

#### ORIGINAL RESEARCH

# Measuring the quality of Hospital Food Services: Development and reliability of a Meal Quality Audit Tool

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#### **Abstract**

**Aim:** To develop and test the reliability of a Meal Quality Audit Tool (MQAT) to audit the quality of hospital meals to assist food service managers and dietitians in identifying areas for improvement.

**Methods:** The MQAT was developed using expert opinion and was modified over time with extensive use and feedback. A phased approach was used to assess content validity and test reliability: (i) trial with 60 dietetic students, (ii) trial with 12 food service dietitians in practice and (iii) interrater reliability study. Phases 1 and 2 confirmed content validity and informed minor revision of scoring, language and formatting of the MQAT. To assess reliability of the final MQAT, eight separate meal quality audits of five identical meals were conducted over several weeks in the hospital setting. Each audit comprised an 'expert' team and four 'test' teams (dietitians, food services and ward staff). Interrater reliability was determined using intra-class correlation analysis.

**Results:** There was statistically significant interrater reliability for dimensions of Temperature and Accuracy (P < 0.001) but not for Appearance or Sensory. Composition of the 'test' team appeared to influence results for Appearance and Sensory, with food service-led teams scoring higher on these dimensions. 'Test' teams reported that MQAT was clear and easy to use.

**Conclusions:** MQAT was found to be reliable for Temperature and Accuracy domains, with further work required to improve the reliability of the Appearance and Sensory dimensions. The systematic use of the tool, used in conjunction with patient satisfaction, could provide pertinent and useful information regarding the quality of food services and areas for improvement.

Key words: audit, food service, hospital, meal, quality, reliability.

#### Introduction

The quality of institutional food services is important as it influences patient/client nutritional intake as well as the satisfaction with their overall experience.<sup>1-4</sup> The prevalence of malnutrition in hospital and residential aged care settings is reported to be in the order of 30 and 50%, respectively.<sup>5,6</sup> The causes of malnutrition are both diverse and complex, with inadequate nutritional intake contributing substantially.<sup>5,7</sup>

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The reasons behind inadequate nutritional intake are multifactorial and may be the result of an individual's age and/or disease-related factors and also the quality of the nutrition and food service provided.<sup>8,9</sup> Numerous studies have reported that meal quality can influence a patient's level of consumption.<sup>2,10,11</sup> Consequently, hospital food must satisfy standards of quality as well as provide the nutritional requirements of patients, taking food preferences into account.

Patient satisfaction is a widely accepted measure of food service quality, <sup>12–16</sup> with it being considered a key indicator of health-care quality. <sup>17</sup> Meal quality has been identified as a key aspect of patient satisfaction with hospital food services <sup>18–21</sup>; however, patient satisfaction with hospital food services is a complex phenomenon, and a patient's assessment of meal quality is likely to be influenced by many factors, including expectations of the hospital food, interactions with staff and the often negative experience of being hospitalised. <sup>22</sup> Patients can only comment from a subjective perspective on a limited number of components

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of the meal, including appearance, smell and taste, but rarely on other quality components, including accuracy (e.g. correct serve size or texture) or nutritional quality. One study reported that patient opinions about meal quality were often conflicting and not adequate from a food service quality improvement standpoint. These findings were reinforced in another study that found that patients can describe and appraise quality overall; however, they do not provide feedback that is rich enough to understand the source of a problem or what food services could do in terms of quality improvement.<sup>23</sup> Satisfaction is largely related to expectation, 16 so if an expectation of the quality of the food service is low, then satisfaction may be ranked highly, and no incentive for improvement is provided. Given the breadth of findings among studies that look at meal quality improvement from the patient's perspective, there is a distinct paucity of literature around hospital meal quality beyond patient feedback, with very few studies using meal quality-specific indicators as the key measure. 18,20,24 In response to this, a tool was developed to audit the quality of hospital meals in order to systematically identify areas for ongoing improvement. The purpose of this paper is to describe the development and determine the interrater reliability of the Meal Quality Audit Tool (MQAT).

#### **Methods**

The MQAT was developed for use in practice to determine the quality of a delivered meal during a normal meal service at the point of service to patients. The primary dimensions of the tool are Appearance, Temperature, Accuracy (tray) and Sensory. The four dimensions of the MQAT are summarised in Table 1, along with the assessment items, process and scoring.

The MQAT was developed by the primary author in 1994 using expert opinion and was modified over time with extensive use across four metropolitan and regional hospitals and feedback from dietitians and food service managers to improve usability and usefulness. In 2009, after 15 years of use in practice, a phased approach was used to refine the MQAT and test the interrater reliability. In Phase 1, 12 groups of undergraduate dietetic students (total n = 60) were surveyed about their definition of meal quality to test content validity. Students then used the tool to assess a test meal and provided feedback on the usability. Students were chosen to test the tool as they were naïve to the tool itself but had some skills and understanding of the desired outcome. Modifications were then made to the language in the MQAT (e.g. 'appealing' was used instead of 'attractive' to describe the appearance of the meal) and a change to a numerical scoring system (rather than percentages).

Phase 2 was also completed in 2009 and involved testing the revised MQAT with senior dietitians working in patient food services (n = 12). The dietitians trialled the tool in their practice and completed a survey to further test the content validity of the MQAT and gain feedback

on the usability and usefulness in practice. The experts were also asked to provide scores as a percentage for each of the quality domains, which were then compared to the scores provided by the rating system of the tool. From the survey responses, it was clear that the experts agreed with the scoring and weighting of the four dimensions, confirming the content validity of the tool. Temperature targets were also modified to reflect the temperatures required for meal quality rather than food safety. Finally, minor modifications were made to the MQAT instructions and formatting to improve usability. The final MQAT is included in the Appendix.

In 2012, a series of audits were conducted to determine the reliability of the finalised MQAT as Phase 3 of the study. Eight separate meal quality audits were conducted over several weeks. These were carried out in a large metropolitan tertiary referral hospital, where approximately 1700 patient meals are centrally hot-plated every day using a heat-serve food production system. To determine the interrater reliability of the tool, at each audit, five identical plated meals were independently audited by five teams: one 'expert' team (reference standard) and four 'test' teams. The 'expert' team comprised at least three of the same four dietitians (MB, MHJ, AB and another food service dietitian), who were all experienced in food services and in the use of the MQAT. Consistent with recommended procedures (Table 1), the 'test' teams each had three members and consisted of at least one dietitian, one senior food services staff member and one other health professional (e.g. nursing or allied health staff member). Teams were led by either a dietitian or food service officer trained to use the tool. At each audit, the identical meals were inspected by the 'expert' team for consistency. All teams then simultaneously and independently conducted the audits according to the recommended MQAT procedure. The audits took each team between 10 and 15 minutes to complete. A different diet order was selected for each of the eight meal quality audits (three texture modified diets; four high-protein, high-energy diets; one full diet), and systematic errors were made at three of the audits (e.g. item missing or food spill). Scores for each element of the MQAT from each team and each audit were calculated. In addition to completing the MQAT, teams completed a brief evaluation related to the content validity and usability of the MQAT, as well as providing an opportunity for suggestions for improvement. This project was approved by the Human Research Ethics Committee as a quality improvement activity.

Agreement between the 'expert' and 'test' teams was determined by noting the number of occasions when the score of the audit teams was within 0.5 points of the expert team. The degree of agreement between teams was further assessed using intra-class correlation analysis using the one-way random model for each of the four variable scales (Appearance, Temperature, Accuracy, Sensory) across meals. For the purpose of analysis, each team is considered a unit (i.e. one rater). Statistical analyses were conducted using SPSS version 21.0 (IBM Corp. Armonk, NY, USA).

 Table 1
 Overview of the Meal Quality Audit Tool (MQAT) and procedures

			Scoring (score	Scoring (score of 1–5, 5 being highest)	ghest)			Calculating final score (final score of 1–5 5 being highest)
	Items assessed	Items assessed Assessment process	5	4	3	2	1	(home 0 0 1)
Appearance	Tray setting complete meal	Visual inspection Very	Very appealing	Appealing	Okay	Unappealing	Very unappealing	Sum of Score <sub>tray setting</sub> $\times$ 3 and Score <sub>complete meal</sub> $\times$ 7 ÷ 10
Temperature	Temperature Each meal item Thermometer probe, compared t	Thermometer probe, compared to	All items 'correct' <sup>(b)</sup>	All items 'correct' <sup>(b)</sup> or 'adequate' <sup>(c)</sup>	<del>_</del>	3 items 'inadequate'(d) OR 1 item	>3 items 'inadequate'(d) OR >2 items	Score 1–5 (as described)
		predetermined targets <sup>(b)</sup> –(f)			risk <sup>(f)</sup> item 'inadequate <sup>,(d)</sup>	'unacceptable' <sup>(e)</sup>	'unacceptable'(e) OR >1 high risk <sup>(f)</sup> item 'unacceptable' <sup>(e)</sup>	
Accuracy	Table setting, food items, portion size, food texture	Visual inspection No errors	No errors	l error	2 errors	3 errors	4+ errors OR 1 critical diet error <sup>(g)</sup>	Sum of Score <sub>table setting</sub> × 1 and Score <sub>food items</sub> × 4 and Score <sub>portion</sub> × 2 and Score <sub>food</sub>
Sensory	Aroma, temperature, appearance,	Taste testing of each meal item	Very good	Good	Okay	Poor	Very poor	Average of score for each meal item

taste, texture Audit procedures 1. An audit team is formed, with staff representing at least the following areas: dietetics, food services and ward nursing/allied health/medical. A group leader is required and must be trained in the use of the tool (via written training manual and demonstration of a meal quality audit by a trained auditor).

2. An extra meal is ordered and delivered to the ward as per usual processes.

3. The team audits this meal after delivery of the last patient meal, using the MQAT

4. Scores are decided by the group through consensus.

5. Audits to be scheduled once per week (rotating through all meals, all days of the week and different diets), with additional ad hoc audits if negative feedback is received All results from the audits are used to inform continuous quality improvement of the patient foodservice. regarding a particular food item or meal to address this issue in a timely manner

(a) Refer to https:/www.health.qld.gov.au/nutrition/resources/fs\_mqatfor for full MQAT and procedures.

<sup>(</sup>b) Correct: >60 °C (hot food), >65 °C (hot liquid), <10 °C (cold items), frozen (frozen items).

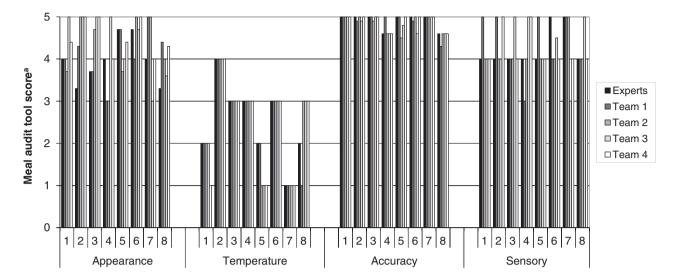
<sup>©</sup> Adequate: >55 °C (hot food), >60 °C (hot liquid), 10–15 °C (cold items), soft but still solid (frozen items).

<sup>(</sup>d) Inadequate: 50-55 °C (hot food), 55-60 °C (hot liquid), 15-20 °C (cold items), starting to melt (frozen items).

<sup>(</sup>e) Unacceptable: <50 °C (hot food), <55 °C (hot liquid), >20 °C (cold items), melted (frozen items).

<sup>(</sup>f) High risk: items containing meat, poultry, seafood, egg.

<sup>(</sup>a) Critical diet error: relating to incorrect texture (i.e. lumps in smooth puree diet)



**Figure 1** Meal Quality Audit Tool scores for eight different meals, each rated by five separate teams (expert and four test teams) for Appearance, Temperature, Accuracy and Sensory. <sup>a</sup>Each bar in the graph represents the score given by each team, grouped by dimension. Dimensions scored on a 5-point scale, with 5 indicating the highest quality.

**Table 2** Interrater reliability of dimensions of Meal Quality Audit Tool (with five teams assessing eight meals)

Meal quality dimension	ICC (95% CI) <sup>(a)</sup>	Р
Appearance	0.013 (-0.14-0.42)	0.407
Temperature	0.855 (0.67-0.96)	< 0.001
Accuracy	0.603 (0.30-0.88)	< 0.001
Sensory	0	0.996

<sup>(</sup>a) Single measures reported.

ICC, intra-class correlation coefficient.

#### Results

Results for the eight audits from the 'expert' and 'test' teams are displayed in Figure 1. The audits provided 32 opportunities for the comparison of score agreement between 'test' teams and the 'expert' team for each of the four quality dimensions. 'Test' team scores were found to be similar (within 0.5) to 'expert' scores on: 15 (47%) occasions for Appearance, 24 (75%) occasions for Temperature, 29 (90%) occasions for Accuracy and 18 (56%) occasions for Sensory quality dimensions.

As shown in Table 2, intra-class correlation indicated statistically significant interrater reliability for the quality dimensions of Temperature and Accuracy (P < 0.001) but not for the Appearance (P = 0.407) or Sensory dimensions (P = 0.996). On average, 'test' teams led by food services staff scored Appearance dimensions higher than other 'test' teams in six out of eight audits; and scored higher on Sensory dimensions in five out of eight audits.

All 'test' teams rated the MQAT as clear and easy to use, with some suggestions for training support materials, such as photo examples of an accurate tray setting and serve sizes and additional training on temperature checking.

Generally, teams agreed that the MQAT assessed all aspects of meal quality; however, some suggested that more guidance be given to assist scoring the Appearance and Sensory dimensions, that ease of opening packaged items should be assessed and that food texture should be given a higher weighting for texture-modified meals (such as smooth puree or minced and moist).

#### **Discussion**

The MQAT was developed to provide a means of systematically measuring meal quality and identifying areas for improvement of hospital food services. The tool was found to be reliable for the quality dimensions of Temperature and Accuracy and less so for Appearance and Sensory dimensions. This discrepancy is likely because of the objective scoring system applied for Temperature (specified target ranges) and Accuracy (number of errors), while Appearance (level of attractiveness) and Sensory dimensions (ranked very poor through to very good) rely on a more subjective assessment. A large inter- and intra-individual variation in meal quality related to appearance, aroma and taste has been described previously,2 which may be related to individual preferences, symptoms and expectations. The subjective nature of these dimensions was noted by the 'test' teams, who requested more guidance around assessing these parts of the MQAT. To address this issue, clearer definitions have been introduced in the training in the use of the MQAT at our site, including asking auditors to assess quality 'against a standard of a meal you would be happy for a member of your family to receive'. While the reliability of this version of the tool has not yet been tested, in practice, user feedback suggests that this has assisted with scoring the Appearance and Sensory dimensions.

In this study, the composition of the audit team was found to influence scoring where higher scores were observed when a food service staff member led the 'test' team compared with non-food service staff. This may be explained by a difference in expectations of the quality of meals between staff groups. Staff from food services may score the subjective dimensions higher as their expectations of quality relates to what is perceived as achievable within resource constraints. On the other hand, it is possible that dietitians and other clinical staff may be more critical and have higher expectations of the quality of hospital meals.<sup>25</sup> This finding confirms the importance of having staff with different backgrounds on the audit team to reduce opinion bias in scoring and to bring a dimension of different expectations and a reasonable understanding of system constraints to provide a sensible balance for scoring. Whilst the instructions for using the MQAT state that team consensus is required for scoring, it is likely that the audit leader may influence the scoring because of a greater familiarity with the tool. This needs to be addressed as part of training in the use of the tool. The inclusion of ward staff, including medical, nursing, allied health and administrative staff, in the meal quality audit and improvement process also provides an excellent opportunity for marketing the goodand/or poor-quality features of the patient meal service and reinforces the message that the food served is part of the clinical treatment of the patients. Including consumers (patients and/or family) on the audit team could be a useful addition to the process by giving feedback on the subjective dimensions of meal quality from the patient's perspective, mediating ratings between different members of the audit team and providing another avenue to engage consumers in food service quality improvement activities beyond satisfaction surveys. Consumer representation on the MQAT audit team should be tested in the future evaluation of the tool.

This study describes the first tool we have found that assesses dimensions of meal quality within an institutional setting. Regular use of the MQAT in clinical practice can provide dietitians and food service managers with additional information not captured through patient satisfaction surveys, and use of the MQAT alongside patient data allows for the systematic and proactive assessment of meal quality and identification of areas for improvement, and it can act as a tool to evaluate and track improvement over time. Furthermore, there is potential to use the tool for benchmarking purposes across facilities; however, caution should be taken when comparing scores as different institutions may set different standards of meal quality depending on the setting and client priorities and goals of care. Interrater reliability between sites would need to be established before comparisons between institutions could occur. While the MQAT was specifically developed for use in the acute care setting, the principles of meal quality translate across institutions, and the application of the MQAT in other settings such as residential aged care, disability care homes and correctional facilities should be explored. There are a number of limitations related to the development of the MQAT that should be noted. As the MQAT was developed in practice and evolved over time, scientific methods were not used to prospectively develop and define quality dimensions in the tool, and while the content validity has been established through use and survey with naïve and expert groups, construct and criterion validity has not yet been tested. While changes have been made to the local application of the tool to improve the reliability of the Appearance and Sensory dimensions, this has not yet been formally evaluated. Qualitative enquiry may extend our understanding of these dimensions and is an opportunity for future work.

Overall, the MQAT was found to have content validity and is generally reliable, especially for the quality dimensions of Temperature and Accuracy. Reliability of Appearance and Sensory quality dimensions may be improved by providing clearer definitions and training related to the standards and ensuring a mixed team composition. Furthermore, patient feedback provides valuable data on Appearance and Sensory dimensions, and this data can be used alongside the MQAT results for these dimensions. The systematic use of the MQAT, in conjunction with a valid process for determining patient satisfaction, provides useful information regarding the quality of food services and areas for improvement.

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#### **Conflict of interest**

No conflict of interest has been declared by the authors.

### **Authorship**

MB, MHJ and AB designed the study. AB, MB and MHJ participated in data collection. MB, MHJ, LR and AY undertook data analysis and interpretation. MB, AB, JE and AY drafted the manuscript, and all authors contributed to editing and completion of the manuscript.

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### Appendix

### **Meal Quality Audit**

The Purpose of a Meal Quality Audit is to evaluate the quality of a meal, independent of patients, at ward level during a normal meal service and identify any areas for improvement.

The Meal Quality Audit tool provides the means to:

- 1. Systematically identify wide-ranging quality improvement issues by scheduling regular audits to cover the entire menu and use results as a reportable Key Performance Indicator.
- 2. Investigate complaints or reported issues with meals or specific menu items on an ad hoc basis.
- 3. Objectively and subjectively rank meals and menu items.
- 4. Assist in the change management process of implementing a new menu.
- 5. Assist with ongoing monitoring of quality of menu items and self benchmarking.

Quality is determined by the assessment of total tray appearance, accuracy of tray items, food items and portion sizes, and the sensory properties of the meal.

#### Procedure:

- 1. A "test" meal is discretely ordered (staff are blinded) to be plated and sent to a ward along with other patient meals. Audits will occur across all days of the menu cycle, meal times and wards.
- 2. Observe the arrival of the meal trolley to the ward and meal distribution. The "test" meal should not be removed from the trolley until the last tray is handed out.
- 3. Ideally, the test meal should be assessed at the ward station to encourage ward staff to participate.
- 4. The test team should comprise at least 3 people, including a staff member from Nutrition/dietetics, Food Services and an independent ward staff member. If a texture modified diet is being assessed, also include a Speech Pathologist in the team.
- 5. Do not remove any lids until the whole testing team has assembled and is ready to commence the audit.
- 6. Read the following instructions and complete the meal audit in the order on the audit tool.

#### **INSTRUCTIONS**

## for auditing a meal using the Meal Quality Audit Tool

#### **PART A Appearance**

Look at the overall appearance, including placement of items, stains, spills, chips etc. Minimize lifting any lids during this step because this will affect temperature assessments in Part B.

#### PART B Accuracy - Temperature

Assess temperature against targets. Test all items, excluding: condiments, plain bread or rolls, vegetables served in small pieces e.g. peas, sliced carrots, broccoli, cauliflower or 'undressed' vegetables served as part of a salad.

#### PART C Accuracy -table setting, food items, portion size and food texture

Table setting – check for adequate cutlery to consume all food items and correct condiments, napkins.

<u>Food Items</u> – check that all food items specified on the menu card have been provided.

<u>Portion Sizes</u> – visually assess portions against set specifications.

<u>Food Texture</u> – Food items meet the diet texture specifications

#### **PART D Sensory Evaluation**

Foods should be scored against a standard of a meal you would be happy for a member of your family to receive. Some sensory properties when applied to specific items will require special interpretations. For example, if lack of aroma is expected for milk then milk is ranked highest and "excellent" is circled. Similarly, lack of texture (a puree diet) may also be considered "excellent" if this is what is expected. If an individual involved in the testing usually dislikes a food items being tested, they should not participate.

After ranking all foods individually, give an overall score for the meal for sensory quality.

#### Summary

After completing parts A – D, complete Summary Page writing the final scores for each part and outline any problems if identified and recommendations for improvements.

## **Meal Quality Audit Tool**

## **Summary**

Date:		Diet Description:					
Trolley le	ft kitchen:						
Audit Star	rt Time:	Audit Finish Time:					
Assessme	nt Team:			_			
Scores:				_			
ocores.	Quality	component	Score	Goal			
	Part A - Appearance						
	4						
Part C – Accuracy Table Setting, Food Items, Portion sizes and Food Texture							
	Part D - Sens	cory		4			
Problems	Identified:						
Recomme	ended Actions:						

PART A – APPEARANCE								
	Very Appealing	Appealing	Okay	Unappealing	Very Unappealing	Weighting	Score	
Tray Setting Attractive without stains, chips or spills	5	4	3	2	1	x 3		
Complete Meal Attractive and corresponds to plating specifications	5	4	3	2	1	x 7		
<b>Comments</b> Subtotal								
Final Score (Part A) = Subtotal ÷ 10								

## **PART B – ACCURACY Temperature**

#### **Background on temperature assessments**

The temperature targets below are based on food safety temperature targets for holding of hot and cold foods, but additionally allow for a reasonable delivery time to the patient/client.

For a cold plate and rethermalize system, different temperature targets would need to be determined. \*High risk items include: items containing meat, poultry, seafood, egg.

	Temperature targets									
Test food	Correct	Adequate	Inadequate	Unacceptable						
Hot Food	>60°C	>55°C	50°C - 55°C	<50°C						
Hot Liquids	>65°C	>60°C	55°C - 60°C	<55°C						
Cold Items	<10°C	10°C - 15°C	15°C - 20°C	>20°C						
Frozen Items	frozen	soft but still solid	Starting to melt	melted						

•	eratures and assessme Temp			<u> </u>	erature Assessn Inadequate	
Item	Temp	°C	Correct	Adequate	Inadequate	Unacceptable
Item	Temp	°C	Correct	Adequate	Inadequate	Unacceptable
Item	Temp	°C	Correct	Adequate	Inadequate	Unacceptable
Item	Temp	°C	Correct	Adequate	Inadequate	Unacceptable
Item	Temp	°C	Correct	Adequate	Inadequate	Unacceptable
Item	Temp	°C	Correct	Adequate	Inadequate	Unacceptable
Item	Temp	°C	Correct	Adequate	Inadequate	Unacceptable
STEP 2 – Interpreting	the temperatures fron	n Step	1 above, p	rovide an ove	erall score for t	emperature

3 items

inadequate;

unacceptable

2

or 1 item

Final Score

(Part B)

> 3 items inadequate; or

>1 high risk item\*

unacceptable

≥2 items unacceptable; or

1

All items

correct or

adequate

4

1-2 items or

1 high risk item\*

are inadequate

3

All

items

correct

5

PART C – ACCURACY									
Table Setting, Food Items, Portion Sizes & Food Texture									
	No Errors	1 Error	2 Errors	3 Errors	4+ or critical diet error	Weighting	Score		
Table Setting – correct and appropriate cutlery, dishes, napkins, condiments.	5	4	3	2	1	x 1			
Food Items – correct and appropriate according to diet ordered	5	4	3	2	1	x 4			
Portion Sizes – correct and appropriate as specified	5	4	3	2	1	x 2			
Food Texture – correct as required eg smooth, no lumps, correct thickness	5	4	3	2	1	x 3			
Comments						Subtotal			
						core (Part C) ubtotal ÷ 10			

PART D - FOOD ITEM SENSORY EVALUATION Aroma, Temperature, Appearance, Taste, Texture									
Meal Item	Very Good	Good	Okay	Poor	Very Poor	Comments			
	5	4	3	2	1				
	5	4	3	2	1				
	5	4	3	2	1				
	5	4	3	2	1				
	5	4	3	2	1				
	5	4	3	2	1				
	5	4	3	2	1				
	5	4	3	2	1				
	5	4	3	2	1				
	5	4	3	2	1				
Overall Sensory Evaluation (Final Score Part D)	5	4	3	2	1				

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