

Factors influencing the occurrence of food waste in the food service process in hospitals – a literature review

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ABSTRACT

Purpose: Food waste is a current and very important topic everywhere food is produced and consumed. From the facility management perspective, food wastage involves much more than just wasted food. Food waste is process waste as it manifests where process steps are probably not working very well. Of course, food waste has always, and will always, occur to some extent. However, the amount and the areas where food waste arises in the food service process is of high value to know.

Methodology: The project is based on a literature review about factors influencing the food waste along the food service process in hospitals. The literature was searched in German, English, French and Swedish and was among the main topics of the search food provision, food service in healthcare organisations, malnutrition and food waste research. At the same time, all publications were recorded in a database. In a next step, the literature was assigned to one or more process steps or topics based on the factors described. This was followed by the renaming and combination of the factors to obtain a general wording.

Key findings: The results derived from this is a list of factors related to food waste in the food service process in hospitals. It contains more than 100 factors divided into the fourteen process steps of the food service process as well as two holistic topics regarding hospitals in general. Overall, there is a larger number of factors related to the process steps at the beginning of the food service process than later on, means after consumption. Furthermore, results show that the food service process is a difficult and demanding process. The fact that patients go to hospital to get well and not to eat, makes the whole situation additionally challenging.

Intended impact of the study: For the first time food waste from a facility management perspective was looked at in such detail. The food waste factors from literature are the basis to develop an observation guideline to complete the list of factors. Furthermore, these factors provide valuable insights about the complexity of food waste reduction as well as providing ideas to reduce food waste in the food service process in hospitals.

Paper Type: Research Paper

Keywords: Food Service, Food Waste, Hospital, Process optimisation, Facility Management

1. INTRODUCTION & BACKGROUND

Due to the rising population as well as the economic growth, more food is needed worldwide (Alexandratos and Bruinsma (2012) as cited in Halloran et al., 2014 p. 294). Therefore, the necessity to reduce food waste is of urgent concern. (Alexandratos and Bruinsma (2012) as cited in Halloran et al., 2014 p. 294). The Food and Agriculture Organization of the United Nations (FAO) (2014) and the European Parliament have concluded that the reduction of food waste can only be achieved when reliable data is available (Kranert et al., 2012). Currently, there is a critical lack of data regarding food waste (Betz et al., 2015). This is also the case looking at food waste from a facility management (FM) perspective. So far food waste research in the food service process had the aim to learn about the nutritional situation of people (Williams and Walton, 2011). For FM food waste can be looked at as process waste, as a not well working process leads to process waste. The process of food service has the characteristic that process waste is measurable as food waste is a valuable and measurable type of waste. Other FM processes do not have such a type of process waste as e.g. idle runs and miscalculations are not generating this kind of waste as food waste is for the food service process. From an FM perspective, it is therefore important to know which factors influence food waste in the various process steps or the process as a whole. Therefore, the aim of this study is to discover the various factors related to food waste based on literature along the food service process. The related research question is:

Which factors in the literature influencing food waste along the food service process are described?

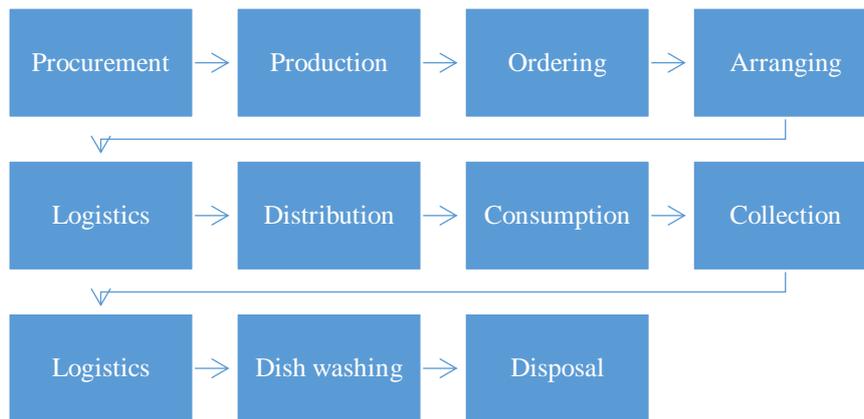
The field of research refers to hospitals because food is classified as food waste in these institutions much faster than in other institutions, for more explanation see section food waste in hospital.

This research paper is based on four chapters. In chapter 1, the introduction and background to the study are outlined. The introduction is already provided in the lines above. In the next paragraphs, the background information aligned to this research is in focus. This is followed by the methodology in chapter 2. In chapter 3, the findings of the study are explained and discussed. Finally, chapter 4 contains the conclusion, relevance of findings as well as some comments regarding further research.

Food service in hospitals

According to Lennerts (2009 p. 177), around 9% of the costs spent for facility management in hospitals are related to food service. This finding is in line with the number of 'BEG Analytics AG' (2017), which found out that 2 - 11% of the overall costs are spent on food service. In addition, the quality and experience of patients with the food is one of the most important factors for a hospital's image (Aden and Schneider, 2012, von Eiff, 2012). Therefore, the food service has an important role for FM as well as for the whole hospital. The food service process, is according to Wilson, Evans and Frost (2000) as cited in Walton (2012 p. 223) the most complex in the whole hospital context. The different steps are shown in Figure 1 and explained below the figure.

Figure 1 Visualisation of food service process in hospitals based on Bober (2001), Kelm et al. (2008), Kreutz (2012), Arens-Azevêdo and Lichtenberg (2011)



In the following, the food service process shown in Figure 1 is explained step by step. The description is based on Bober (2001), Kelm et al. (2008), Kreutz (2012), Arens-Azevêdo and Lichtenberg (2011). The food service process starts with Procurement. In this process step, goods are ordered and stored until they are used. In the next step, Production, the dishes are prepared and produced. Meanwhile, the customers select their meal in the process step Ordering. Based on this information, the Arranging of the meals is carried out. The trays ready for the patients are then transported to the wards in the process step Logistics. As a next step, the delivered trays are Distributed to the patients. During Consumption, patients eat their meals. After that, the trays are collected and brought back to the kitchen area for Dish washing. With the Disposal of the food waste as well as the other types of waste, the process chain ends.

The process steps described above are the basis for the data collection as well as the data analysis in the PhD project. In Swiss hospitals, the food production for the various customer groups, such as patients, staff, visitors and external customers, is done at the same time and mostly with the same facilities and staff.

Food waste in hospital

Research conducted in hospitals with respect to food primarily deals with the topic of patient malnutrition. The measurement of food waste has been a side issue in these studies over the last 50 years (Barton et al., 2000, Dupertuis et al., 2003, Edwards and Nash, 1999, Sonnino and McWilliam, 2011, Williams and Walton, 2011). Initial measurements of food waste from a facility management perspective, however, have revealed the dimension of the issue. 15% of all the trays delivered to the ward to be consumed by the patients return to the dish washing area for disposal untouched (Züger and Honegger, 2014). Furthermore, 30% of the cost of goods spend for patients meals are thrown away (Züger and Honegger, 2014). These costs include only the amount of waste from the meals prepared for the patients. As all food and beverages which have entered a patient's room needs to be disposed of, the food waste problem can only be minimised when the whole process of food service in hospitals is looked at and improved.

2 METHODOLOGY

This study is based on a literature review. According to Wilson (2010 p.55) "A literature review can be described as 'identifying, evaluating and critically assessing' what has been published on your chosen topic". Furthermore, a literature review needs to be seen as a process (Saunders et al., 2016, Wilson, 2010). The literature review conducted with respect to the topics of the theoretical part as well as the important factors regarding food waste in the different food

services process steps. As a first step, literature was collected. This was done in German, English, French and Swedish. Additional literature in Danish and Norwegian was considered, as the writing is similar to Swedish. The key topics for the research were food provision, food service in healthcare institutions, malnutrition and food intake, general food waste research as well as food waste reduction in the out-of home catering, interdisciplinary cooperation in the food service process in hospitals and food waste experiences from hotel management. In a second step, which was concurrent with the first, one the literature found was collected in a database for literature. In a third step the literature was assigned to the corresponding process steps, based on the factor described. Mostly the belonging was clear based on the literature and the content described. Where this was not the case the researcher decided to which process step this factor belong to. As the food service process is highly standardised regarding the different process steps, the allocation structure was clear. The additional topics of general hospital and overall arise while analysing the literature. The fourth step was to rename and combine factors that belong to the same process step and have the same meaning. This leads to the fact that most factors have more than one source, as displayed in the findings.

3 FINDINGS

The influencing factors collected based on the literature review are assigned to the different process steps of the food service process as well as to two holistic hospital-related topics - Overall and General Hospital. Overall refers to the food service process as a whole, while General Hospital focuses on topics regarding the hospital setting itself. In total, 107 influence factors related to food waste are collected. The number of food waste factors for each process step as well as the two additional topics are shown in Table 1. Most factors are related to Overall and General hospital. Looking at the food service process steps, Planning, Procurement, Storage, Producing and Arranging have ten or more factors. Of the remaining steps, Ordering and Service-distribution have between five and ten factors, while have the process steps Preparing, Logistics to ward, Disposal and Accounting have between one and five food waste factors. No such factors were found in the literature with respect to Service collection, Logistics from ward and Dish washing.

Table 1 Overview number of food waste factors

	Number of factors related to food waste
Planning	11
Procurement	10
Storage	10
Preparing	1
Producing	13
Ordering	7
Arranging	11
Logistics to ward	1
Service distribution	7

Service collection	0
Logistics from ward	0
Dish washing	0
Disposal	3
General hospital	14
Overall	17
Accounting	2

The detailed list of all 107 factors from literature related to food waste are shown in the Table 2. In the right column the factors are listed and in the left column the related reference(s) are shown. Each parts starts with a clear heading naming the process step or the topic the following factors belong to. After every list of factors, a short summary is given to provide a better understanding of the factors.

Table 2 list of food waste factors along the food service process

Factors	References
Planning	
Improved menu management	(Barton et al., 2000, Höss, 2014)
Calculation of quantities	(Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014, Beretta, 2013, Göbel et al., 2014b, Goonan et al., 2014, Schendekehl, 2014, Canali et al., 2014, Göbel and Blumenthal, 2014)
Expectations target groups	(2014, Göbel et al., 2014b, Höss, 2014, Schendekehl, 2014, Canali et al., 2014, Göbel and Blumenthal, 2014)
Menu card	(Göbel et al., 2014a, Schweizer Eidgenossenschaft Projektgruppe Food Waste, 2013)
No choice/improve choice	(Dupertuis et al., 2003, Precey, 2008, NHSE Hospitality, 2005, McCaffree, 2009)
Optimised planning	(Beretta, 2013, Göbel et al., 2014a, Göbel et al., 2012, Goonan et al., 2014, Rohner, 2014, Schendekehl, 2014, Wagner, 2015, Canali et al., 2014)

Precise goods scheduling	(Schendekehl, 2014)
Quality reviews	(Precey, 2008, Iff et al., 2008)
Regional dishes	(Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014, Friedrich et al., 2010, Göbel et al., 2014b)
Seasonal dishes	(Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014, Göbel et al., 2014a, Göbel et al., 2014b)
Variation in demand	(Göbel et al., 2014a, Stenmarck et al., 2011, Huber, 2009)
The above mentioned factors are relevant to avoid food waste already in the planning stage due to the targeted orientation of the product range.	
Procurement	
Careful supply chain management	(Chardoul and Coddington, 2012, Goonan et al., 2014)
Defined responsible person for procurement	(Schendekehl, 2014)
Flexible suppliers	(Schweizer Eidgenossenschaft Projektgruppe Food Waste, 2013)
Knowledge of what is on stock	(Beretta, 2013, Schendekehl, 2014)
Lack of good practice	(Canali et al., 2014)
Lack of knowledge	(Beretta, 2013, Stenmarck et al., 2011)
Deliveries and amounts geared to internal processes	(Göbel et al., 2012, Höss, 2014, Schendekehl, 2014, Stenmarck et al., 2011)
Regional suppliers	(Beretta, 2013, Friedrich et al., 2010, Schweizer Eidgenossenschaft Projektgruppe Food Waste, 2013)
Procurement source reduction	(Chardoul and Coddington, 2012)
Warehouse management system	(Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014, Schendekehl, 2014)
Factors in procurement show that food waste can be avoided with the help of tools, due to the overview they provide.	
Storage	

Careful storage	(Beretta, 2013, Göbel et al., 2014a, Göbel et al., 2012, Canali et al., 2014)
Chilled or frozen food is stored immediately	(Engström and Carlsson-Kanyama, 2004, Göbel et al., 2014a)
Equipment and containers	(Huber, 2009, Canali et al., 2014)
Vacuum treatment	(Wagner, 2015)
Principle of “first in first out”	(Schendekehl, 2014)
Expiration of best-before date	(Göbel et al., 2014a, Göbel et al., 2012, Stenmarck et al., 2011, Canali et al., 2014)
Appropriate temperature scheme for food which is kept warm and served portion-wise	(Engström and Carlsson-Kanyama, 2004)
Space to store leftovers	(Engström and Carlsson-Kanyama, 2004)
Storability	(Schendekehl, 2014)
Time needed to prepare leftovers for storage	(Engström and Carlsson-Kanyama, 2004)
Factors in the storage process step show that the handling of food in relation to storage is essential to avoid food waste.	
Preparing	
Portionable frozen food	(Schweizer Eidgenossenschaft Projektgruppe Food Waste, 2013)
Preparing has only one factor, therefore this is more an example who food waste can be prevented.	
Producing	
Colour	(Stroebele and De Castro, 2004)
Cooking	(Dupertuis et al., 2003)
Flexibility to tailor production ot changing demands	(Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014, Göbel et al., 2014b)
Inappropriate food is served	(Dupertuis et al., 2003, Edwards and Nash, 1999, Thibault et al., 2011)
Nutritional quality	(Díaz and García, 2013, Höss, 2014)
Overproduction	(Schendekehl, 2014, Fachhochschule Münster Institut für Nachhaltige Ernährung und

	Ernährungswirtschaft, 2014, Göbel et al., 2014b, Göbel et al., 2012, Goonan et al., 2014)
Recipes	(Göbel et al., 2014a, Göbel et al., 2014b, Höss, 2014)
Reuse of leftovers	(Beretta, 2013, Göbel et al., 2014a)
Seasoning	(Betz et al., 2015, Huber, 2009)
Smell	(Stroebele and De Castro, 2004)
Taste	(Díaz and García, 2013, Dupertuis et al., 2003, Göbel et al., 2012)
Temperature	(Stroebele and De Castro, 2004, Huber, 2009)
To fatty food	(Betz et al., 2015)
Many factors are related to the characteristics of the food produced.	
Ordering	
Asking menu size	(Schendekehl, 2014, Ofei et al., 2014, NHSE Hospitality, 2005)
Food preferences	(Barton et al., 2000, Göbel et al., 2014a)
Menu system to order meals	(Goonan et al., 2014, Doward, 2013, Göbel et al., 2014a, Ofei et al., 2014, NHSE Hospitality, 2005)
Optimising feeding of patient	(Dupertuis et al., 2003, Höss, 2014)
Excess ordering	(Barton et al., 2000, Sonnino and McWilliam, 2011, Canali et al., 2014)
The absence of patient-self menu selection	(Thibault et al., 2011)
Lead time for ordering	(Ofei et al., 2014, NHSE Hospitality, 2005)
These factors show that a menu ordering system is central to systematically making orders together with patients/guests.	
Arranging	
Additional meals prepared as backup	(Precey, 2008)
Amount ordered was not amount delivered	(Edwards and Nash, 1999, Göbel et al., 2014b, Sonnino and McWilliam, 2011, Göbel and Blumenthal, 2014)
Buffet is loaded during the whole service time	(Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014, Göbel et

	al., 2014a, Schendekehl, 2014, Göbel and Blumenthal, 2014)
Buffet is loaded fully every day	(Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014, Göbel et al., 2014a, Göbel and Blumenthal, 2014)
Calculated portions are not ladle portions	(Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014, Göbel et al., 2014a, Göbel et al., 2014b, Göbel and Blumenthal, 2014)
Creative arranging	(Wagner, 2015, Huber, 2009)
Flexible arranging of buffet	(Wagner, 2015)
Portioning	(Schweizer Eidgenossenschaft Projektgruppe Food Waste, 2013, Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014, Precey, 2008, Göbel et al., 2014b, Göbel et al., 2012, Iff et al., 2008, Huber, 2009, Göbel and Blumenthal, 2014)
Too much food served for oneself by own choice	(Betz et al., 2015, Roth, 2014)
Customers expect shelves to be fully stocked	(Stenmarck et al., 2011)
Portioning size standards	(2014, Höss, 2014, Göbel et al., 2014a)
Factors of arranging show that the right dish should be served in the right quantity.	
Logistics to ward	
Meals are served too late (Process problem logistics and service)	(Edwards and Nash, 1999)
Logistics to ward has only one factors, it shows that cooperation is essential.	
Service distribution	
Few people responsible for food service distribution to patients	(Almdal et al., 2003)
Aid for patient with problem to eat independently	(Dupertuis et al., 2003, Barton et al., 2000)
Member of staff with well-defined responsibility	(Dupertuis et al., 2003, Almdal et al., 2003)
Member of staff with special training	(Dupertuis et al., 2003, Almdal et al., 2003, Precey, 2008, Göbel et al., 2014a, Iff et al., 2008, Sonnino and McWilliam, 2011, Fachhochschule Münster

	Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014, NHSE Hospitality, 2005, McCaffree, 2009)
No nursing staff	(Dupertuis et al., 2003, Almdal et al., 2003, Precey, 2008, Doward, 2013)
Service of food	(Dupertuis et al., 2003, Barton et al., 2000, Doward, 2013, Sonnino and McWilliam, 2011, McCaffree, 2009)
Inadequacy of meal serving time	(Thibault et al., 2011, Sonnino and McWilliam, 2011)
Factors show that service of food is a difficult and demanding task that belongs in the capable hands of professionals.	
Service collection	
This process step was probably not considered, as consumption is already through and the food waste quantity can no longer be directly influenced.	
Logistics from ward	
As mentioned for service collection the reason is probably the same.	
Dish Washing	
As stated for service collection the reason is most likely the same.	
Disposal	
Absence of a feedback system for food waste	(2014, Göbel et al., 2014a, Goonan et al., 2014, Doward, 2013, Ofei et al., 2014, Roth, 2014)
Prohibition of feeding food waste to animals in Switzerland	(nd, Canali et al., 2014)
Number of waste collections per week	(Baier and Reinhard, 2007)
Factors in the process step of disposal have no direct influence on the actual food waste situation. Nevertheless, the information about the amount and type of food waste disposed can be of great help as feedback loop.	
General hospital	
Meal means highlight of the day for patients	(Edwards and Nash, 1999)
Increased morbidity	(Dupertuis et al., 2003)
Interruption while eating	(Betz et al., 2015, Edwards and Nash, 1999)

Absence of hunger	(Betz et al., 2015, Stanga et al., 2003, Huber, 2009, Kondrup, 2001)
Discomfort	(Betz et al., 2015)
Malnutrition	(Almdal et al., 2003, Dupertuis et al., 2003, Kondrup, 2001)
Mortality	(Dupertuis et al., 2003)
Patient is discharged from hospital	(Barton et al., 2000, Goonan et al., 2014)
Patient must keep an empty stomach	(Barton et al., 2000, Goonan et al., 2014)
Patient is transferred	(Barton et al., 2000, Goonan et al., 2014, Ofei et al., 2014)
Physical setting	(Stroebele and De Castro, 2004)
Presence of other people	(Stroebele and De Castro, 2004)
Stress	(Betz et al., 2015)
Time pressure	(Edwards and Nash, 1999)
These factors show that eating in hospital is important but not the reason to be there.	
Overall	
Benchmarking	(Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014)
Communication between teams	(Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014, Friedrich et al., 2010, Göbel et al., 2014a, Schendekehl, 2014, Wagner, 2015, Huber, 2009, Ofei et al., 2014, NHSE Hospitality, 2005, McCaffree, 2009, Göbel and Blumenthal, 2014)
Communication with customer	(Engström and Carlsson-Kanyama, 2004, Göbel et al., 2014a, Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014)
Cross-linking and overlapping tasks with others	(Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014, Göbel et al., 2014a, Goonan et al., 2014, Halloran et al., 2014, Schendekehl, 2014, Huber, 2009)

Doggy bag	(Schweizer Eidgenossenschaft Projektgruppe Food Waste, 2013, Wagner, 2015)
Flexibility	(Dupertuis et al., 2003, Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014, Canali et al., 2014)
Information and knowledge flow	(Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014, Barton et al., 2000, Goonan et al., 2014, Schendekehl, 2014, Sonnino and McWilliam, 2011)
Duration of stay	(Dupertuis et al., 2003)
Meal time	(Dupertuis et al., 2003, Huber, 2009, NHSE Hospitality, 2005)
Process feedback system	(Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014, Goonan et al., 2014)
Protected meal times	(Connolly et al., 2011, Doward, 2013, Sonnino and McWilliam, 2011, NHSE Hospitality, 2005)
Quality	(Barton et al., 2000, Díaz and García, 2013, Doward, 2013, Dupertuis et al., 2003, Goonan et al., 2014, Höss, 2014)
Sensitisation of staff	(Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014, Göbel et al., 2014a, Goonan et al., 2014, Schendekehl, 2014)
Staff awareness of economic value of food waste	(Engström and Carlsson-Kanyama, 2004, Göbel et al., 2014a, Göbel and Blumenthal, 2014)
Staff ideas for reducing losses	(Engström and Carlsson-Kanyama, 2004, Schendekehl, 2014)
Support executive board	(Fachhochschule Münster Institut für Nachhaltige Ernährung und Ernährungswirtschaft, 2014)
Further use of unserved meals on the ward	(Ofei et al., 2014)
Factors show that the catering process has a lot to do with people throughout the process, so cooperation is essential.	
Accounting	
Weight-related menu prices	(Engström and Carlsson-Kanyama, 2004)

Smart price arrangements	(Wagner, 2015)
Accounting has no direct impact on food waste as these two factors show but financial incentives can help to avoid potential food waste.	

Findings show that a high variety of factors is related to food waste. The presented list is certainly not complete but provides a detailed overview. The selection of search topics in the literature research has certainly had an influence on the fact that some process steps contain more detailed factors and others less. However, it has been noticed in many articles that consumption is the main focus. The majority of these factors were not taken into account in these results, most of them can still be found in the categories Overall and General Hospital. If factors specifically referred to production, they were added to Production. The fact that some process steps have no or hardly any factors related to food waste is therefore not directly related to the literature used but much more to the fact that these process steps have not been researched.

4 CONCLUSION

Process steps at the beginning have more influence based on a larger number of factors than process steps later in the process. This is not surprising due to the process logic that nothing can be changed regarding food waste after consumption. Overall, the factors show that the food service process is a difficult and demanding process. There are many different people involved in the process who have to co-operate with each other to ensure a target food service. To make it more difficult, guests did not come to the hospital to eat, but to get well.

In further research, the list of food waste factors can be used as basis for an observation guideline to complete the picture of food waste factors from an FM perspective. Which than can be used to invent a tool to help FM partitions analysing and in a further step optimise their food waste situation. In addition the list of factors related to food waste in hospitals can be developed further to be applied to other food service providers.

These findings are relevant for facility managers responsible for the food service process as they provide concrete indicators as to what avenues can be explored in the quest to reduce food waste. In addition, the results show how complex and interlinked food waste reduction is. Furthermore, this is an important initiative as it is the first time food waste has been looked at in such detail from a facility management perspective and will greatly facilitate meaningful progress in this area.

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