Research Contribution

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ANALYSIS OF TEMPERATURE OF PATIENT MEALS

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ABSTRACT

Perceptions of food temperature from post-discharge satisfaction questionnaires and actual temperatures changes during the assembly and delivery of patient meals were explored. Modifications in tray assembly were done in an attempt to improve service temperatures. Results indicated temperature ratings differed based on age and length of stay; younger patients were more satisfied then older individuals; those with a length of stay of more than ten days were least satisfied. Temperature monitoring revealed the greatest loss of temperature occurred during the tray assembly process. Modifications in the tray assembly process had minimal impact on serving temperatures.

Keywords: Patient satisfaction, temperature of foods, tray assembly and delivery.

INTRODUCTION

The concept of patient satisfaction is an emerging one, and has developed over the years into an important variable in medical care. Patient satisfaction assessments are required by accrediting agencies and are used by hospitals for internal and external benchmarking. Overall patient satisfaction with an inpatient hospital experience is influenced by several domains (Hendriks, Oort, Vrielink, & Smets 2002; Jha, Orav, Zheng & Epstein 2008). The satisfaction with foodservice has been identified as a component of overall quality (Otani, Waterman, Faulkner, Boslaugh, Burroughs, & Dunagan 2009).

Several studies have suggested that the temperature of food is important for patient satisfaction with foodservice (Maller, Dubose & Cardello 1980; Stanga, Zurfluh, Roselli, Sterchi, Tanner, & Knecht 2003; Wright, Connelly, & Capra 2006). However, the temperature of food often is the lowest rated of the foodservice variable (DeLuco and Cremer 1990; Fallon, Gurr, Hannah-Jones, & Bauer 2008; Lengyel, Smith, Whiting, & Zello 2004; Sahin, Demir, Celik, & Teke 2006; Wright, Capra, & Alikbari 2003). Temperature of food has been identified as a component of food quality (Dubé, Trudeau, & Belanger 1994), food issues (Lau and Gregoire, 1998), and meal service quality (Fallon et al., 2008; Wright et al., 2003). The temperature of hot foods also has been analyzed as a variable separated from temperature of cold foods in some research (Wright et al., 2003; Wright et al., 2006). When patients' written comments regarding meal service were analyzed, it was found that the temperature of food received the most comments, and the majority of those comments were negative (Tranter, Gregoire, Lafferty & Fullam 2009).

The majority of these studies used questionnaires to examine aspects that influenced overall satisfaction with foodservice. Most studies have not examined the temperature of food alone, but as a variable in overall satisfaction with foodservice (Dube et al., 1994; O'Hara and Harper 1997; Stanga et al., 2003; Wright et al., 2003; Sahin et al., 2006;Wright et al., 2006; Fallon et al., 2008). Often this research has focused on "uncontrollable" factors that influence patient satisfaction with foodservice such as demographic characteristics, of age, gender, and length of stay (LOS). No study to date has looked at individual foods or types of foods that are of most concern to patients. One study measured the temperature of food at the point of assembly and then at point of delivery to determine the change in food temperature and compared two systems of meal service, the trolley method and the traditional plated method, but did not analyze where in the assembly and delivery process temperature was lost (Hartwell and Edwards, 2001).

To date no study has focused on the change in temperature of food during the entire tray assembly and delivery process and what influences patients' ratings of food temperature. Therefore, the objectives of this study were to (1) explore whether satisfaction with food temperatures differs based on patients' age, gender, education level, ethnicity, and length of stay, (2) identify specific foods or categories of foods whose temperatures were of most concern to patients, (3) document changes in food temperature during the tray assembly and delivery process, (4) identify possible areas for improvement in maintaining food temperatures during the tray assembly and delivery process

METHODOLOGY

This study had five phases to explore various aspects of the temperature of hospital patient meals. The university's institutional review board approved the study's protocol prior to data collection.

Food production and tray assembly, at the institution where this study was conducted, was done in a centralized unit using a conventional food production system. Tray assembly was completed by eight foodservice employees who work at stations along a conveyor belt and placed requested food items on the meal tray. A supervisor checked the accuracy of the trays before they were placed in non-insulated transportation carts.

The tray line setup contained three stations with hot foods. Hot entrees were placed on pre-warmed plates on induction heat, insulated bases. Once the entrée was placed on the tray, the remainder of hot and cold side dishes, hot and cold beverages, and desserts were added to the tray. An insulated dome was placed over the entree at the end of the tray line after the accuracy of the tray was checked. The coffee was dispensed from two machines and was served in an insulated mug with a plastic lid; the mugs were not pre-warmed prior to coffee being poured into them.

To help maintain food temperature, the institution utilized the Aladdin Temp-Rite® Heat On Demand® Ultra™ Heat Activator with foam insulated Allure® base and cover. The Heat Activator uses induction heat and takes 12 seconds to heat the base to 200 to 240

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degrees Fahrenheit. According to the manufacturer, the temperature of the base should be maintained for up to one hour after it is heated. Food was served on ceramic plates that were pre-warmed to 170 degrees Fahrenheit using the Aladdin Temp-Rite® Dish Heater. Food and Nutrition Services employees were on the unit and delivered trays to the patients when the cart arrived on the unit. The average length of time from the beginning of tray assembly for the first tray for a unit to service to the last patient on the unit is approximately 29 minutes and 42 seconds.

For the first phase of this study, data from Press Ganey® questionnaires completed by post discharged patients were compiled and analyzed from three medical and surgical units. The Press Ganey® questionnaire measures overall patient satisfaction, with three questions focused on foodservice. The results of this study only explored patient's ratings of one of the foodservice questions, the temperature of food served. Patients rated temperature of food on a five-point scale (very good, good, fair, poor, and very poor). Demographic data, including patient's age, gender, length of stay (LOS), ethnicity, and education level, were obtained as well.

In the second phase of this study, inpatients from the designated medical and surgical units who rated food temperature a three or below (fair, poor, or very poor) on the institution's Food and Nutrition Services (FNS) inpatient questionnaire were interviewed to determine facets contributing to the lower food temperature ratings. The FNS inpatient questionnaires were delivered at meal times to all inpatients on a daily rotation schedule. Interviews were conducted with inpatients until patterns were seen in types of foods prompting lower ratings were identified. Informed consent was obtained by the researcher prior to the interview, with all interviews being conducted by the same researcher to ensure consistency in questioning. A total of 22 semi-structured interviews were conducted.

For the third phase of this study, the tray assembly and delivery process was timed for three medical and surgical units. Each unit was analyzed three separate times, resulting in a total of nine measurements of the entire tray assembly and delivery process. The times were recorded at ten points in the tray assembly and delivery process as these points were considered to be potential areas in which changes could be made to help control temperature loss and included: in the steam table, first tray placed into the cart, middle tray placed into the cart, the last tray placed into the cart, when the cart door was closed, when the cart reached the unit, when the first, middle and last trays were passed, and one hour after the last tray was passed. The time point one-hour later was to replicate a tray being held for patients who were in procedures or could not start eating their meals right away. The purpose of the third phase of this study was to establish the times in which the temperature would be tracked. Because there were significant differences in the times monitored in this phase and the three units were assembled throughout the meal tray line timeframe, scenarios were developed to capture these potential differences. The best-case scenario was the best times (shortest times) recorded in the assembly and delivery process. The worst-case scenario was the worst times (longest times) recorded in the tray assembly and delivery process. These timeframes were used to develop the four scenarios that were used in the study. The beginning best and worst scenarios were the temperatures recorded from trays assembled at the start of the meal service tray line. The middle best and worst scenarios were temperatures recorded from trays assembled during the middle of the meal service tray line.

The purpose of phase IV was to analyze the change in temperature during the tray assembly and delivery process for the foods identified by patients in Phase II. This was completed in two parts. The first component of Phase IV was to assure the foam insulated Allure® bases used in tray assembly were heating properly. The second component of Phase IV was tracking the change in temperature for the specified food items during the assembly and delivery process. Temperatures of four food items were measured ten times during the tray assembly and delivery process. The initial temperatures of selected foods were recorded in the steam table and were monitored over nine key points in the tray assembly and delivery process for six test trays. All food temperatures were measured using the Cooper Atkins® AquaTuff ™ Model #: FW2000MK. This model is NSF (National Sanitation Foundation) and CE (European Commission) certified and is accurate within 1 degree Fahrenheit within the complete temperature range (-100 – 500°F). The temperature probe was placed in the food item as soon as the food item was portioned onto the plate. Once the lid was placed on the item, it was not removed as the temperature reading device was outside of the covered item allowing temperatures to be monitored and recorded without lifting the lid.

After phase IV was completed and analyzed for trends in temperature loss, two interventions were developed and tested in phase V that were designed to potentially minimize temperature loss during the tray assembly process: pre-warming hot beverage cups and placing the insulated dome lid on the entrée plate at the time of entrée portioning. Each intervention (pre-warming hot beverage cups and placing the lid on the plate at the time of portioning) was analyzed on separate days for a total of three measurements, to provide a adequate data. The same times and procedures were used in Phase IV and Phase V. To determine if pre-warming hot beverage cups would result in higher service temperatures, cups were warmed in the dish machine and immediately brought to the tray line and filled with coffee. To reduce temperature loss during the first minute food is placed onto the tray, the tray line was manipulated to change the order of lid placement. During phase IV of this study, hot food was placed onto the pre-warmed plates Heat On Demand® Ultra™ Heat Activator bases first and the rest of the food was placed onto the tray prior to placement of the foam insulated Allure® cover at the end of the tray line. For phase V, the lid was placed onto the base immediately after the food was put onto the plate.

SPSS version 17.0 (Chicago, IL) was used for all data analyses. Descriptive statistics (including means, standard deviations, and frequencies) were calculated for Phase I and II. Analysis of Variance (ANOVA) was used to explore differences in ratings based on demographic characteristics in Phase I. Independent samples t-test and Analysis of Variance (ANOVA) were used to compare food temperatures across the four scenarios in Phase III and between temperatures collected in Phase IV and V. Significance level was set at $p \leq 0.05$.

RESULTS AND DISCUSSION

Phase 1 Patient Satisfaction Ratings

A total of 4,095 completed Press Ganey® satisfaction questionnaires were returned to the medical center between January 1, 2008 and December 31, 2009. Of the total sample, 2,303 were excluded because they were not from the specified medical and surgical units used for the study; an additional 25 were excluded from the sample due to missing data points. The total number of returned satisfaction questionnaires analyzed was 1767 (43%). During this time period there were 19,319 patients admitted to the three units used in this study.

The average age of respondents was 60 years old and the majority of the respondents were non-Hispanic white (83.5%). The average length of stay (LOS) was four days. The sample was educated with 71% of individuals indicating they had at least some college education. The majority of respondents were female (57%). The actual patients admitted to the three units differed somewhat demographically from the patients who returned the Press Ganey® satisfaction questionnaires. Of note, fewer (66.3%) of the total patient population identified themselves as non-Hispanic white.

ANOVA of "Temperature of Food" based on five demographic variables was completed. Ratings differed significantly based on age and length of stay (LOS). Individuals in the younger age categories were more satisfied with the temperature of their food than patients in the older age categories (Table 1). Patient with a LOS of greater than ten days were the least satisfied (Table 1). There were no significant differences observed in temperature ratings based on the other demographic characteristics (gender, education level, and ethnicity).

The result of older individuals being less satisfied with the temperature of their food is similar to the results of Wright et al., (2006). However, these results are contradictory to the results of earlier studies by Maller et al., (1980), DeLuco and Cremer (1990), Dubé et al's., (1994) and Lau and Gregoire (1998), who all found older individuals were generally more satisfied with the temperature of their food. The result of individuals with a LOS of more than ten days having a lower level of satisfaction with food temperatures is consistent with the results of earlier studies by Maller et al., (1980) and Stanga et al., (2003), who found that a longer LOS resulted in lower satisfaction with food temperature.

Table 1: Comparison of ratings for temperature of food served by demographic characteristics of discharges patients

	n	Mean[1,2]	SD
Age			
<50	313	4.13^{x}	0.92
50-59	414	3.95^{y}	1.01
60-65	293	3.99^{y}	0.83
66-75	412	4.00^{y}	0.88
>75	239	3.91^{y}	0.93
Education			
High School or less	458	4.05	0.928
Some College	494	3.96	0.961
Four Year Degree	239	3.92	0.917
Beyond Four Year Degree	396	4.05	0.831
Length of Stay			
1 Day	349	4.04^{x}	0.906
2 Days	328	4.10^{xy}	0.867
3 Days	352	3.97^{wx}	0.933
4 Days	212	3.92^{xz}	0.973
5 Days	103	4.11^{x}	0.873
6-10 Days	221	3.92^{xz}	0.929
>10 Days	85	3.78^{wyz}	0.993
Race			
White non Hispanic	1289	3.98	0.917
Black	209	4.10	0.874
Other including non Hispanic	131	3.92	1.020
Gender			
Female	952	3.99	0.918
Male	719	4.00	0.922

[1]Scale 1= very poor, 2= poor, 3= fair, 4= good, 5= very good
[2]Different superscripts (x, y ,z) in rows indicate differences between means (p<.05) using analysis of variance

Phase II Patient Interviews

A total of 22 interviews were conducted between April 2010 and July 2010, with patients from the three units. Interviewees were selected based on results from the in-patient foodservice satisfaction questionnaires (i.e a rating of three or below for temperature), and then seen by the Patient Advocate to determine willingness to participate in the study.

Hot beverages were cited frequently during the interviews (ten comments for coffee and four comments for tea) as an item at an undesirable temperature. There were only three comments for cold beverages not being at an acceptable temperature. The most frequently cited food items with unsatisfying food temperatures were hot entrees (13 comments), with chicken tenders and baked chicken being the most often mentioned entrées (five comments for chicken tenders and two comments for the baked chicken). Scrambled eggs were cited as having an undesirable food temperature eight times. Breakfast breads including toast, pancakes, waffles, and French toast were cited as having undesirable food temperatures (11 comments), with pancakes (nine comments) being the most frequently mentioned. Other items such as side dishes, broth/soup, and vegetables all were mentioned fewer than four times. Based on the results of the interviews coffee, scrambled eggs, pancakes, and chicken tenders were used for the assessment of temperature change in Phase IV.

Phase III Timing of Tray Assembly

Analysis of the timing of the assembly and delivery process showed significant ($p<0.05$) differences in the amount of time spent assembling and delivering the trays at three points: the time from assembly of the first tray to service; the time required to reach the specific unit after the cart door was closed; and the total time for the assembly and delivery process. Therefore, to better replicate the assembly and delivery process, the best times and worst times for each time point were used for the temperature collection. For example the best time for the cart reaching the unit was ten minutes and the worst time for the cart reaching the unit was 21 minutes after the start of assembly of the meal trays on that cart. Because, the medical and surgical units were assembled at different points in the tray line process, test trays were either started at the beginning of the

Figure 1: Average "Best Case Scenarios" temperature changes for test food items

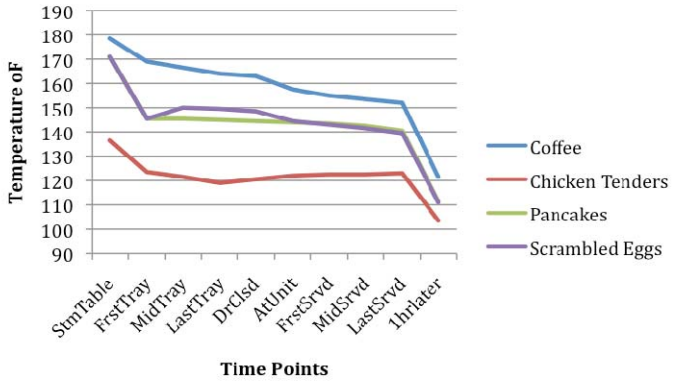


Table 2: Analysis of temperature change in food items between scenarios during the tray assembly and delivery process [a]

			Comparisons of Temperatures			
	Best Case Scenario[b]	Worst Case Scenario[c]	Beginning Best: Middle Best[d]	Beginning Best: Middle Worst[e]	Beginning Worst:: Middle Best[f]	Beginning Worst: Middle worst[g]
	Time (minutes:seconds)					
StmTable	0	0	Coffee** Chicken Tenders**	Coffee** Chicken Tenders**	Coffee** Chicken Tenders **	Coffee** Chicken Tenders**
FrstTray	0:04	0:30	ns	ns	ns	ns
MidTray	1:33	7:40	ns	ns	ns	ns
LastTray	3:47	10:25	ns	ns	ns	ns
DrClsd	4:41	11:30	ns	ns	ns	ns
AtUnit	10:06	21:00	ns	ns	ns	ns
FrstSrvd	12:25	24:10	ns	ns	Coffee *	ns
MidSrvd	15:25	32:50	ns	ns	Pancakes*	ns
LastSrvd	17:55	47:30	ns	Coffee**	Coffee* Pancakes**	ns
1hrlater	1:17:55	1:47:30	ns	ns	Coffee * Pancakes**	ns

[a]Analysis of variance with Bonferroni Correction, food items with differences in temperatures are listed
[b]Best Case Scenario: The best times recorded in the tray assembly and delivery process
[c]Worst Case Scenario: The worst times recorded in tray assembly and delivery process
[d]Beginning Best: The temperatures recorded from trays at the start of the meal service trayline using the "best" times
[e]Beginning Worst: The temperatures recorded from trays at the start of the meal service trayline using the "worst" times
[f]Middle Best: The temperatures recorded from trays during the middle of a meal service trayline using the "best" times
[g]Middle Worst: The temperatures recorded from trays during the middle of a meal service trayline using the "worst" times
*p≤0.05
**p≤0.01

tray line process for the meal period or during the middle of the tray line. This was done to see if units at the beginning of the tray line would have different temperatures than units at later in the tray line.

Phase IV Monitoring Temperatures of Food Items

Temperatures for each food item were collected on six separate days, on three occasions the food items temperatures were taken at the beginning of the tray line and three occasions during the middle of the tray line. Figure 1 displays a visual of the change in temperature that occurred in all food items during the best-case scenario. The pattern of temperature change was similar for all items in each scenario with an initial drop in temperature of 10 to 25 degrees when the hot food item/beverage was placed on/in the service ware, items maintained their temperature for about 25 to 30 minutes, and then had a gradual drop in temperature thereafter. All food items were below optimal serving temperatures recommended by Molt (2006) at the point of service to the patient.

Analysis of variance was used to explore differences between temperatures taken at various points in the tray assembly and service process. As shown in Table 2, few differences existed between the scenarios.

Phase V Change in Practices

Results of Phase V indicated that neither pre-warming the coffee cup nor placing the lid on the hot entrée plate earlier resulted in a significant improvement in service temperatures. Results of the pre-warmed coffee cup compared to the non-pre-warmed coffee cup can be seen on Figure 2. Figure 3 displays the temperature of the scrambled egg temperatures in phase IV and phase V.

CONCLUSIONS AND APPLICATIONS

Comparisons of patients food temperature ratings based on demographics in this study are similar to results of other researchers who examined patient satisfaction with food temperatures. Differences in ratings were found based on patient's age and length of stay with younger patients being more satisfied then older patients and those with the longest lengths of stay being least satisfied.

Figure 2: Comparison of coffee temperatures in warmed and not warmed cup

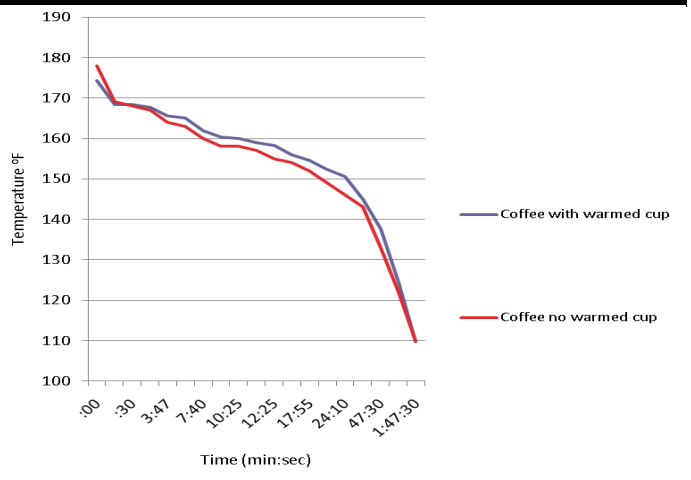
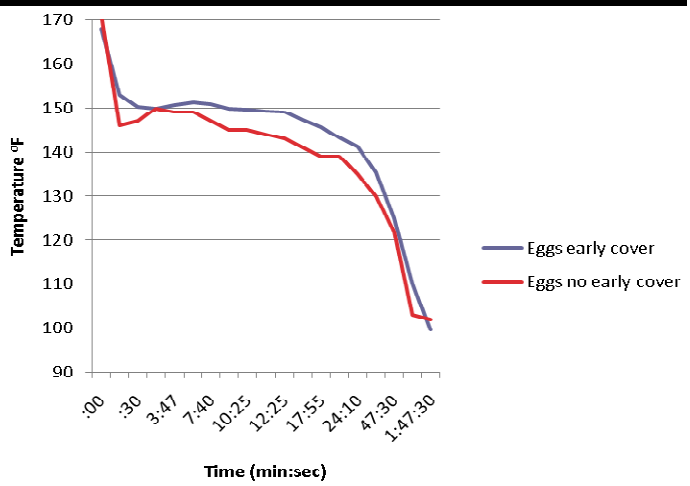


Figure 3. Comparison of temperature of scrambled eggs with and without being covered early in tray assembly process



During phase II of this study, inpatients interviewed cited multiple food items as having unsatisfactory food temperatures with the most common items being coffee scrambled eggs, chicken tenders, and pancakes. Although, results of this study are limited to findings from one medical center, they do provide inpatient information for managers at other hospitals who are concerned about the temperature of foods served to patients.

Tracking the temperature of food items from the steam table to the end of service and identifying points where temperature changes occur can assist administrators to improve operations. Based on the results of this study, large drops in temperature occurred during the tray assembly process. For eggs and pancakes this drop in temperature was often more than 20 degrees. For food items that were placed on the Heat On Demand® Ultra™ Heat Activator bases and then covered with the foam insulated Allure® cover, the items maintained their temperature once the lid was placed onto base often for 25 to 30 minutes. Placing the insulated lid onto the plate earlier in the tray assembly process did not result in a significant improvement in temperature for the scrambled eggs. Likewise, pre-warming the coffee cups prior to service did not provide any improvement in temperature.

Based on these results, foodservice managers at hospitals utilizing a centralized tray assembly process need to be aware of the initial loss of temperature that occurs in the tray assembly process and the somewhat limited holding time provided by insulated bases, both of which reinforce the need to ensure that hot food items are held at as high a temperature as possible on the tray line and that meal trays are assembles and delivered as quickly as possible. Additional research is needed to help identify ways to reduce food temperature loss in the tray assembly and delivery process. A comparison of the impact of alternative delivery systems i.e. decentralized preparation, galley kitchens, or heated carts on patient satisfaction with food temperature is also warranted to help identify best practices. Further research on types of foods, which do or do not hold temperature well in the assembly and delivery process is also recommend, as the sample size for this study was small.

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