ORIGINAL ARTICLE

Validation and Reliability of a Questionnaire for Evaluating the Performance of Hospital Food Service Operations

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ABSTRACT

Introduction: This study aimed to identify standardized indicators for food service operations in Malaysian hospitals and to validate these indicators comprehensively. Methods: A new questionnaire was distributed to 160 government, private, and teaching hospital food service administrators. Construct validity and reliability were assessed using exploratory factor analysis (EFA), discriminant and convergent validity, composite reliability (CR), and internal consistency reliability. Results: The final Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (MSA) of EFA was 0.869. A total of 69.9% of the variation was explained by the factors "Food Production and Distribution Management," "Patient or Customer Service Management," and "Operational Management". Items correlation with factors grouping established internal consistency (Cronbach's alpha = 0.891). The AVEs above 0.5 showed convergent validity and composite reliability above 0.80, indicating the internal consistency of scale items. There were significant correlations between "Operational Management" and "Patient or Customer Service Management" ($r = 0.550$, $p < 0.01$), "Food Production and Distribution Management" ($r = 0.204$, $p < 0.01$), and "Operational Management" and "Food Production and Distribution Management" ($r = 0.156$, $p < 0.05$). The significant difference in subscale means for "Patient or Customer Service Management" (in-house: 2.96, outsourced: 2.55, $p < 0.05$) and "Food Production and Distribution Management" (in-house: 2.83, outsourced: 3.25, $p < 0.05$) between food service operations indicate discriminant validity. Conclusion: The findings of this study revealed that this questionnaire is validated and reliable, and further research should be undertaken to identify specific indicators that can be used to evaluate hospital food service quality.
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INTRODUCTION

The success of a food service operation primarily depends on its service quality. Healthcare food service operations must implement a comprehensive and progressive quality improvement strategy to maintain quality standards while improving organizational efficiency, productivity, and cost-effectiveness (1). Foodservice provision must carefully consider the inputs and the transformation process to produce high-quality results. The American Society for Quality (ASQ) defines "quality" as "a product or service that is free of defects, and the characteristics of a product or service that have any bearing on its ability to satisfy stated or implied needs" (2). Quality improvement increases customer satisfaction, reduces cycle times and costs, and minimizes errors and revisions.

Implementing quality management practices was also suggested to improve the efficacy and quality of services and goods provided by various organizations (3). Total quality management (TQM) is one of the most well-known and well-recognized strategies used in quality management. The TQM is a management philosophy emphasizing work processes and people to improve

customer satisfaction and organizational success (4). Balasubramanian (2016) defines TQM in healthcare services in three ways: the first definition focuses on an organization's strategy and attitude change to reduce costs while meeting the needs of patients and customers; the second is to increase patient satisfaction while accounting for all revenues and expenses during a healthcare procedure; and the third is to combine a management philosophy and a management method for continuous quality improvement (5). The main objective of applying TQM in hospital services is to constantly improve the quality of healthcare provision to meet patient expectations and improve treatment outcomes (6). In addition, studies have reported that quality improvement increases an organization's overall performance (7). The TQM can potentially reduce errors while facilitating the establishment of a patient-centered, safe, and effective system, resulting in increased patient satisfaction (7).

Furthermore, previous studies have illustrated the implementation of TQM in the food and beverages sector. Munizu (2013) discovered that implementing TQM practices impacts product quality performance if leadership, strategic planning, customer focus, information and analysis, people management, and process management are considered (8). Mambanda et al. (2017) discovered that the most effective TQM techniques for Zimbabwe's food and beverage sector comprised customer focus, management commitment and leadership, strategic planning, supplier quality management, staff training, and continuous improvement (9). However, few studies have concentrated on implementing total quality management for quality performance in the healthcare food service industry. Chong et al. (2000) identified three TQM characteristics when studying the perceived TQM process to evaluate the performance of food and nutrition service provision in healthcare organizations, including organizational, informational, and quality management (10). Generally, the TQM models discussed in earlier studies suggested that every managerial action consisted of planning, implementation, and assessment phases.

The literature thoroughly explains several models used in the food service industry to evaluate the quality of services. Among the models, the SERVQUAL model developed by Parasuraman was widely used to measure patient satisfaction with the quality of services provided by service organizations in the food service and healthcare sectors (11). However, the focus of the patient satisfaction survey on hospital food service is also a limitation; it is insufficient to gather information from patients about goals and interpersonal aspects that provide insight into patients' desires for individualized care (12). Previous research has revealed that gaining insight into hospital food service management is considered one of the strategies related to improving the quality of hospital food service operations (13). Besides that, the perspectives and experiences of stakeholders also aided in understanding the various factors involved in delivering hospital food, such as the food procurement process, food production, and food service to patients' orders, which affect patient satisfaction and food consumption (12, 14, 15). Thus, it is recommended that TQM be implemented in hospital services to improve healthcare service quality continually and fulfil patient expectations (5,7).

The use of a validate questionnaire as a measurement tool offers a robust, data – driven framework for enhancing strategic decision – making, service delivery, and quality improvement in hospital food service management (16). Specially, such a tool enables hospital administrators to identify and prioritize key areas for improvement through Importance – Performance Analysis (IPA), a method originally developed by Martilla and James (1977) (17). By revealing discrepancies between perceived importance and actual performance across critical domains such as menu planning, hygiene practices, and staff management, IPA facilitates more effective resource allocation and strategic planning. This particularly crucial in culturally diverse settings like Malaysia, where dietary need and preferences vary significantly across ethnic and religious groups (18).

Furthermore, the validated instrument enhances service delivery by collecting detailed, domain specific feedback from both patients and staff. Unlike conventional satisfaction surveys, it captures nuanced insights that inform targeted interventions, thus promoting more personalized and culturally sensitive care (19). Incorporating principles of TQM, the tool also supports continuous quality improvement by establishing baseline metrics for regular audits and longitudinal performance tracking (5). High internal consistency of the tool ensures reliable benchmarking and facilitates evidence – based decision making, including interventions such as staff training, process optimization, or equipment upgrades. Ultimately, the validated measurement instrument fosters accountability, transparency, and alignment with national healthcare goals.

Hospital food service operations are critical to patient care and impact healthcare facilities' general performance and patient satisfaction. Despite their significant importance, a noticeable gap exists in a standardized instrument for evaluating and enhancing their performance and effectiveness. Therefore, this study aims to address this gap by developing a validated and reliable tool for assessing the performance of hospital food services.

MATERIAL AND METHODS

Participant and procedure

The data collection for this study was conducted from January 2023 to June 2023. The convenience purposive

sampling method was used to select a respondent. Before data collection, the Ministry of Health in Malaysia, the Clinical Research Council, and the Research Management Institute at University Teknologi MARA approved ethics and data collection. Permission for data collection was obtained using phone calls, emails, and WhatsApp applications from the heads of departments or representatives from dietetics and food service provision at government, private, and teaching hospitals in Malaysia. Respondents were selected based on specific inclusion and exclusion criteria. After obtaining their verbal and informed consent, the respondents were provided with a link to a Google form containing the recently developed questionnaire to evaluate the performance of food service operations. To enhance the survey response rate, the researcher will contact the respondents using phone calls, emails, and the WhatsApp application to remind them to complete the survey. However, if respondents do not complete the survey after the third follow-up, they will be regarded to have withdrawn from the study.

Sample characteristics

The sample size for the exploratory factor analysis in this study was determined by considering the number of variables or items, the complexity of the factor structure, and the acceptable level of statistical power. This study employed a five-point Likert scale. Hence, the minimum sample number required for an exploratory factor analysis is 1:3 per item (20). Thus, 133 samples, which includes 20% of dropped out, is the minimal sample size needed for a 37-item scale. The respondents must be Malaysian citizens, be employed in the food service and dietetics department's administrative team in a position such as Head of department, general manager, dietitian or catering dietitian, catering or assistant catering officer, and possess at least six months of experience in the field. They are required to be fluent in Malay or English. Respondents were only included in the study if they met the inclusion criteria.

Research instrument

A recently developed questionnaire from a previous study by Osman et al. (16) was revised to conduct a contract validity and reliability test. The questionnaire is divided into three sections: Part A: Respondent and hospital demographic information; Part B: the importance of food service indicators for quality improvement; and Part C: Food service performance. A 5-point Likert scale was employed to evaluate the respondents' perceptions of the importance of food service indicators for quality improvement. The scale ranged from 1 to 5 on the importance of the indicators (1 = Not important, 2 = Less important, 3 = Important, 4 = Very important, 5 = Extremely important). The performance score ranged from 1 to 5 (1 = far below standard, 2 = below standard, 3 = meet standard, 4 = above standard, 5 = far above standard). Nevertheless, construct validity and reliability tests were conducted using importance indicators as part of the validation procedure.

Data analysis

The data analyses for construct validity and internal consistency reliability were conducted using IBM SPSS Statistics version 26 for Windows. All responses provided were used (no case-wise deletion), and no imputation was carried out. Each item that underwent testing for normality revealed that it was distributed normally. Nominal and ordinal data were summarised using frequencies and percentages, while continuous data were summarised using mean and standard deviation. This study employed exploratory factor analysis, discriminant and convergent validity, composite reliability estimation, and internal consistency reliability estimation to assess the validity and reliability of this newly developed questionnaire.

(i) Construct validity

Exploratory factor analysis was employed to evaluate construct validity and identify complex interrelationships between items and group items that are components of integrated constructs. The principal components method of extraction and varimax rotation were applied to estimate the number of factors and to provide decisions regarding the retention or rejection of individual items. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity were used to evaluate the null hypothesis and determine the appropriateness of the questionnaire items for factor analysis. The KMO values equivalent to or greater than 0.70 are generally acceptable. At the same time, those less than 0.50 are typically considered unacceptable, suggesting that the correlation matrix is not factorable (21). The analysis determined the number of factor solutions generated by eigenvalues greater than 1.0 for each factor. Items that did not meet the minimum commonalities of 0.46 and factor loading values of 0.49 were eliminated (22). The p-value was set at a level of statistical significance that was less than 0.05.

To ensure the questionnaire was reliable and valid, established thresholds were applied during exploratory factor analysis (EFA). A KMO value above 0.7 indicated adequate sampling and that item correlations were suitable for factor analysis (23). Factors with eigenvalues greater than 1.0 were kept, following Kaiser's rule, as they explained more variance than a single item. Item commonalities of at least 0.46 were accepted, since values above 0.4 are generally adequate in social science research. Factor loadings of 0.49 or higher confirmed strong links between items and their factors, improving interpretability and consistency. Together, these thresholds support the questionnaire's construct validity and reliability, ensuring it measures meaningful and stable underlying concepts.

Convergent validity was used to determine the level of correlation between distinct items of the same construct

that are in agreement by calculating the factor loading of the items, composite reliability (CR), and the average variance extracted (AVE). The reliability levels are higher when the values of AVE and CR are higher, with a range of 0 to 1. An AVE of 0.5 or greater indicates convergent validity (21). The formula for calculating the average variance is the sum of squared loadings divided by the number of items.

(ii) Discriminant validity

The discriminant validity of this study was assessed using Pearson's correlation, with the underlying assumption that items should correlate more strongly among themselves than with other items from other constructs that are not supposed to correlate. The correlation coefficient (r) was interpreted as negligible (0.00–0.10), weak (0.10–0.39), moderate (0.40–0.69), strong (0.70–0.89), and very strong (0.90–1.00) between the subscales (24). In addition, independent samples t-tests and ANOVA were used to compare the mean scores of the final sub-scale based on the type of hospitals, job positions, and food service operation. The level of statistical significance has been set at $\alpha = 0.05$ for all analyses.

(iii) Internal consistency and reliability of the items

The composite reliability (CR) and Cronbach's alpha were used to determine the internal consistency reliability of the overall scale and subscales (24). Internal consistency was considered acceptable when the Cronbach's alpha value exceeded 0.70 (24). The items in the test are highly correlated, as indicated by a high alpha level. The items in the test are highly correlated, as indicated by a high alpha level. The CR for each construct was determined by counting the squares of completely standardized factor loadings and dividing by this sum, including the total variance of the error term for the i^{th} indicators (24). The formula for calculating CR is as follows:

$$CR = \frac{\sum_{i=1}^{n} \lambda_i^2}{\sum_{i=1}^{n} \lambda_i^2 + \sum_{i=1}^{n} \mathrm{Var}(e_i)}$$

Where n is the number of items, λi is the factor loading of item (i), and Var (ei) is the variance of the error of item (i). Composite reliability values between 0.6 and 0.7 have been considered acceptable (25).

RESULTS

Demographic characteristics

The questionnaire was completed by 160 respondents, with 35 (21.9%) males and 125 (78.1%) females. The average age of the respondents was 33.31 (±5.560) years, with a range of age from 23 to 50 years. The majority of the respondents were catering or assistant catering officers (n = 95, 59.4%), followed by dietitians or catering dietitians (n = 37, 23.1%), heads of departments or operation directors (n = 21, 13.1%), and managers or catering managers (n = 7, 4.4%). The respondents' mean service duration ranged from 1 to 30 years, was 7.53 (±5.663) years. Among the respondents, 120 (75.0%) held a degree, 37 (23.1%) held a diploma, and three (1.9%) had completed a master's degree or Doctor of Philosophy (PhD) education qualification. Government hospitals (n = 101, 63.1%), private hospitals (n = 46, 28.7%), and teaching hospitals (n = 13, 18.1%) were the most frequently employed locations by the respondents. The information describing food service operations and the hospital background is presented in Table I.

Table I: Demographic characteristics of the respondents (n = 160)

Demographic characteristics	n (%)	Mean (SD)
Sex		
Male	35 (21.9)	
Female	125 (78.1)	
Age (years)		33.31 (5.650)
Job position		
Head of department/ director/ operation director	21 (13.1)	
Manager/ catering manager/ outlet manager	7 (4.4)	
Dietitian/ catering dietitian	37 (23.1)	
Catering officer/ assistant catering officer	95 (59.4)	
Length of service (years)		7.53 (5.663)
Academic qualification		
Diploma	37 (23.1)	
Degree	120 (75.0)	
Master/ Doctor of Philosophy	3 (1.9)	
Type of hospital		
Government	101 (63.1)	
Private	46 (28.7)	
Teaching	13 (18.1)	
Region of hospital location		
Northern	74 (43.6)	
Central west	36 (22.5)	
Southern	12 (7.5)	
East coast	28 (17.5)	
Sarawak/Sabah	10 (6.3)	
Location of hospital		
Urban	122 (76.3)	
Sub-urban	32 (20.0)	
Rural	6 (3.8)	
Number of hospital beds		
Less than 100	13 (8.1)	
100 to 249	33 (20.6)	
250 to 349	30 (18.8)	
350 to 500	18 (11.3)	
More than 500	66 (41.3)	
Type of food service operation		
In-house/ self-operated	117 (73.1)	
Outsourced / contracted	43 (26.9)	
Type of delivery system		
Centralised	106 (66.3)	
Decentralised	5 (3.1)	
Hybrid	49 (30.6)	
Type of food service system		
Conventional (cook-served)	141 (88.1)	
Ready-prepared (cook-chill or cook-freeze)	12 (7.5)	
Commissary (central production kitchen)	4 (2.5)	
Others	3 (1.9)	

Table II presents the items of the newly developed questionnaire. Most respondents rated six items as unimportant or less important, including the following: "Systematisation of the diet ordering process" (56.3%), "Staff courtesy when meals are served" (53.1%), "Existence of purchasing and ordering standards and procedures" (51.2%), "Nutritional analysis of menu" (50.1%), and "Appropriateness of workflow and workspace in the kitchen" (50.0%).

Table II: The constructs, items, and responses of the questionnaire (n = 160)

Construct	Question items[a]	% Not/ less important	% Moderately important	% Very/ extremely important
Operational management	1. Review the contract's specification/ standard of procedure (SOP) periodically.	44.4	22.5	33.1
	2. Systematisation of the diet ordering process.	56.3	16.9	26.8
	3. Food production cost control measures.	46.2	13.8	40.0
	4. Existence of purchasing and ordering standards and procedures.	51.2	30.0	18.8
	5. Inspection of all food ingredients at all points (e.g., receiving, storing, food preparation, etc.).	49.4	33.1	17.5
Food production and distribution management	6. Utilisation of a variety of ingredients.	33.7	25.6	40.7
	7. Temperature control of raw materials and storage area.	46.3	24.4	29.3
	8. Kitchen staffs in neat and clean uniforms.	34.4	31.9	33.7
	9. Verify if any infectious diseases are present among the staffs.	44.4	18.1	37.5
	10. Nutritional analysis of menu.	50.1	16.2	33.7
	11. Menu evaluation.	36.2	29.4	34.4
	12. Establishing standards for nutritional recommendations and menu planning.	46.3	25.6	28.1
	13. Routine daily monitoring and food tasting before food delivery to wards.	42.5	35.0	22.5
	14. Utilisation of standardised recipe in the development of normal and therapeutic menus.	32.5	28.7	38.8
	15. Monitoring the temperature of heated food during transportation to wards.	46.3	27.5	26.2
	16. Monitoring the cleanliness of food production and assembly areas.	35.7	38.8	25.5
	17. Monitoring and regulating the time of food distribution.	41.9	28.1	30.0
Patient/ customer service management	18. Overall patient/ customer satisfaction.	46.3	20.6	33.1
	19. Overall food quality and taste.	45.6	23.1	31.3
	20. Providing a variety of food choice for patient with normal diet.	44.4	19.4	36.2
	21. Offering a menu with a variety of cooking styles for patients on therapeutic diets.	42.5	34.4	23.1
	22. Various selection of healthy and appetising menus.	38.2	32.5	29.3
	23. Providing information about diet order for inpatients.	39.4	21.9	38.7
	24. Staff courtesy when meals are served.	53.1	15.0	31.9
	25. Kitchen porters in clean and tidy uniforms while meals are being served in the wards.	35.7	28.7	35.6
	26. Keeping the food at a consistent temperature while it is being served.	31.2	23.8	45.0
Equipment and facilities management	27. Appropriateness of workflow and workspace in the kitchen.	50.0	23.1	26.9
	28. The accessibility of lift during food delivery.	48.8	20.6	30.6
	29. Establishing good ventilation system in the kitchen and assembly area.	43.8	26.9	29.3
	30. Management of safety in food service facilities.	43.2	28.7	28.2
	31. Cleaning and sanitary management of food production and assembly area.	42.5	30.6	26.9
	32. Utilisation of appropriate food trolleys to maintain temperature during food delivery.	60.0	15.0	25.0
Staff management	33. Staff training programmes other than therapeutic meal training (e.g., leadership training, stress management, halal practice course, GMP, etc.)	42.5	33.8	23.7
	34. Therapeutic meal training program for all food handler staffs.	41.9	29.4	28.7
	35. Ratio of staffs and the job description.	41.9	30.6	27.5
	36. Evaluation of staff skill/ competency.	41.9	28.7	29.4
	37. Management of staff working behaviours.	48.8	19.4	31.8

[a]Responses were on a 5-point Likert scale: Not important/ Less important/ Moderately important/ Very important/ Extremely important.

Validity and reliability of the questionnaire

The KMO measure of sampling adequacy (MSA) was 0.899, as indicated by the initial EFA, suggesting that the data was appropriate for factor analysis. The results were shown to be significant by Bartlett's Test of Sphericity, with a value of $\chi2(666) = 5478.845$ ($p < 0.001$), indicating that they are acceptable for factor analysis. Five factors were identified by analyzing scree plots and Eigenvalues exceeding 1.0, which accounted for 69.9% of the total variance. However, Item 13 did not substantially load any construct during the initial EFA. There were 17 items (Items 17, 21, 22, 23, 24, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37) loaded onto a factor other than its important factor. Therefore, the 18 items were excluded from the subsequent analysis.

The Kaiser–Meyer–Olkin MSA was found to have a value of 0.869 by the repeated EFA. Bartlett's Test of Sphericity results indicated statistical significance, with a value of 2315.642 ($p < 0.001$). Three factors were identified by analyzing scree plots and Eigenvalues more significant than 1.0, collectively accounting for 66.9% of the variance explained. However, Item 3 was eliminated due to its multiple factors loading, and Item 15 was excluded due to its loading into another factor. The final EFA revealed that the Kaiser-Meyer-Olkin MSA had a value of 0.857, and the results of Bartlett's Test of Sphericity were significant, with a value of $\chi2(153) = 1906.026$ ($p < 0.001$). The analysis of scree plots and Eigenvalues exceeding 1.0 revealed three factors that accounted for 69.9% of the variance explained. "Food Production and Distribution Management", "Patient or Customer Service Management", and "Operational Management" were identified as the factors of the questionnaire scale, with the factor loadings ranging from 0.575 to 0.893. Finally, the sum of the commonalities among all revised items exceeded 0.50. The factor loadings, communalities (h2), and percentage of variance for principal factor extraction and varimax rotation on revised items were presented in Table III.

Table III: Varimax rotation, factor loadings, communalities (h^2), and percentage of variance for the principal component factor extraction on the revised items. (n = 160)

Item	F1	F2	F3	h^2
9. Verify if any infectious diseases are present among the staffs.	.893			.803
10. Nutritional analysis of menu.	.879			.779
6. Utilisation of a variety of ingredients.	.852			.754
11. Menu evaluation.	.838			.721
14. Utilisation of standardised recipe in the development of normal and therapeutic menus.	.825			.741
7. Temperature control of raw materials and storage area.	.818			.683
12. Establishing standards for nutritional recommendations and menu planning.	.816			.684
8. Kitchen staffs in neat and clean uniforms.	.729			.630
16. Monitoring the cleanliness of food production and assembly areas.	.575			.557
20. Providing a variety of food choice for patient with normal diet.		.867		.763
18. Overall patient/ customer satisfaction.		.819		.727
19. Overall food quality and taste.		.786		.709
25. Kitchen porters in clean and tidy uniforms while meals are being served in the wards.		.739		.621
4. Existence of purchasing and ordering standards and procedures.			.842	.741
5. Inspection of all food ingredients at all points (e.g., receiving, storing, food preparation, etc.).			.804	.663
2. Systematisation of the diet ordering process.			.697	.677
1. Review the contract's specification/ standard of procedure (SOP) periodically.			.690	.629
Percent of variance	38.085	23.931	7.884	
Cumulative percent variance	38.085	62.016	69.899	

Note: F1 – Food production and distribution management; F2 – Patient/customer service management; F3 – Operational management

Internal consistency for the factors of "Food Production and Distribution Management," "Patient or Customer Service Management," and "Operational Management" had Cronbach's alpha values of 0.935, 0.864, and 0.826, respectively, confirming the reliability of the questionnaire. Cronbach's alpha coefficient for the factors with total scale reliability was 0.891, signifying that the items correlated with their factor grouping, thereby establishing internal consistency. The AVE values corresponding to the factors for "Food Production and Distribution Management," "Patient or Customer Service Management," and "Operational Management" were 0.653, 0.647, and 0.579, respectively. The AVE values were greater or equal to 0.5, confirming the convergent validity. The composite reliability values for "Food Production and Distribution Management," "Patient or Customer Service Management," and "Operational Management" were 0.944, 0.879, and 0.845, respectively, demonstrating internal consistency in scale items. The summary of reliability results for the revised questionnaire is displayed in Table IV.

Table IV: The summary for Composite Reliability (CR), Average Variance Extracted (AVE), and Internal Consistency Reliability (Cronbach's alpha) of the finalised questionnaire. (n=160)

Constructs	*Reliability (Cronbach's alpha)	AVE	CR
Factor 1: Food production and distribution management	0.935	0.653	0.944
Factor 2: Patient/customer service management	0.864	0.647	0.879
Factor 3: Operational management	0.826	0.579	0.845

Table V summarizes the descriptive statistics (means and standard deviations) for the three subscales of the revised hospital foodservice performance questionnaire, along with Pearson's correlation coefficients (r) indicating the relationships among the subscales. A moderate positive correlation was found between "Operational Management" and "Patient or Customer Service Management" ($r = 0.550$, $p < 0.01$), suggesting a significant association between operational efficiency and the quality of patient–service delivery. This indicates that improvements in contract's specification and purchasing standard of procedure, inspection of food ingredients, and systematic diet ordering process may contribute to enhanced food service quality and patient satisfaction. In contrast, "Food Production and Distribution Management" demonstrated a weak positive correlation with "Patient or Customer Service Management" ($r = 0.204$, $p < 0.01$). This suggests that while back-end processes such as meal preparation, menu analysis, staff hygiene and tray delivery service do influence patient perceptions, their impact may be less direct or mediated by other factors. The correlation between "Operational Management" and "Food Production and Distribution Management" was also weakly positive ($r = 0.156$, $p < 0.05$), indicating limited alignment between administrative operations and kitchen-based production workflows. This may reflect structural or functional separation between departments, potentially affecting overall system integration. These findings collectively suggest that while each subscale represents a distinct domain of hospital food service performance, "Operational Management" plays a more central role in shaping patient experiences, whereas "Food Production and Distribution Management" may require targeted strategies to enhance its visibility and impact on service quality.

Table V: Pearson's correlation coefficients (*r*) and means (SD) of the revised subscales (n = 160)

	Mean (SD)	Food production and distribution management	Patient/ customer service management	Operational management
Food production and distribution management	2.94 (1.01)	1.000	.204**	.156*
Patient/ customer service management	2.85 (1.07)	.204**	1.000	.550**
Operational management		2.55 (0.91)	.156*	.550**

*$p < 0.01$, **$p < 0.05$

The categories of hospital type, job position, and type of food service operation were considered while analyzing the differences between the revised subscales, as shown in Table VI. A comparison of subscale means between different kinds of hospitals revealed significant differences in "Operational Management" (government: 2.73, private: 2.28, teaching: 2.14, $p < 0.01$) and "Patient or Customer Service Management" (government: 2.74, private: 2.28, $p < 0.01$). The results also show significant differences in averages between different "Patient or Customer Service Management" job types. The results showed that there was a significant level of $p < 0.05$ for Dietitian/Catering dietitian (2.43), Director/Operation director/Head of department (2.85), Manager/Catering manager/Outlet manager (2.64), Catering officer/ Assistant dining officer (3.03). A significant difference was observed in the subscale means between different types of food service operations when it came to "Patient or Customer Service Management" (in-house: 2.96, outsourced: 2.55, $p < 0.05$) and "Food Production and Distribution Management" (in-house: 2.83, outsourced: 3.25, $p < 0.05$). The findings demonstrated that the newly developed questionnaire to evaluate the performance of hospital food service operations had demonstrated discriminant validity.

Table VI: Mean differences across hospital types, job positions, and food service operations in the revised subscales (n = 160)

		Mean (SD)		
		Food production and distribution management	**Patient/ customer service management**	**Operational management**
Type of hospital	Government	2.97 (0.94)	3.05 (1.09)	2.73 (0.88)
	Private	2.83 (1.16)	2.42 (0.98)	2.28 (0.94)
	Teaching	3.14 (0.91)	2.85 (1.07)	2.14 (0.67)
	F-value	0.59	5.76**	5.61**
Job position	Director/ Operation director/ Head of department	2.74 (0.91)	2.85 (0.95)	2.56 (0.91)
	Manager/ Catering manager/ Outlet manager	3.52 (1.25)	2.64 (1.06)	2.29 (1.25)
	Dietitian/ Catering dietitian	2.90 (1.02)	2.43 (1.06)	2.24 (0.83)
	Catering officer/ Assistant catering officer	2.96 (0.96)	3.03 (1.06)	2.69 (0.89)
	F-value	1.11	3.00*	2.45
Type of food service operation	In-house	2.83 (0.97)	2.96 (1.10)	2.61 (0.89)
	Outsourced	3.25 (1.05)	2.55 (0.92)	2.39 (0.94)
	t-value	-2.38*	2.22*	1.34

*$p < 0.05$. **$p < 0.01$

DISCUSSIONS

The purpose of this study was to evaluate the recently developed questionnaire to ensure that it is valid and reliable for use in assessing food service operations for quality improvement in Malaysian hospitals. This newly developed questionnaire was revised using exploratory factor analysis and showed excellent internal reliability. It covered various relevant aspects and was straightforward for food service personnel to complete. The questionnaire demonstrated discriminant validity based on the pilot study done in hospitals nationwide. However, further evidence of discrimination and responsiveness was required before suggesting its usage to guide or evaluate improvement for hospital food service operations in Malaysia.

The questionnaire in this study was designed within a Total Quality Management (TQM) framework to guide food service managers in developing strategies for operational improvement, initially incorporating five TQM components—customer focus, staff training and education, process management, people management, and quality improvement. Following validation, only three sub-scales, aligned with domains in implementation theory and focusing on customer focus and process management, were retained. This contrasts with previous studies, such as Chong et al. (2000), which identified components like information, quality management, and organizational management, and Mentziou et al. (2014), who recommended further TQM-based research due to inconsistent recognition of factors such as temperature and hygiene standards in hospital food service quality oversight (11, 26). Two initially proposed sub-scales, Equipment and Facilities Management and Staff Management, were removed after exploratory factor analysis revealed that aspects such as kitchen workflow, workstation setup, and use of food trolleys for temperature maintenance were considered less critical for quality evaluation. This finding diverges from Ahmed's (2018) study in Egyptian hospitals, which emphasized the necessity of adequate tools, well-planned kitchens, proper receiving areas, adherence to production plans, and regular monitoring of food temperatures to ensure high-quality food production and service (14).

The study's descriptive analysis found that factors such as staff courtesy during meal service, systematic diet ordering, purchasing and ordering standards, menu nutritional analysis, and ordering practices were perceived as non-essential for evaluating food service quality. Prior research, including Ahmed et al. (2015), identified patient expectations, food production, nutritional considerations, and menu variety as key influences, with a Malaysian public hospital study noting that limited menu variety and lack of advance menu information contributed to patient dissatisfaction, alongside inadequate staff assistance during meal delivery (15, 18). The "Staff Management" sub-scale was removed after exploratory factor analysis due to item overlap with other factors, despite respondents considering its elements important. Comparisons with an Australian study on food service satisfaction in elderly care facilities highlighted domains such as family expectations, job satisfaction, food quality, staff training, consultation, and resident relationships as critical (27). Similarly, Ahmed (2018) underscored the importance of staffing levels, skills, training, and communication in improving food production systems, emphasizing the value of staff development programs and effective communication strategies (14).

Exploratory factor analysis retained three sub-scales including "Operational Management", "Patient/ Customer Service Management", and "Food Production and Distribution Management" with the latter showing high internal consistency and strong factor loadings,

indicating its importance. Food production in hospitals is a complex process involving elements such as cooking techniques, standard recipes, and portion control, all of which affect cost and quality (14). However, studies have shown that staff often rely on personal experience rather than standard recipes, raising concerns about consistency and safety (14,15). Food safety is a critical issue, as improper handling, poor hygiene, and unsanitary preparation areas can lead to contamination and foodborne illnesses, with pathogens potentially introduced at any stage from preparation to distribution (28,39). Ahmed (2018) reported unhygienic and disorganized food preparation environments, improper storage, and inadequate attention to personal hygiene among staff (14). To address these risks, regular education and training of food service personnel are essential to improve knowledge, ensure proper food handling practices, and support the effective implementation of hospital food safety measures.

In the "Patient/Customer Service Management" subscale, four items were rated as highly important with strong factor loadings: 'providing a variety food choices for patients with a normal diets', 'overall patient/customer satisfaction', 'overall food quality and taste', and 'kitchen porters are dressed in clean and tidy uniforms while meals are served in the ward'. Studies consistently show that food quality and service level are key drivers of patient satisfaction, with staff manners, attitudes, and appearance significantly influential perceptions of food quality. While most patients report satisfaction with meals and service, concerns remain regarding staff hygiene and meal temperature (30,31). In the "Operational Management" subscale, one item was eliminated during factor analysis as the item was loaded into the "Food Production and Distribution Management subscale". Cost-control strategies were emphasized as vital for improving hospital food service operations. Effective cost management such as using activity-based costing, supervising staff to ensure standardized recipes are followed, maintaining equipment, and minimizing preparation waste can enhance efficiency and quality. Managers play a crucial role in forecasting meal portions and tracking prepared, served, and consumed quantities to reduce leftovers and optimize resource use (32,33).

The study found that although "Systematisation of the diet ordering process" was considered less important, it had a high factor loading, highlighting the need for reliable, error-free diet prescriptions particularly for therapeutic menus, where inaccuracies can have serious health and safety consequences (34). Delivering large volumes of meals accurately and on time in hospitals is complex and prone to errors, with translation mistakes identified as a common cause in Thai hospitals; reducing transcription steps could help prevent such issues (35,36). The newly developed questionnaire demonstrated strong internal consistency reliability, with Cronbach's alpha and composite reliability (CR) values exceeding 0.70 across all sub-scales, and convergent validity confirmed through average variance extracted (AVE) values above 0.5, high CR, and strong factor loadings (19). These results indicate that the questionnaire is a reliable and valid tool for assessing hospital food service performance in Malaysia and identifying areas for quality improvement.

This study's discriminant validity analysis revealed positive associations among the three key indicators of hospital food service operations: "Operational Management", "Patient/Customer Service Management", and "Food Production and Distribution Management", and demonstrated the questionnaire's potential to detect variations in meal service, policies, and operational management across hospitals. While no significant differences were found between in-house and outsourced operations for key performance indicators, subscale scores varied by hospital type and job position, with catering officers and assistant catering officers scoring higher in patient or customer service management, reflecting their deeper understanding of patient preferences, as noted by Vijayakumaran et al. (2018) (13). These findings highlight the value of diverse staff participation in evaluations, though job roles should be considered a potential confounder in cross-hospital or longitudinal comparisons. Notably, differences emerged between in-house and outsourced operations in food production, distribution, and patient service management, contrasting with South Korean research where in-house services outperformed outsourced ones (37).

The findings of this study underscore the multifaceted nature of hospital foodservice operations and the critical need for targeted, evidence-based interventions to enhance patient satisfaction, nutritional intake, and operational efficiency. Drawing from both empirical data and recent literature, several practical strategies are recommended to address the limitations identified and support continuous quality improvement. This study reinforces the importance of three interrelated subscales: operational management, food production and distribution, and patient/customer service in shaping the overall quality and performance of hospital food service systems in Malaysia. To strengthen operational management, hospitals should implement centralised plating systems and optimised meal ordering protocols. These approaches improve portion control, reduce food waste, and enhance workflow efficiency. Evidence from Malaysian hospitals suggests that digital ordering prompts and revised foodservice contracts can significantly improve service delivery and consistency (39,40). Upgrading kitchen equipment and aligning food service specifications with current operational needs are also critical for long-term sustainability.

In terms of food production and distribution, strategic menu planning that reflects Malaysia's multicultural dietary landscape is essential. Incorporating halal-

certified meals, regional flavors, and rotating menus across ward classes can reduce monotony and better meet patient expectations (39). Enhancing food presentation and temperature control through insulated trays and culturally familiar garnishing has been shown to positively influence patient intake and satisfaction (40). Distribution systems should also be streamlined, with clear coordination between catering officers, kitchen staff, and central porterage services to ensure timely and hygienic meal delivery (41).

Finally, improving patient/customer service management requires a shift toward flexible meal timing, room service models, and real-time feedback mechanisms. These interventions promote patient autonomy and reduce clinical disruptions during mealtimes. Mixed-mode survey administration—combining digital platforms with face-to-face engagement—can capture diverse patient and staff perspectives, guiding service refinement (42). Staff training programs focused on food safety, communication, and accountability are essential for fostering a responsive and patient-centered foodservice culture. Collectively, these strategies offer a scalable and culturally attuned framework for enhancing hospital foodservice operations in Malaysia.

This study introduces a newly developed and revised questionnaire designed to evaluate hospital food service performance across three core domains: operational management, food production and distribution management, and patient/customer service management. A key strength of the instrument lies in its rigorous development and validation process, which drew upon the expertise of a multidisciplinary panel comprising food service professionals, researchers, and academicians. This approach ensured that the instrument achieved both content relevance and contextual appropriateness for hospital settings. Face validity was further reinforced through triangulation of expert feedback, a comprehensive literature review, and experiential insights from target users, thereby enhancing its cultural resonance and practical applicability within Malaysian hospitals.

Preliminary findings provide support for discriminant validity; however, further psychometric testing is required to fully establish construct validity, criterion validity, test–retest reliability, and responsiveness to change. These additional evaluations are critical to confirming the instrument's stability, predictive capability, and sensitivity to the effects of quality improvement interventions. Confirmatory Factor Analysis (CFA) is recommended to test the hypothesized factor structure and evaluate model fit indices such as Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Tucker–Lewis Index (TLI) (43). In the present study, Exploratory Factor Analysis (EFA) was employed instead, due to constraints related to sample size and subgroup imbalance. EFA is particularly appropriate in the early stages of scale development, when theoretical models are still being refined (44,45).

The decision to defer CFA aligns with methodological guidelines recommending a minimum sample size of 200 for robust factor structure validation (46,47). In this study, the limited number of participants and uneven subgroup distribution restricted the ability to perform multi-group CFA or assess discriminant validity across demographic categories. Future research should prioritize recruiting larger and more demographically balanced samples to enable multi-group CFA, allowing for the assessment of measurement invariance and subgroup-specific validity.

Practical challenges were also encountered in the administration survey, including a low response rate among foodservice staff and a shortened data collection period. Such challenges are common in hospital-based research, where heavy workloads, shift schedules, and institutional gatekeeping may limit staff availability (48). To address these barriers, strategies such as on-site hospital visits, online survey distribution, and appointments of hospital-based liaisons are recommended to improve engagement and follow-up. Mixed-mode administration and personalized communication have also been shown to enhance response rates in healthcare surveys.

CONCLUSIONS

This study demonstrates that the newly developed questionnaire, adapted from previous research, is a valid and reliable instrument for assessing hospital foodservice operations in Malaysia. Factor analysis confirmed the presence of key dimensions such as operational management, food production and distribution, and patient/customer service management, that are central to evaluating and improving hospital food service performance. The findings highlight the importance of menu planning design, food hygiene and safety, food quality, meal ordering systems, operational standards and procedures in enhancing both nutritional outcomes and patient satisfaction. Practical strategies such as centralised plating, flexible meal timing, and real-time feedback systems present scalable, context-appropriate solutions for Malaysian healthcare settings. Future research should undertake longitudinal evaluations to determine the sustainability, cost-effectiveness, and clinical impact of such interventions. Areas of particular promise include the integration of digital food service platforms, application of computational gastronomy in therapeutic diet design, and implementation of multidisciplinary collaboration models. Further psychometric testing, especially to establish construct validity, responsiveness to change, and measurement invariance across demographic groups will strengthen the tool's applicability for continuous quality improvement. Comparative analyses between public and private institutions, as well as rural and urban contexts, could

yield valuable insights into the structural and cultural factors influencing food service performance. These directions will support the development of a more resilient, patient-responsive, and culturally standards for hospital food service system in Malaysia.

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