35.3 million euros, however, this was on average a loss of 953g/patient/day (Dias-Ferreira, Santos, & Oliveira, 2015). Food sectors could see a 14-fold return on investment if they introduce food waste reduction measures (NZ Food Waste Champions 12.3, 2023).

Environmental factors:

For every tonne of food sent to a landfill with gas capture in Aotearoa, based on 2020 calculations,

around 0.6 tonnes of CO2 equivalent (CO2e) are released (Ministry for the Environment, 2022). Using this calculation, the total food waste in the hospital per year is 35,415.692kgs (35.4 tonnes), therefore, 21,249.577kgs (21.2 tonnes) of CO2 equivalent are produced annually through food waste at the Dunedin Public Hospital. The emissions created by the hospitals food waste is the equivalent to driving 100,000 km in an average car, annually. To remove 21.2 tonnes of CO2e from the atmosphere, it would take 314 native trees and shrubs growing for 20 years. This does not include the production emissions, to grow, produce, transport and manufacture this food.

Barriers:

In a hospital setting, food waste involves many people including suppliers, food service staff, hospital staff and patients. Therefore, there are a lot of potential contributing personnel. A study by Goonan (2013) analysed how the implications of food waste are perceived differently by different levels of staff in hospitals. Managers raise discussion from a financial perspective, meanwhile, the kitchen staff drew upon financial and social implications. Overall, there was minimal discussion about the environmental consequences of food wastage (Goonan, 2013). Attitudes, habits and previous work experience of food service personnel are also discussed as influential factors in waste generation (Goonan, 2013).

Anecdotally there was some staff who had a negative response to the presence of the auditor. No formal survey of staff attitudes was undertaken, as this fell outside the scope of this project. A further study should be done to analyse the attitudes, behaviours and habits of the hospital staff to understand the effects this has towards food waste. Furthermore, the physical space is a limiting factor in the current hospital for the likes of extra bins. However, it was possible to not put the food in the landfill bin as demonstrated when auditing the food.

Recommendations:

Prevention:

According to Goonan, 2013., most food waste occurs during service and as a result of overproduction due to inconsistency during portion control, forecasting challenges and the unpredictable nature of the hospital environment (Goonan, 2013).

One key finding for food waste prevention in Hospitals was changing the food service model to a 'room service model' (Carino, Porter, Malekpour, & Collins, 2020) (Williams & Walton, 2011)

(McCray, Maunder, Krikowa, & MacKenzie-Shalders, 2018). This is where food is freshly cooked to order anytime between 7 am - 7 pm and delivered to the patient. A shorter time between ordering food equates to less food being wasted, reducing up to 30% of food waste using this room service model (Wageningen Food & Biobased Research, 2019). This food service model is internationally recognised as the best practice for food waste reduction (McCray, Maunder, Krikowa, & MacKenzie-Shalders, 2018). McCray et al (2018) did a study of Mater Hospital in Brisbane, introducing room service and reported a 15% food cost reduction and a reduction in plate waste from 29% to 12%. Nutrition outcomes, based on energy and protein consumption also improved significantly as did various measures of patient satisfaction (McCray, Maunder, Krikowa, & MacKenzie-Shalders, 2018). Similarly, food waste has been reduced at Mercy Hospital in Dunedin since the introduction of the room service model, with food costs reduced by an average of 14% and plate waste reduced from 30% to 10% (McCray, Maunder, Krikowa, & MacKenzie-Shalders, 2018). Mercy Hospital did state that this model requires a lot more planning, a different kitchen set up and systems as well as more staff. However, with the figures above, this remains one of the most impactful changes to reduce food waste.

Computerising the food systems for counting meal numbers to help with forecasting and precision of numbers (Goonan, 2013). Dunedin Public Hospital has already implemented a computerised food system to some extent.

It has been observed that almost half of food waste is created through portioning (Wageningen Food & Biobased Research, 2019). Some case studies have exemplified and suggested smaller plates or alternatively having staff training on portion sizes (Health care without Harm, 2016) (Goonan, 2013) (Williams & Walton, 2011). An option of choosing small, medium or large portion size when ordering could also benefit plate waste, this also has been implemented at the Dunedin Public Hospital.

When discussing with the kitchen staff the issue of food waste and untouched meals, many exclaimed that the nurses are responsible for ordering excess meals for patients who have already left. Thus, there would need to be some retraining or a change of mindset for the nurses on the wards with food waste and ordering systems.

In this study vegetables were the highest wasted food at dinner. Often there was one of the vegetable options left e.g. beans. I would suggest allowing further choice of what to include / exclude with each meal. Additionally, breakfast waste had milk as one of the highest wasted food options, thus I would suggest the deliverer of the food would introduce a jug of milk to pour for the patient rather than individual milk containers. Following that, the unopened yogurt waste is also a high contributor. Therefore, I would suggest having it as a self-service yogurt table, or optional with your milk, from the catering staff.

On the waste hierarchy, second to prevention is re-use. Similarly on the food waste hierarchy, second to prevention is feeding hungry people. There are many different ways surplus edible food can be reused by hospital food services such as incorporating it into different dishes, making it available to staff, or donating it to food rescue organisations (Cook, Goodwin, Porter, & Collins, 2022). Furthermore, selling it to hospital visitors and staff may result in increased patient-family interaction, reduced food waste, and a financial return (Ofei, Holst, Rasmussen, & Mikkelsen, 2014).

My final suggestion would be to implement the "Target, Measure, Act" approach, which was developed by the UN Environment Programme FAO. It includes setting formal goals, regularly measuring food waste and putting actions into place. Some goals made through measuring or regularly auditing would be to reduce the daily average from 97.3 kgs down to 80kgs, then 70kgs, etc. This would ultimately halve the amount of food waste to align with SDG Goal 12, with target 3 aiming to "halve food waste per capita", furthermore, target 5 being to "Substantially reduce waste generation through prevention, reduction, recycling and reuse, by 2030".

Food Waste Reduction Plan

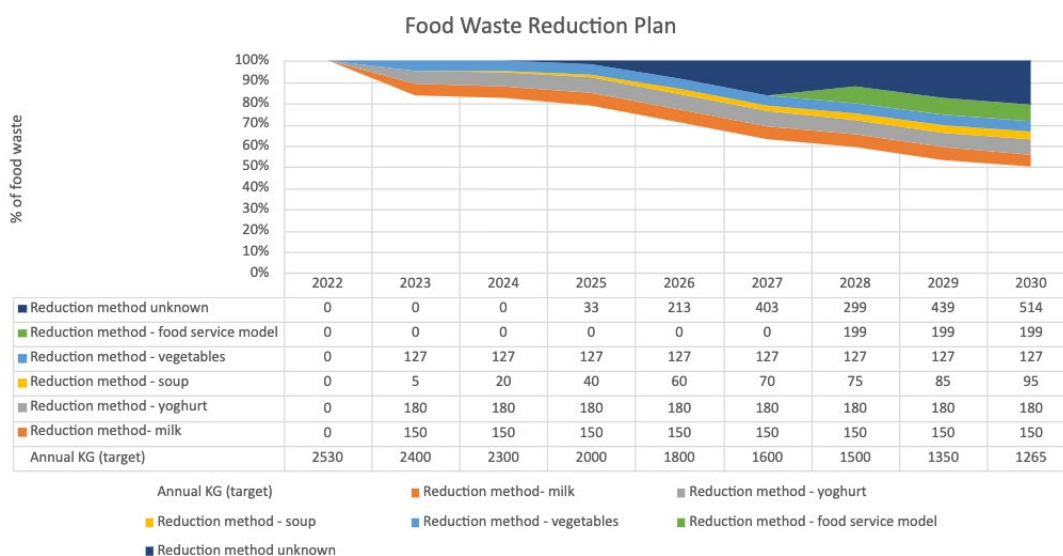|	2022	2023	2024	2025	2026	2027	2028	2029	2030
Reduction method unknown	0	0	0	33	213	403	299	439	514
Reduction method - food service model	0	0	0	0	0	0	199	199	199
Reduction method - vegetables	0	127	127	127	127	127	127	127	127
Reduction method - soup	0	5	20	40	60	70	75	85	95
Reduction method - yoghurt	0	180	180	180	180	180	180	180	180
Reduction method- milk	0	150	150	150	150	150	150	150	150
Annual KG (target)	2530	2400	2300	2000	1800	1600	1500	1350	1265

Figure 8. Food waste reduction plan graph by percentage

The reduction starts at 2023, until 2030. Starting with an annual plate waste total of 2530kgs in 2022, the Dunedin Public Hospital should aim to reduce this by 50% to 1265kgs. The opportunity for the food service model to come into fruition could happen in 2028 when the new hospital is built. The reduction methods of vegetable choice, yoghurt and milk delivery are constant as they can instantly reduce food waste once installed, which can happen this year. The soup will slowly be instigated as the menu will become refined and be of better quality with further testing. However, there is still roughly 20% of unknown reduction left by 2030 with all these proposed reduction methods. If this 50% reduction is achieved, the Dunedin Public Hospital will be able to halve the food waste costs by 50% also, saving roughly $150,000. Attitude by management and staff could result in greater reduction.

Post-Waste Solutions:

Cook et al (2022) studied 85 international hospitals' alternatives for food waste to landfill, using the food recovery hierarchy as a base. The following results of chosen alternatives to landfill waste put in order of the food recovery hierarchy were to donate food (21), feeding animals (2), Industrial use / anaerobic digestion (11), Composting (34), and Other (17). The only barrier found in this study was having contaminated waste streams, while some of the benefits included a reduction in hauling fees, a reducing in staff handling waste and most importantly decrease in the amount of waste sent to landfill (Cook, Goodwin, Porter, & Collins, 2022).
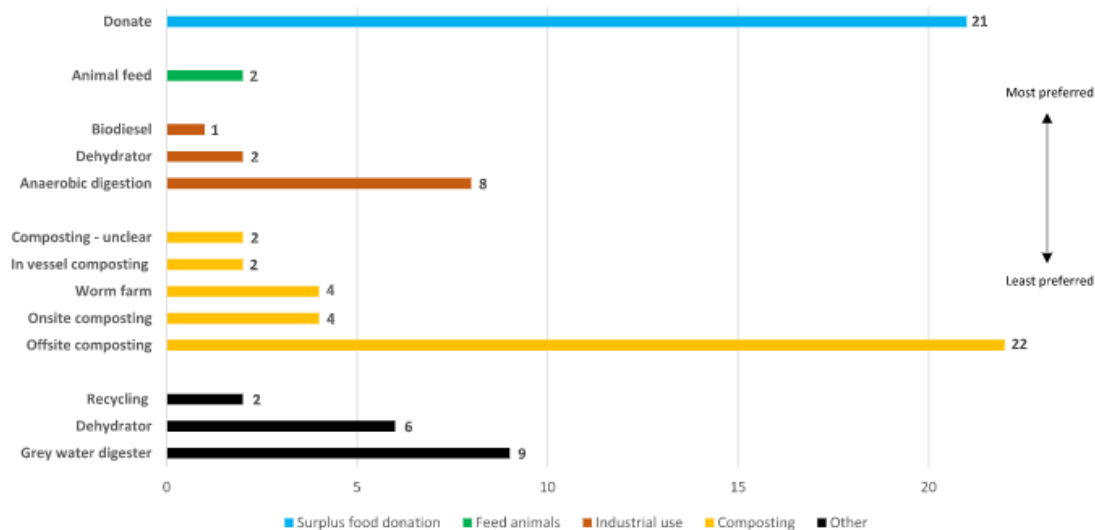

Figure 9. The number of food and food-related waste management strategies used in hospital food service settings according to their position in the food recovery hierarchy (Carino, Porter, Malekpour, & Collins, 2020)

Additionally, other case studies have demonstrated their success with vermiculture and vermicomposting at an industrial scale on-site, both here at New Zealand hospitals and in Australia (Kristiana, Nair, Anda, & Mathew, 2005) (Whiteland, 2018) (McCray, Maunder, Krikowa, & MacKenzie-Shalders, 2018). An on-site Worm farm in a hospital in South Auckland took in all 400kg of food waste from plate scrapings (plate waste) produced daily (Whiteland, 2018).

Two of the top options are not viable with the health and safety regulations of New Zealand, donating food and feeding to animals. However, if this were to come possible I would suggest using KiwiHarvest, Footprint for cafes, Havoc Pig Farms and potentially chicken farms.

Some viable suggestions are anaerobic digestion using Ecogas in New Zealand. This would mean it would need to be shipped away to the North Island which has its own footprint, furthermore needing to have appropriate storage for the transportation of this waste. Furthering this, there may also be a cost to ship or sign up to this partnership. This company was contacted, however, didn't get back.

However, for the top recommendation, I would recommend composting either onsite or offsite. Offsite, the Hospital could team up with the Dunedin City Council and their green waste initiative which is incoming, for more information the DCC will need to be contacted. The option for onsite is either EcoStock or Joraform 'big pig' rotational composter. EcoStock was contacted, but didn't get back. The Joraform has recently been installed at Mercy Hospital in Dunedin (18 months) and takes roughly 30 L of their waste (they have a very low amount of waste due to their food service model). The bin size is, however, 270 L, and looking online there is also 400 L composting units available. Looking further into the 400 L unit, it states to process up to 80 L per week, therefore, I would suggest purchasing this as well as the 270 L unit to withstand the Dunedin Hospitals 97kgs of weekly waste. It's insulated, therefore, it gets quite hot and can compost a variety of scraps, including cooked foods, meat, dairy, even compostable coffee cups. It's pest proof and is easy to turn and aerate. It is recommended to do a six week cycle. A 400 L Joraform composter costs $2,795, while the 270 L bin costs $895. However, the only downfall they have stated is it can smell in the early stages of breaking down, therefore, is positioned away from people. Furthermore, there will need to be a garden to use this compost on.

The last suggestion for a post-waste solution would be to have either onsite or offsite worm farms or vermicomposting. Onsite worm farms have been demonstrated to be successful operation at Mercy Hospital in Dunedin, which have been in operation for about six years. However, these worm farms

only taking 8 L of Mercy Hospitals food waste as they also have a rotational compost. Mercy Hospital stated that it produces very high quality fertilizer. WormsRus provides onsite commercial worm farms as pictured in the image below (Figure 10). WormsRus was contacted, but didn't get back. An offsite vermicomposting option is Central WormWorxs in Cromwell, which it will need to be stored and transported to. This company was contacted, however, didn't get back. Comparatively, there was communication with MyNoke. This year MyNoke will introduce an organic waste collection for businesses in partnership with Waste Management for Dunedin City. They provide the collection service and do the contracting while MyNoke farms receive and process the organic waste dropped off by them to feed the worms. This has been successfully piloted in Hamilton. For the Hamilton service, MyNoke offers Worm Food Bins, being 140 L wheely bins, collected weekly by Waste Management. Each bin is $28+GST including collection drop-off etc. MyNoke are, however, looking at increasing the frequency of pick up due to increased demand and also offering an alternative volume option such as a hook bin for larger volume requirements. The average weight created by Dunedin Public Hospital is well within this range. Attached below is the Worm Food Bin Menu outlining what can go into the bins. As you will see it offers a wide variety of waste materials that normal worm bins do not. Not only food waste (including meat, eggshells, small bones, all citrus, and onion peels), but worm approved non-PLA and PFAS coffee cups and lids, kitchen paper towels, bathroom paper handtowels, bamboo cutlery and dishes, and flattened carboard and fibre packaging (with staples and tape removed). Thus, expanding the hospitals recycling range. With your waste coming to a MyNoke farm, the volume is broken down by 80% leaving pure premium Aa grade Vermicast making up the last 20%. This product then goes back into New Zealand soils enriching them and completing a full environmental circular economy – Soil to Soil (MyNoke, 2023).

Figure 10. WormsRus Worm farm bins exemplified at Opotiki District

Conclusion:

Organic and food waste is a wicked problem, having multiple streams and no one answer (Närvänen, Mesiranta, Mattila, & Heikkinen, 2020). As demonstrated through the audits and graphs there are multiple streams of food waste with no one particular source. There are multiple reasons for food waste such as ordering systems, appetites, appearance and quantity, to name a few. However, as described above, there are some prevention methods to counteract this food waste in the first place such as food service model, catering staff inputs, further choice and serving sizes. Furthermore, it's crucial to change the model of waste disposal from landfill as this is hugely environmentally, economically and socially impactful. The suggestions suitable for the Dunedin Public Hospital are either worm farms and/or composting, both commercial or onsite. This will drastically help work towards the Sustainable Development Goal 12.3, to half consumer food waste by 2030. This study highlighted two further areas requiring research. Firstly, the potential barriers to preventing and reducing food waste posed by attitudes, behaviours and habits of the hospital staff. Secondly, addressing the food service costs at the production level, as this study is focused on waste at the end of the supply chain. Changing the food service model to a room service model indicated a 14-15% food cost saving at the production level of the food service. Overall, there are vast opportunities for combating food waste within the hospital setting; All of which will ensure a cleaner, greener and more sustainable future for all.

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Appendix

MyNoke information of waste cycle (MyNoke, 2023)

Figure 12. MyNoke information on appropriate waste (MyNoke, 2023)