

University of Wollongong

Research Online

Faculty of Health and Behavioural Sciences -
Papers (Archive)

Faculty of Science, Medicine and Health

1-1-2009

Patient satisfaction and energy intakes are enhanced by point of service meal provision

Sarah Mahoney
University of Wollongong

Amanda Zulli
University of Wollongong

Karen Walton
University of Wollongong, kwalton@uow.edu.au

Follow this and additional works at: <https://ro.uow.edu.au/hbspapers>



Part of the [Arts and Humanities Commons](#), [Life Sciences Commons](#), [Medicine and Health Sciences Commons](#), and the [Social and Behavioral Sciences Commons](#)

Recommended Citation

Mahoney, Sarah; Zulli, Amanda; and Walton, Karen: Patient satisfaction and energy intakes are enhanced by point of service meal provision 2009, 212-220.
<https://ro.uow.edu.au/hbspapers/269>

Research Online is the open access institutional repository for the University of Wollongong. For further information contact the UOW Library: research-pubs@uow.edu.au

Patient satisfaction and energy intakes are enhanced by point of service meal provision

Abstract

Aim: This systemic review aimed to investigate the effects of various methods of point of service meal provision on patient satisfaction and energy intakes of hospital patients. **Methods:** 'Medline' and 'Wiley Interscience' online databases (1999–2008) were consulted using search terms such as 'food service' and 'food delivery in hospital'. Cross-referencing was also used to select studies that compared the provision of full diets to hospital patients using two different methods of food service delivery. **Results:** Searching yielded 268 studies, of which 18 met the inclusion criteria (hospitals, all ages, oral intake only). Patient satisfaction was measured in 12 studies, while 9 studies measured energy intake, 9 measured food wastage and 4 studies measured costs. **Conclusion:** There is evidence to suggest that a more personalised meal service system in hospitals has the ability to improve energy intakes and patient satisfaction. Further research is necessary to evaluate the long-term implications on cost-effectiveness.

Keywords

service, meal, patient, provision, satisfaction, energy, intakes, enhanced, point

Disciplines

Arts and Humanities | Life Sciences | Medicine and Health Sciences | Social and Behavioral Sciences

Publication Details

Mahoney, S., Zulli, A. & Walton, K. (2009). Patient satisfaction and energy intakes are enhanced by point of service meal provision. *Nutrition and Dietetics*, 66 (4), 212-220.

REVIEW

Patient satisfaction and energy intakes are enhanced by point of service meal provision

Sarah MAHONEY, Amanda ZULLI and Karen WALTON

School of Health Sciences, University of Wollongong, Wollongong, New South Wales, Australia

Abstract

Aim: This systemic review aimed to investigate the effects of various methods of point of service meal provision on patient satisfaction and energy intakes of hospital patients.

Methods: 'Medline' and 'Wiley Interscience' online databases (1999–2008) were consulted using search terms such as 'food service' and 'food delivery in hospital'. Cross-referencing was also used to select studies that compared the provision of full diets to hospital patients using two different methods of food service delivery.

Results: Searching yielded 268 studies, of which 18 met the inclusion criteria (hospitals, all ages, oral intake only). Patient satisfaction was measured in 12 studies, while 9 studies measured energy intake, 9 measured food wastage and 4 studies measured costs.

Conclusion: There is evidence to suggest that a more personalised meal service system in hospitals has the ability to improve energy intakes and patient satisfaction. Further research is necessary to evaluate the long-term implications on cost-effectiveness.

Key words: food service, hospital, intake, meal provision, patient satisfaction, point of service.

INTRODUCTION

Recent research indicates a relationship between hospital food service systems and subsequent patient satisfaction and energy intake.¹ There is evidence to suggest that a more personalised food service system, such as point of service (POS) meal provision, may have the ability to improve a patient's nutritional status,² which is of considerable importance in the hospital setting.^{1,2}

A pre-plated meal service involves the collection of menu choices up to 24 hours in advance, and the plating of meals in a central location before service.³ A pre-plated, centralised approach is less labour-intensive than POS, but has been criticised for being impersonal.² In addition, unpopular meal times as well as changes to patient health status mean that pre-ordered meals may become unsuitable and will not be consumed.^{4,5} Approximately 75% of hospital patients rely solely on the food service menu as their source of nutrition.⁶ Consequently, better food services can be identified as one of

the multifaceted nutritional care strategies that can potentially influence nutritional status.^{2,6,7}

POS meal provision provides patients with their desired food choice closer to the time of consumption. The most widely recognised form of POS meal delivery is the bulk system, a decentralised approach where patients make their desired food choices in the ward from a bulk trolley.⁴ Other identified POS methods include a room service system, where a patient is required to call the food service department with their meal choice at a time suitable to their appetite, and the meal is delivered within 45 minutes of ordering.⁸ Hartwell and Edwards outlined the 'Steamplicity' concept, which involves new cooking techniques and food choices being made from an extended, static menu, two hours before delivery.⁹ POS provides a more flexible and appealing system in relation to portion control and presentation.¹⁰

Two recent audits in Australia have reported hospital malnutrition rates of 34.7% and 31.4%.¹¹ Malnutrition continues to be an under-recognised problem and is a significant risk factor for increased length of stay, hospital costs and mortality. In order to combat this growing problem, the factors influencing patient malnutrition must be investigated. Some patients admitted to hospital are already malnourished, and the stress related to hospitalisation can further reduce food intakes and nutritional status as length of stay extends.^{2,11} To date, systematic evaluation of hospital food service systems and their effects on patient satisfaction

S. Mahoney, Bachelor of Nutrition and Dietetics, Student Researcher, Nutrition and Dietetics

A. Zulli, Bachelor of Nutrition and Dietetics, Student Researcher, Nutrition and Dietetics

K. Walton, PhD, APD, Lecturer

Correspondence: S. Mahoney, 12 Beattie St, Jamberoo, NSW 2533, Australia. Email: sarahmahoney87@gmail.com

Accepted August 2009

and energy intake has been minimal.¹⁰ However, POS meal provision provides a possible avenue by which hospitals can provide patients with a better-quality food service.^{2,7}

The primary aim of this study was to conduct a systematic review of all available studies, to examine the effects of various methods of POS meal provision on patient satisfaction and energy intake in hospitals. The secondary aim was to assess, where possible, changes in food wastage and cost-effectiveness, brought about by an altered meal delivery system.

METHODS

Databases and search terms

Two researchers were involved in the selection of published studies for this review. 'Medline' (1950–present) and 'Wiley Interscience', formerly 'Synergy' (1999–present) databases were used and papers were cross-referenced to locate further relevant studies. Searching was limited to papers published between January 1990 and September 2008. Search terms included: 'food service', 'POS', 'methods of meal provision', 'plate and bulk food delivery', 'food delivery and hospitals', 'POS meal provision', 'room service' and 'patient satisfaction and food service'. Included studies were published in English, available in full text and met the selection criteria. No unpublished work was sought. Online databases were available through the University of Wollongong and there was no hand searching of journals.

Selection criteria

- Studies involving humans
- Studies comparing two different methods of meal provision
- Studies conducted in a hospital setting
- Participants were required to be on normal oral intake, with no specific dietary prescription

Data extraction

Titles and abstracts of all identified articles were reviewed. Full-text articles were obtained for studies that met the inclusion criteria or those whose relevance was not clear from the title and abstract. Disagreements about the inclusion of studies were resolved by discussion between the researchers. For comparison against the conventional pre-plated method and the primary outcome measures, data from relevant studies were extracted based on study design, setting and method of food service delivery. Each researcher evaluated the degree to which each selected study was positive, negative, mixed or inconclusive, based on the primary and secondary study outcomes.

RESULTS

Searching yielded 15 488 papers of which 268 were obtained for detailed appraisal. Twenty-four papers met the

selection criteria for a more comprehensive review; 18 were found to be appropriate for inclusion in the present review. The studies reviewed involved a total of 5646 hospital patients. Four key topics: patient satisfaction, energy intakes, food wastage and cost-effectiveness, form the basis of the present results and discussion. All relevant information about participants, methods and key outcomes from the included studies are outlined in Appendix I.

Patient satisfaction

Twelve studies reported increased levels of patient satisfaction as a result of changed meal delivery systems.^{1,8,9,12,13–18} Timing, portion size, texture, taste, temperature, variety and appropriateness of food choices were reasons stated to explain increased satisfaction with POS food delivery.

Energy intake

Nine studies measured the effects of a POS system on energy intakes.^{8–10,19,14–17,20} Energy intake was primarily measured by weight of food served pre and post consumption,^{9,10,19,15,16} however, visual estimation techniques were also used.^{8,14,17,20} Total energy intakes increased in eight of the nine studies,^{8–10,19,15–17,20} with one study showing no significant difference between a pre-plated method and a POS bulk system.¹⁵

Food wastage

Nine studies measured the effects of food delivery systems on food wastage.^{8,9,19,14–16,21–23} Eight assessed ward waste in terms of total waste (plate waste + trolley waste) using various forms of POS,^{8,9,14,21–23} with six of these showing a significant reduction in food waste following a change in food service.^{8,9,14,16,21,24} The volume of food waste was quantified by visual estimation^{8,14,21} or weight measurements.^{9,16,23} The energy values of meals and mid-meals used in each study were highly variable. In contrast, two studies reported an increase in total food waste through the adoption of a bulk system.^{15,22} Five studies also assessed plate waste separately from total waste, finding reductions in the amount of food left uneaten by patients.^{19,15,16,22,23}

Cost-effectiveness

Four studies^{8,13,14,18} showed significant reductions in the cost of breakfast, lunch and mid-meals following the implementation of a bulk system, but no significant cost reductions for dinner meals. Using room service, Williams *et al.*¹⁴ was the only study to provide an estimated annual savings figure of approximately \$30 000 in a paediatric setting.

DISCUSSION

The relationship between meal service systems and patient outcomes is a complex issue and is discussed below in terms

of the four key topics: patient satisfaction, energy intakes, food wastage and cost-effectiveness.

Patient satisfaction

Patient satisfaction is significantly correlated with the quality of the food service provided,²⁴ indicating that it is a fundamental outcome to measure. Patient satisfaction with food services can assist in achieving appropriate nutrient intakes and timely recovery.²⁵ Twelve studies investigated patient satisfaction and food intake using different food service delivery systems. Food distribution systems can play an essential role in maintaining the nutritional quality, content, temperature and texture of foods,⁴ and have been found to be the most important factors, contributing to patient satisfaction.²⁵

Another important factor to consider is the relationship between emotions and being in hospital. The anxiety of being hospitalised²⁶ can contribute to a decreased appetite, and a positive association has been found between positive emotions and satisfaction with food services.²⁷ In support of this, a number of studies have found that providing patients with autonomy and choice over what and when they eat enhances satisfaction and resultant energy intakes.^{26,28}

Five of the 12 studies used data collection methods (surveys, questionnaires and interviews) that had been tested for reliability and validity.^{1,8,9,29,18} These POS studies (using bulk system, room service and the Steamplicity concept) reported improved patient attitudes when compared with a pre-plated meal service. The common improvements related to taste, texture, presentation of food and more personalised interaction with staff. These results may be the consequence of a shift away from 'institutionalised stereotyping', which Hartwell *et al.*¹ describe as patients having an expectation of poor quality in hospital food. Patients may not always know what they would like to eat 24 hours in advance of a meal, and their needs often change.¹² Therefore, the more appealing nature of POS provision, including greater perceived control over meal choices, has the potential to greatly increase the satisfaction, and possibly the recovery of patients in hospital.

Although the reliability or validity of the methods used in the remaining seven studies was either not known or not established, these studies^{12,30,13-17} produced conclusions similar to those using validated methods, and reported significant increases in patient satisfaction with a POS system. Three of the reported studies^{8,12,30} conducted satisfaction evaluations with critically ill hospital patients and both the room service and bulk systems allowed patients to order meals of an appropriate temperature and portion size, without compromising nutritional value. The room service method^{8,30} was particularly effective, as patients experiencing symptoms, such as nausea and loss of appetite, were able to phone the kitchen to order meals when they were able to eat.

Non-traditional POS food delivery systems can enhance patient satisfaction. In addition to food quality factors, this enhancement can also be attributed to an increased level of staff interaction with patients. Personal contact with staff is known to provide beneficial emotional support for patients,

meaning that they can become more comfortable in an unfamiliar setting.²⁸

Energy intakes

Assessment of energy intakes is important owing to its direct association with malnutrition and consequent functional ability and recovery.⁶ While pre-plated food services have the potential to meet the energy requirements of patients, the theoretical needs of the patient continually fail to be met. This is because of factors such as appetite, choices available, assistance required and meal delivery method.³¹ If consistent improvements in energy intakes were achieved as a result of POS meal provision, it would be reasonable to assume that the use of a POS meal service system over an extended period of time may reduce the prevalence of malnutrition in hospitals.

Macronutrient intake must be considered when determining all factors contributing to increased energy intake. Larsen and Toubro reported increases in energy intakes on an *ad libitum à la carte* menu; however, this increase was only found to be significant in obese cardiology patients.²⁰ The increase was largely attributable to significant increases in fat intakes, and significant reductions in carbohydrate intake.²⁰ This raises considerable concerns, as a diet low in saturated fat and high in polyunsaturated fat, fruits, vegetables and grains is essential in order to minimise the risk of further cardiac events.³² This study highlights the need for some level of monitoring of an *ad libitum* menu, particularly in relation to fat sources for 'at-risk' patients and also underlines the desirability of providing dietary advice to patients and educating them on the most beneficial meal items to improve their health.

Three of the four studies using visual estimations provided training in the use of this form of measurement to ensure accurate estimations.^{8,14,20} The idea that visual estimations can be validated against weighted measurements is supported by Njis *et al.*, who concluded that both observation and weighing techniques can provide accurate estimates of energy intake.³³ All the studies using visual estimation techniques reported significant increases in food intakes. Improved intakes varied from 314 to 2500 kJ/day. The greatest improvements resulted from the bulk system and room service systems,^{16,20} however, significant increases were also discovered when using the Steamplicity concept.⁹ While the food service systems differed between studies, all were characterised by a more personal approach, where food choice was made close to, or at point of consumption. Studies that did not give a choice at POS, but allowed patients to change their mind if their appetite for their pre-ordered food had diminished, also achieved increases in energy intakes.^{10,19} However, these increases were much lower than a direct POS approach, indicating that it is in fact the POS concept that has the greatest impact on improved consumption.

Food wastage

Food waste is an important consideration because it is related to patients' intakes and influences costs.³⁴ Two

studies found that total waste increased when the bulk system was introduced.^{15,22} However, this was primarily due to excessive trolley waste rather than plate waste, with plate waste being significantly reduced.

The studies that used a room service system found significant reductions in total waste.^{8,14} This may be because trolley waste did not have to be considered in the calculation, and there was a reduction in calls for new trays, which would normally arise as a result of changing preferences. The remaining studies that evaluated bulk and dining room POS systems showed significant reductions in total waste; however, these levels still exceeded the recommendations.^{8,9,14,16,21,23}

Improved communication about requirements between ward and food service staff could prevent the supply of meals that are excess to the ward requirements. A pilot initiative with this concept suggested that total wastage could be reduced by up to 30% if food service staff were to call and confirm final meal numbers two hours before service.¹⁵

Plate waste is of great importance as it can reflect nutrient intakes, and high levels of plate waste can be indicative of poor health status.³⁵ Studies that measured plate waste and total waste separately found significant reductions,^{9,19,16,22,23} in plate waste as a consequence of POS delivery systems, so it would seem that more control over personal food choices and time of meals may increase consumption. These findings are particularly applicable to seriously ill patients who have a higher susceptibility to changing preferences, poor appetites and therefore malnutrition.²⁶

Another important consideration in plate waste studies is the degree to which the choice of smaller portion sizes accounts for reduced plate waste, rather than being indicative of increased consumption. It was therefore reassuring in the present review to find that four^{8,19,14,16} of the five studies that measured plate and total waste separately reported significant increases in energy intakes together with reductions in plate waste.

Cost-effectiveness

The long-term use of a POS meal delivery system may reduce food service costs through reduced food wastage; however, it is clear that there are substantial costs involved in the establishment of POS, including renovations, new equipment and new staff. It is critically important that these are taken into account when evaluating the economic implications of POS. In the present review overall decreases in costs related to food waste and the purchase of food were found; however, initiation costs were not considered in the four studies.^{8,13,14,18} One study reported annual savings of more than \$30 000 based on reduced waste and purchase of food,¹⁴ suggesting that long-term use of POS may ultimately result in economic benefits that outweigh initiation costs.

The financial success of POS meal provision also relies on communication between food service and ward staff, appropriate systems and technology.³⁶ Further research is required to evaluate the economic implications of POS meal provision in hospitals.

LIMITATIONS

No * symbol was used with search terms when retrieving articles, which may have affected the search results. There are no standardised methods for measuring food waste, which makes comparisons between studies and different hospitals difficult. Research involving both adults and children in a variety of disease states were included in this review.

CONCLUSION

There is sufficient evidence to suggest that POS meal provision in hospitals can improve patient satisfaction and energy intakes. This more personal approach can reduce plate waste, suggesting that its implementation may influence the nutritional status of patients positively. The size of the hospital as well as the health status of patients must be taken into account when considering recommendations for the most appropriate POS food delivery system. The room service method may be most effective in a critically ill patient population, or in smaller patient groups; while the bulk system and Steamplivity concept would be more applicable in larger patient populations. The use of POS meal delivery systems may reduce costs associated with food services; however, more long-term research is needed to clarify this.

ACKNOWLEDGEMENTS

We would like to acknowledge the contributions of Linda Tapsell, Peter Williams and Holley Jones.

REFERENCES

- Hartwell HJ, Edwards JSA, Beavis J. Plate versus bulk trolley food service in a hospital: comparison of patients' satisfaction. *Nutrition* 2007; **23**: 211–18.
- O'Flynn J, Peake H, Hickson M, Foster D, Frost G. The prevalence of malnutrition in hospitals can be reduced: Results from three consecutive cross-sectional studies. *Clin Nutr* 2005; **24**: 1078–88.
- McGlone PC, Dickerson JWT, Davies GJ. The feeding of patients in hospital: a review. *J R Soc Promot Health* 1995; **115**: 282–8.
- Hwang Li-Jen J, Desombre T, Eves A, Kipps M. An analysis of catering options within NHS acute hospitals. *Int J Health Care Qual Assur* 1999; **12** (7): 293–308.
- Beck AM, Balknas P, Furst P. Food and nutritional care in hospitals: how to prevent undernutrition report and guidelines from the Council of Europe. *Clin Nutr* 2001; **20**: 455–60.
- Allison SP. Hospital food as treatment. *Clin Nutr* 2003; **22**: 113–14.
- Vivanti A, Banks M, Aliakbari J, Suter M, Hannan-Jones M, McBride E. Meal and food preferences of nutritionally at-risk inpatients admitted to two Australian tertiary teaching hospitals. *Nutr Diet* 2008; **65**: 36–40.
- Kuperburg K, Caruso A, Dello S, Mager D. How will a room service delivery system affect dietary intake, food costs, food waste and patient satisfaction in a paediatric hospital? A pilot study. *J Foodserv* 2008; **19**: 255–61.

- 9 Hartwell HJ, Edwards JSA. Hospital food service: a comparative analysis of systems and introducing the 'Steamplicity' concept. *J Hum Nutr Diet* 2006; **19**: 421–30.
- 10 Wilson A, Evans S, Frost G. A comparison of the amount of food served and consumed according to meal service system. *J Hum Nutr Diet* 2000; **13**: 271–5.
- 11 Banks M, Ash S, Bauer J, Gaskill D. Prevalence of malnutrition in Queensland public hospitals and residential aged care facilities. *Nutr Diet* 2007; **64**: 172–8.
- 12 Pietersma P, Follet-Bick S, Wilkinson B, Guebert N, Fisher K, Pereira J. A bedside food cart as an alternative food service for acute and palliative oncological patients. *Support Care Cancer* 2003; **11**: 611–14.
- 13 White M, Wilcox J, Watson R, Rogany A, Meehan L. Introduction of a patient-centred snack delivery system in a children's hospital increases patient satisfaction and decreases foodservice costs. *J Foodserv* 2008; **19**: 194–9.
- 14 Williams R, Virtue K, Adkins A. Room service improves patient food intake and satisfaction with hospital food. *J Pediatr Oncol Nurs* 1998; **15**: 183–9.
- 15 Hartwell H, Edwards JSA. A comparative analysis of 'plated' and 'bulk trolley' hospital food service systems. *Food Serv Technol* 2003; **3**: 133–42.
- 16 Friel M, Nielsen MA, Biltz C, Gut R, Mikkelsen BE, Almdal T. Reorganization of a hospital catering system increases food intake in patients with inadequate intake. *Scan J Food Nutr* 2006; **50** (2): 83–8.
- 17 McLymont V, Cox S, Stell F. Improving patient meal satisfaction with room service meal delivery. *J Nurs Care Qual* 2003; **18**: 27–37.
- 18 Folio D, O'Sullivan-Maillet J, Touger-Decker R. The spoken menu concept of patient foodservice delivery systems increases overall patient satisfaction, therapeutic and tray accuracy, and is cost neutral for food and labor. *J Am Diet Assoc* 2002; **102**: 546–8.
- 19 Wilson A, Evans S, Frost G, Dore C. The effect of changes in meal service systems on macronutrient intake in acute hospitalized patients. *Food Serv Technol* 2001; **1**: 121–2.
- 20 Larsen CS, Toubro S. The effect of conventional v. a' la carte menu on energy and macronutrient intake among hospitalized cardiology patients. *Br J Nutr* 2007; **98**: 351–7.
- 21 Marson H, McErlain L, Ainsworth P. The implications of food wastage on a renal ward. *Br Food J* 2003; **105**: 791–9.
- 22 Edwards JSA, Nash AHM. The nutritional implications of food wastage in hospital food service management. *Nutr Food Sci* 1999; **99** (2): 89–98.
- 23 Kelly L. Audit of food wastage: differences between a plated and bulk system of meal provision. *J Hum Nutr Diet* 1999; **12**: 415–24.
- 24 Sheehan-Smith LM. Hotel-Style room service in hospitals: the new paradigm of meal delivery for achieving patient satisfaction of food service. *J Am Diet Assoc* 2004; **104** (2): A43.
- 25 Dube L, Trudeau E, Belanger MC. Determining the complexity of patient satisfaction with foodservices. *J Am Diet Assoc* 1994; **394** (5): 1–7.
- 26 Williams R, Hinds PS, Ke W, Joan Hu X. A comparison of calorie and protein intake in hospitalized pediatric oncology patients dining with a caregiver versus patients dining alone: a randomized, prospective clinical trial. *J Pediatr Oncol Nurs* 2004; **21** (4): 223–32.
- 27 Belanger MC, Dube L. The emotional experience of hospitalization: Its moderators and its role in patient satisfaction with foodservices. *J Am Diet Assoc* 1996; **96**: 354–60.
- 28 Watters CA, Sorensen J, Fiala A, Wismer W. Exploring patient satisfaction with foodservice through focus groups and meal rounds. *J Am Diet Assoc* 2003; **103**: 1347–9.
- 29 Hartwell H, Edwards JSA. A preliminary assessment of two hospital food service systems using parameters of food safety and consumer opinion. *J R Soc Promot Health* 2001; **121**: 236–42.
- 30 Wadden K, Wolf B, Mayhew A. Traditional versus room service menu styles for pediatric patients. *Can J Diet Pract Res* 2006; **67** (2): 92–4.
- 31 Fenton J, Eves A, Kipps M, O'Donnell CC. The nutritional implications of food wastage in continuing care wards for elderly patients with mental health problems. *J Hum Nutr Diet* 1995; **8**: 239–48.
- 32 American Heart Association. American Heart Association Guidelines for primary prevention of cardiovascular disease and stroke: 2002 Update. *Circulation* 2002; **106**: 388–91.
- 33 Njis KAND, deGraaf C, Siebelink E, Blauw YH, Vanneste V, Kok FJ, van Staveren WA. Effect of family-style meals on energy intake and risk of malnutrition in Dutch nursing home residents: A randomised controlled trial. *J Gerontol* 2006; **61A**: 935–42.
- 34 Barton AD, Beigg CL, Macdonald A, Allison SP. High food wastage and low nutritional intakes in hospital patients. *Clin Nutr* 2000; **19**: 445–9.
- 35 Deutekom EJ, Philipsen H, Ten Hoor F, Huyer Abu-Saad H. Plate waste producing situations on nursing wards. *Int J Nurs Stud* 1991; **28**: 163–74.
- 36 Mikkelsen BE, Beck AM, Balknas UN *et al.* *What Can Foodservice Operators Do To Remedy Undernutrition In Hospitals.* *Foodservice Research International* 2002; **13**: 269–79.

APPENDIX I

Summary of clinical studies testing point of service meal provision

Reference number	Author/year	Number of participants	Duration	Food service systems	Outcomes	Conclusions
1	Hartwell <i>et al.</i> , 2007, United Kingdom	180 Adults	2 months	Pre-plated system vs bulk system	Patient satisfaction	Bulk trolley method provides more palatable texture, temperature and flavour when compared with the pre-plated method. Patient satisfaction enhanced through provision of point of service food consumption. Significant differences ($P = 0.01$) in temperature rating for minced beef dish, poached fish and potato dish with the bulk system providing hotter meals. Significant increases were seen in patient satisfaction levels, with 93% preferring the prompt delivery, and in overall macronutrient consumption at lunch meals. An increasing trend of macronutrient consumption was noticed at breakfast and dinner, but was not significant. Significant reductions were observed in cost of breakfast and lunch rotations (36% and 29%, respectively) and food wastage (23%).
8	Kuperburg <i>et al.</i> , 2008, Canada	54 Children	6 days	Pre-plated system vs room service	Patient satisfaction, energy intake, total waste and cost-effectiveness	Steamplacidity concept was the preferred food delivery method. Wastage reduced by 16% when food was ordered two hours in advance. Higher mean intakes of 80 g at lunch and 84 g at dinner discovered with change in foodservice method (no significance tests performed). Bulk system significantly increased patient energy intake by 397 kJ/day ($P < 0.004$). Mainly as a result of significantly higher intakes during the main meal bulk service (272 kJ, $P < 0.006$) as well as improved plate presentation and flexible portion size.
9	Hartwell and Edwards, 2006, United States of America	52 Adults	4 weeks	Pre-plated system vs Steamplacidity	Patient satisfaction, energy intake and plate waste	Food cart is more flexible for oncology patients, with 95% of patients preferring the bulk system. Improvements seen for to timing and variety. 90% of patients preferred portions, and 94% agreed that there were more appropriate food choices. 86% patients served by the bulk method thought food items were of correct temperature vs 21% served by pre-plated system.
10	Wilson <i>et al.</i> , 2000, United Kingdom	108 Adults	Not stated	Pre-plated system vs bulk system. (pilot)	Energy intake	Consumer satisfaction enhanced using the bulk system attributed to improvements in the texture and temperature of the food delivered.
12	Pieterma <i>et al.</i> , 2003, Canada	27 Adults	10 days	Pre-plated system vs bulk system	Patient satisfaction	
29	Hartwell and Edwards, 2001, United Kingdom	180 Adults	Not stated	Pre-plated system vs bulk system	Patient satisfaction	

APPENDIX I Continued

Reference number	Author/year	Number of participants	Duration	Food service systems	Outcomes	Conclusions
30	Wadden <i>et al.</i> , 2006, Canada	40 Children	2-week intervention	Pre-plated system vs room service	Patient satisfaction	Expectations of food service system greatly exceeded patient expectations using the room service method. 65% of group B participants rated food quality as exceeding or greatly exceeding expectations. Statistically significant improvements ($P < 0.001$) in overall satisfaction, quality, temperature and variety of foods with room service system.
19	Wilson <i>et al.</i> , 2001, United Kingdom	173 Adults	3 years	Pre-plated system vs bulk pre-plated at ward level vs Bulk point of service	Energy intake and plate waste.	Bulk pre-plated system resulted in a 113-kJ increase in energy ($P = 0.05$) and a 6.2-g increase in protein intake ($P = 0.006$). The bulk point of service system resulted in a 381-kJ increase in energy ($P = 0.002$) and a 5.3-g increase in protein intake ($P = 0.05$). Plate waste significantly reduced by 26% when adopting a point of service bulk system ($P < 0.001$).
13	White <i>et al.</i> , 2008, Australia	56 Children	6 months	Pre-plated system vs bulk system	Patient satisfaction, cost-effectiveness	A patient-centred snack trolley in a children's hospital significantly increased patient satisfaction, with 87.5% agreeing that the snack trolley improved the foodservice. A 33.3% reduction in foodservice costs was also found.
14	Williams <i>et al.</i> , 1998, United States of America	48 Children	4 weeks	Pre-plated system vs room service	Patient satisfaction, energy intake, plate waste and cost-effectiveness	Energy intakes significantly increased by 28% (314 kJ/day, $P = 0.008$) as well as an 18% increase in protein intakes with a room service system in paediatric oncology patients. Noted reductions in plate waste and call backs for new trays with patients eating 8% more of what they ordered. Projected savings of \$35 712 each year. Improved patient and parent satisfaction with excellent ratings increasing by up to 35%.
15	Hartwell and Edwards, 2003, United Kingdom	62/614 (weighed intakes/questionnaire) Adults	6 days	Pre-plated system vs bulk system	Patient satisfaction, energy intake, plate waste and total waste	Point of service delivery did not significantly increase energy intakes of patients ($n = 62$). Significant increases were seen in patient satisfaction and preferences ($n = 614$). Decreases were seen in plate wastage (5.7%, $n = 62$), with increases in trolley waste exceeding recommendations at a total of 20.5%.

16	Freil <i>et al.</i> , 2006, Denmark	969 Adults	42 days	Pre-plated system vs bulk system	Patient satisfaction, energy intake and total waste	<p>Total energy intakes increased significantly ($P < 0.05$) for patients in the lowest quartile of energy intakes at baseline (i.e. 128 kJ per patient). Intakes in this group were increased by 432 kJ immediately following implementation of the bulk system and increases of 891 kJ, from baseline, two years after its continued service.</p> <p>Patients that were placed in the second quartile of intakes at baseline, averaging at 1200 kJ per patient, showed significant increases of 400 kJ per patient following two years of bulk implementation.</p> <p>No significant increases in energy intakes were found when baseline energy intakes were above an average of 2000 kJ per patient.</p> <p>Total wastage reduction immediately after bulk service implementation was 18%; after two years this was further reduced by 9%.</p> <p>Increases in patient satisfaction with the bulk system were also found to be statistically significant ($P < 0.05$).</p>
17	Mclymont <i>et al.</i> , 2003, United States of America	1190 surveyed 230 baseline 68 intervention Adults	4 weeks	Pre-plated system vs room service (pilot)	Patient satisfaction, energy intake, plate waste	<p>Room service program resulted in a reduction in plate waste with 88.24% patients consuming more than 50% of their meal (compared with 44.78% when adopting the pre-plated method).</p> <p>Patient satisfaction was significantly higher among patients experiencing the room service system. Patients ranked room service higher than the pre-plated system in the areas of: timeliness of meals, taste, quality and temperature of food, attractiveness of food tray and variety of menu choices (no significance tests performed).</p> <p>Decreased waste caused by a reduction in duplicate trays</p> <p>Hospital 1: Statistically significant increases in taste ($P = 0.0015$), courtesy of server ($P = 0.0001$), receiving what was ordered ($P = 0.0002$) and overall satisfaction ($P = 0.0001$). Quantities improved from 'too much/not enough' to 'just enough'</p> <p>Hospital 2: Statistically significant increase in taste, courtesy of server, receiving what was ordered, overall satisfaction, presentation and improvements in food temperature ($P = 0.0001$ for all variables)</p> <p>No significant differences in food and labour costs.</p>
18	Folio <i>et al.</i> , 2002, United States of America	Hospital 1: 298 Hospital 2: 563 Adults	3 months	Pre-plated system vs Spoken menu ordered 2 hours before consumption (similar to Steamplivity system)	Patient satisfaction, cost-effectiveness	<p>Statistically significant increases in taste ($P = 0.0015$), courtesy of server ($P = 0.0001$), receiving what was ordered ($P = 0.0002$) and overall satisfaction ($P = 0.0001$). Quantities improved from 'too much/not enough' to 'just enough'</p> <p>Hospital 2: Statistically significant increase in taste, courtesy of server, receiving what was ordered, overall satisfaction, presentation and improvements in food temperature ($P = 0.0001$ for all variables)</p> <p>No significant differences in food and labour costs.</p>

APPENDIX I Continued

Reference number	Author/year	Number of participants	Duration	Food service systems	Outcomes	Conclusions
20	Larson and Toubro, 2007, Denmark	113 Adults	3 weeks	Pre-plated system vs room service (Free serving hours ad libitum a' la carte kitchen).	Energy Intake Patients divided into BMI < 25 kg/m ² and BMI > 25 kg/m ²	The introduction of an ad libitum a' la carte kitchen (Free) to cardiology patients only significantly increased energy intakes by 2500 kJ/d ($P < 0.001$) in participants whose BMI was >25 kg/m ² . This increase was due to significant increases in fat intakes ($P < 0.001$) with significant reductions in CHO intakes ($P < 0.001$).
21	Marson <i>et al.</i> , 2003, United Kingdom	15 Adults	5-day crossover	Pre-plated system vs bulk system	Total waste and cost-effectiveness	Bulk regeneration system was successful in reducing total ward waste at lunchtime by a total of 48%, potentially reflecting dietary intakes (not quantified) and reducing hospital stay. Statistically significant financial reductions were found ($P < 0.01$) with estimated annual financial savings per lunchtime, per ward of £1819.00.
22	Edwards and Nash, 1999, United Kingdom	966 patient meals Adults	24 hours for each system + extra lunch and evening meal	Pre-plated system vs bulk system	Plate waste and total waste	Plate waste was lowered with bulk system by 7.5%. However, total waste was increased by 22.5% as a result of food remaining on the trolley. System implemented did not reflect true bulk system with patients unable to see food items before service. Advantage of bulk system was the maintenance of acceptable temperature and improved presentation.
23	Kelly, 1999, United Kingdom	N/A (measurements of total ward waste based on amount sent) Adults	7 days (bulk system)	Pre-plated system vs bulk system	Patient satisfaction, plate waste and total waste	The data for the pre-plated system used for comparison with the bulk system was taken from study previously implemented. High level of trolley waste with the bulk system (average 50.5%), however still lower than total waste brought about by plated system (61.6%). Considerable plate waste reduction of 37.2%. Staff found bulk system time-consuming.