Institutionnel and Opérationnel Déterminants of Meal Quality in National Hospitals in Bujumbura

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Abstract

Hospital meals are an integral component of patient care. This study assessed meal quality and examined institutional and operational factors associated with deficiencies in three national hospitals in Bujumbura. A descriptive cross-sectional study was conducted from October 2025 to March 2026. Eighteen lunch meals were assessed : 7 at Prince Regent Charles Hospital (HPRC), 6 at Kamenge Military Hospital (HMK), and 5 at Prince Louis Rwagasore Clinic (CPLR). Data were collected from 216 respondents (54 canteen staff, 54 health personnel, and 108 patients/caregivers). Meal quality was assessed using a 20-criterion checklist covering five dimensions. A score ≥75%, with no critical non-compliance, defined acceptable quality. None of the 18 meals met the acceptability threshold (0%). The mean quality score was 0.57±0.05, with HPRC (0.62), HMK (0.57), and CPLR (0.53). Food safety had the strongest association with quality (r=0.82; p=0.001), followed by nutritional value (r=0.76; p=0.003), taste (r=0.69; p=0.008), dietary diversity (r=0.64; p=0.015), and presentation (r=0.58; p=0.026). Staff hygiene showed 0% compliance, while serving temperature compliance was 83.0% and absence of foreign bodies 100%. Among 162 consumers, 64.8% reported taste satisfaction ≥3/5. Moreover, 83.2% of 107 personnel had received no hygiene/HACCP training, and 93.5% of catering units lacked nutritional standards. Poor meal quality reflects systemic institutional and operational deficiencies. Establishing dietetic services, standardized nutrition and food-safety procedures, continuous staff training, quality control, and improved procurement should be prioritized to improve hospital meal quality and patient care.

Keywords : *Meal quality; Hospital catering; Institutional determinants; Operational determinants; Food safety; Nutritional value; Hospita*

1.Introduction

Hospital food is an essential component of the continuum of care. Beyond its nutritional function, it directly contributes to patients' recovery, the prevention of complications, and the reduction of hospital stays. Reference Organizations such as the World Health Organization (WHO), the Food and Agriculture Organization (FAO), and the Codex Alimentarius emphasize that food safety and the nutritional quality of meals are fundamental requirements in healthcare facilities, particularly for patients who are often vulnerable from immunological, metabolic,

and nutritional perspectives. Globally, foodborne diseases affect hundreds of millions of people every year, and hospitals are not immune to these risks. At the same time, hospital malnutrition remains a major problem, affecting between 20% and 50% of hospitalized patients, depending on the context. Inadequate hospital food can worsen clinical conditions, impair wound healing, weaken the immune system, and prolong hospital stays, thereby generating significant human and economic costs. These findings have led professional organizations such as ESPEN and ASPEN to recommend the systematic integration of nutrition and food safety into healthcare quality standards. In low-resource countries, however, these requirements face structural, logistical, and institutional constraints. In East Africa, several studies have highlighted the lack of standardized hospital catering protocols, shortages of personnel trained in food hygiene and dietetics, as well as inadequate quality control in hospital kitchens. These shortcomings expose patients to a dual risk: foodborne illnesses on the one hand, and quantitatively and qualitatively inadequate nutrition on the other. In Burundi, despite the existence of a legal framework inspired by international food hygiene standards and adherence to Codex guidelines, the specific issue of hospital meal quality remains poorly documented. Hospital catering services often operate without formal dietary supervision, clearly defined operational standards, or regular mechanisms for supervision and quality control. This situation occurs within a broader context of budgetary constraints, national food insecurity, and limited institutional capacity in the area of hospital nutrition. It is within this perspective that the present article is situated, aiming to analyze the institutional and operational determinants of meal quality in national hospitals in Bujumbura. Based on an empirical assessment of meals and an analysis of the contextual factors influencing their production, this study seeks to identify priority areas for improvement in order to promote safer, more nutritious hospital catering services that are better integrated into the healthcare system.

2. Materials and Methods

2.1. Study Setting

The study was conducted in the canteens of three national hospitals in Bujumbura Municipality : Prince Regent Charles Hospital, Kamenge Military Hospital, and Prince Louis Rwagasore Clinic. These referral facilities have in-house catering services that are responsible for the daily preparation and distribution of meals to patients, staff, and accompanying persons. Their central role in the provision of tertiary healthcare in Burundi makes them a relevant setting for analyzing the determinants of hospital meal quality.

2.2. Study Design and Period

This was a descriptive cross-sectional study with an analytical component, conducted over a four-month period from October 2025 to March 2026. Data collection for the meal assessment was carried out between November 3 and 28, 2025, in order to cover several consecutive days at each facility and account for variations in the menus.

2.3. Study Population

The target population comprised three categories of stakeholders directly involved in the hospital catering system :
Canteen staff (cooks, kitchen assistants, and managers);
Healthcare personnel involved in nutrition (nutritionists, nurses, and administrators);
Hospitalized patients and/or their accompanying persons consuming meals provided by the canteen. The secondary population consisted of complete meals served at lunchtime in the three hospitals.

2.4. Sampling

2.4.1. Respondents

The sample size of respondents (n = 216) was determined using the Schwartz formula for cross-sectional studies (z = 1.96; p = 0.5; e = 7%), with an additional 10% allowance for non-response. A two-level proportional stratified sampling approach was applied :

- Actor strata**:** 54 canteen staff (25%), 54 health personnel (25%), and 108 patients/caregivers (50%).
- Distribution by hospital proportional to workload**:** 86 (HPRC), 76 (HMK), and 54 (CPLR).

Within each stratum and hospital, participants were selected purposively based on availability and inclusion criteria.

2.4.2. Meals Assessed

A total of eighteen (18) complete lunch meals were assessed : 7 at HPRC, 6 at HMK, and 5 at CPLR. Samples were collected on consecutive or closely spaced days at each hospital, under normal food production and service conditions.

2.4.3. Inclusion Criteria

- Canteen staff**:** ≥ 3 months of employment, involved in food preparation/distribution, and provision of informed consent.
- Health personnel **:** involved in nutrition-related activities, present during data collection, and provision of informed consent.
- Patients/caregivers **:** consumed at least one meal per day for ≥ 3 days, aged ≥ 18 years (or an adult respondent), in a condition compatible with participation in the interview, and provided informed consent.

2.4.4. Data Collection Tools

Three complementary instruments were used and integrated into a single coded data collection tool:

1. Structured face-to-face questionnaire**.**
2. Direct observation checklist covering practices, equipment, and facilities.
3. Semi-structured interview guide for managers.

Observations were conducted at key stages of the food service cycle (preparation, distribution, and cleaning) to minimize self-reporting bias.

2.4.5. Assessment of Meal Quality (Dependent Variable)

Each meal was assessed using a weighted checklist comprising 20 criteria distributed across five dimensions :

- Nutritional value **:** 6 criteria, weight 2; maximum score = 12.
- Food safety **:** 6 criteria, weight 3; maximum score = 18, including 3 critical criteria.
- Dietary diversity **:** 3 criteria, weight 1.
- Presentation **:** 2 criteria, weight 1.
- Taste : 3 criteria, weight 1, measured through a mini satisfaction survey (1–5 scale) among 162 consumers.

The weighted score (%) was calculated as follows:

$$\text{Score} = [\Sigma(\text{score}_i \times \text{weight}_i) / \Sigma\text{weight}_i] \times 100$$

A meal was classified as acceptable if the score was ≥ 75% and no critical criterion was non-compliant ; otherwise, it was classified as unacceptable.

2.4.6. Independent Variables

The explanatory variables covered five domains : structural, logistical, human, institutional, and environmental factors. They were coded on an ordinal scale :

- 0 = absent/non-compliant
- 1 = partial
- 2 = compliant

2.4.7. Pre-test

A pre-test was conducted among 22 participants (approximately 10%) in services not included in the study, in order to improve the clarity, feasibility, and administration time of the data collection instruments.

2.4.8. Data Analysis

The data were entered, cleaned, and analyzed using Stata MP 17. The analyses included:

- Descriptive statistics;
- Proportion (z) tests ;
- Spearman's correlation analyses ;
- Binary logistic regression to identify determinants associated with poor meal quality.

2.4.9. Ethical Considerations

The study received administrative authorization from the hospital management teams. Written informed consent was obtained from all participants. Anonymity and confidentiality were strictly maintained.

3. Presentation of Results

3.1. Overall Meal Quality by Hospital

The evaluation of the 18 meals revealed universal non-compliance : none of the meals reached the 75% acceptability threshold. The overall mean score was 0.57 ± 0.05, with a gradient across facilities (HPRC > HMK > CPLR). The distribution of scores by hospital highlights a consistent pattern of deficiencies across the three facilities (Table 1).

Table 1. Distribution of Overall Meal Quality by Hospital

Hospital	Meals assessed (n)	Acceptable quality (≥75%), n (%)	Unacceptable quality (<75%), n (%)
HPRC	7	0 (0%)	7 (100%)
HMK	6	0 (0%)	6 (100%)
CPLR	5	0 (0%)	5 (100%)
Total	18	0 (0%)	18 (100%)

3.2. Analysis by Quality Dimensions

Analysis of the mean scores by quality dimension revealed that food safety and nutritional value were the most deficient dimensions and contributed most to the reduction in the overall score. The dimensions of dietary diversity, presentation, and taste contributed less to the overall variability (Table 2).

Table 2. Mean Scores by Meal Quality Dimension According to Hospital (0–1 scale)

Dimension	HPRC	HMK	CPLR	Overall mean	Standard deviation
Nutritional value	0.62	0.58	0.55	0.58	0.04
Food safety	0.71	0.65	0.60	0.65	0.06
Dietary diversity	0.54	0.50	0.47	0.50	0.04

Presentation	0.59	0.55	0.52	0.55	0.04
Taste	0.63	0.57	0.53	0.58	0.05
Overall mean score	0.62	0.57	0.53	0.57	0.05

Acceptability threshold: 0.75 (equivalent to 75%). No dimension reached this threshold in any of the three hospitals. The gradient HPRC > HMK > CPLR was consistent across all five dimensions and for the overall score.

3.3. Compliance with Critical Food Safety Criteria

Detailed examination of the critical criteria shows that staff hygiene (SS4) was non-compliant in all three hospitals (0%), constituting a systematic factor leading to meal disqualification. The other critical criteria also showed relatively high levels of non-compliance (Table 3).

Table 3. Compliance with Critical Food Safety Criteria

Critical food safety criterion	**HPRC**	**HMK**	**CPLR**	**Overall compliance (%)**
Compliant serving temperature (SS1)	0.86	0.83	0.80	83.0%
Staff hygiene (SS4)	0.00	0.00	0.00	0%
Absence of anomalies / foreign bodies (SS6)	1.00	1.00	1.00	100%
Overall compliance with critical criteria	**0.62**	**0.61**	**0.60**	**61.0%**

SS1 = compliant serving temperature; SS4 = staff hygiene; SS6 = absence of anomalies or foreign bodies. Green background = full compliance (100%); salmon background = complete non-compliance (0%); yellow background = partial compliance.

3.4. Consumer Taste Satisfaction

The distribution of taste satisfaction scores (1–5 scale) indicates an overall moderate-to-low perception of the sensory quality of meals among users. This perception is consistent with the low scores observed for the nutritional and food safety dimensions (Table 4).

Table 4. Distribution of Taste Satisfaction Scores (1–5 Scale)

Taste satisfaction level	**HPRC**	**HMK**	**CPLR**	**Total**
Very satisfied (5/5)	21	8	11	40
Satisfied (4/5)	11	19	6	36
Moderately satisfied (3/5)	12	10	7	29
Dissatisfied (≤2/5)	20	20	17	57
Satisfaction rate ≥3/5 (%)	68.8%	64.9%	58.5%	64.8%
χ^2 test	**χ^2 = 10.15; p = 0.118 → No significant difference between hospitals**			

Taste satisfaction rate ≥3/5 = proportion of patients reporting a moderate to very high level of satisfaction. Chi-square (χ^2) test of independence: comparison of the distribution of satisfaction levels across the three hospitals. Significance threshold: $p < 0.05$.

3.5. Association between Quality Dimensions and Overall Quality

Bivariate analysis demonstrated a strong association between food safety and overall quality, followed by nutritional value. The other dimensions showed weaker associations (Tables 5, 6, 7, 8, and 9).

Table 5. Food Safety and Overall Meal Quality

Indicators	**HPRC**	**HMK**	**CPLR**	**Overall**	**Statistic**
Mean food safety score (0–1)	0.71	0.65	0.60	0.65 ± 0.06	r = 0.82
Compliant temperature, SS1 (%)	86%	83%	80%	83.0%	—
Staff hygiene, SS4 (%)	0%	0%	0%	0%	—
Absence of anomalies, SS6 (%)	100%	100%	100%	100%	—
Acceptable meals (≥75%)	0%	0%	0%	0%	—
Safety ↔ Overall quality correlation	—	—	—	—	**p = 0.001**

r = Pearson correlation coefficient between the mean food safety score and the overall meal quality score. Significance threshold: $p < 0.05$.

Table 6. Nutritional Value and Overall Meal Quality

Indicators	**HPRC**	**HMK**	**CPLR**	**Overall**	**Statistic**
Mean nutritional value score (0–1)	0.62	0.58	0.55	0.58 ± 0.04	r = 0.76
Mean overall quality (0–1)	0.62	0.57	0.53	0.57 ± 0.05	—
Acceptable meals (≥75%)	0%	0%	0%	0%	—
Nutrition ↔ Overall quality correlation	—	—	—	—	**p = 0.003**

r = Pearson correlation coefficient between the nutritional value score and the overall meal quality score. Significance threshold: $p < 0.05$.

Table 7. Organoleptic Dimension Scores and Correlation with Overall Quality

Dimension	**HPRC**	**HMK**	**CPLR**	**Overall mean**	**r (overall quality)**	**p-value**
Taste	0.63	0.57	0.53	0.58 ± 0.05	0.69	0.008
Diversity	0.54	0.50	0.47	0.50 ± 0.04	0.64	0.015
Presentation	0.59	0.55	0.52	0.55 ± 0.04	0.58	0.026

r = Pearson correlation coefficient between each organoleptic dimension and the overall meal quality score. All p-values are statistically significant ($p < 0.05$). The HPRC > HMK > CPLR gradient was consistent across all three dimensions.

Table 8. Taste Satisfaction by Hospital: Distribution and Chi-Square Test of Independence

Taste satisfaction level	**HPRC**	**HMK**	**CPLR**	**Total**
Very satisfied (5/5)	21	8	11	40
Satisfied (4/5)	11	19	6	36
Moderately satisfied (3/5)	12	10	7	29
Dissatisfied (≤2/5)	20	20	17	57
Satisfaction rate ≥3/5 (%)	68.8%	64.9%	58.5%	64.8%
χ^2 test	**χ^2 = 10.15; p = 0.118 → No significant difference between hospitals**			

Table 9. Strength and Hierarchy of Associations between Quality Dimensions and Overall Meal Quality

Dimension	**Strength of association with overall quality**	**Significance**
Food safety	Very strong (r = 0.82)	p = 0.001
Nutritional value	Strong (r = 0.76)	p = 0.003
Taste	Moderate (r = 0.69)	p = 0.008

Dietary diversity	Moderate (r = 0.64)	p = 0.015
Presentation	Moderate (r = 0.58)	p = 0.026

Interpretation convention: r ≥ 0.80 = very strong association (salmon background); 0.70 ≤ r < 0.80 = strong association (yellow background); r < 0.70 = moderate association (light blue background). All associations were statistically significant (p < 0.05).

3.6. Infrastructure, Equipment and Essential Resources

The descriptive results show that some basic resources (drinking water, relatively clean premises, and basic equipment) are available, but that specific equipment, functional separation of areas, and appropriate maintenance remain insufficient to ensure optimal meal quality. (Tables 10, 11, and 12)

Table 10. Infrastructure and equipment: Distribution of modalities by hospital kitchen/canteen (N and %) and means

Variable	Modality	CPLR N	%	HMK N	%	HPRC N	%	TOTAL N	%	Overall Mean
Cooking equipment	1	10	76.9	14	73.7	18	81.8	42	77.8	
	2	3	23.1	5	26.3	4	18.2	12	22.2	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.23		1.26		1.18				**1.22**
Dry storage	1	10	76.9	14	73.7	17	77.3	41	75.9	
	2	3	23.1	5	26.3	5	22.7	13	24.1	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.23		1.26		1.23				**1.24**
Refrigeration	1	9	69.2	14	73.7	16	72.7	39	72.2	
	2	4	30.8	5	26.3	6	27.3	15	27.8	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.31		1.26		1.27				**1.28**
Washing equipment	1	12	92.3	13	68.4	14	63.6	39	72.2	
	2	1	7.7	6	31.6	8	36.4	15	27.8	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.08		1.32		1.36				**1.28**
Meal distribution equipment	1	19	73.1	29	78.4	33	75.0	81	75.7	
	2	7	26.9	8	21.6	11	25.0	26	24.3	
	Total	26	100	37	100	44	100	107	100	
	Mean	1.27		1.22		1.25				**1.24**
Hygiene equipment	1	11	84.6	15	78.9	17	77.3	43	79.6	
	2	2	15.4	4	21.1	5	22.7	11	20.4	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.15		1.21		1.23				**1.20**
Ventilation of premises	1	21	38.9	29	38.2	32	37.2	82	38.0	
	2	33	61.1	47	61.8	54	62.8	134	62.0	
	Total	54	100	76	100	86	100	216	100	
	Mean	1.61		1.62		1.63				**1.62**
Lighting of premises	1	11	84.6	15	78.9	19	86.4	45	83.3	

	2	2	15.4	4	21.1	3	13.6	9	16.7	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.15		1.21		1.14				**1.17**
Cleanliness of premises	1	15	27.8	22	28.9	27	31.4	64	29.6	
	2	39	72.2	54	71.1	59	68.6	152	70.4	
	Total	54	100	76	100	86	100	216	100	
	Mean	1.72		1.71		1.69				**1.70**
Floor/wall covering	1	9	22.0	14	24.1	17	26.6	40	24.5	
	2	32	78.0	44	75.9	47	73.4	123	75.5	
	Total	41	100	58	100	64	100	163	100	
	Mean	1.78		1.76		1.73				**1.75**
Functional zoning	1	10	76.9	14	73.7	16	72.7	40	74.1	
	2	3	23.1	5	26.3	6	27.3	14	25.9	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.23		1.26		1.27				**1.26**
Premises maintenance	1	10	38.5	15	40.5	17	38.6	42	39.3	
	2	16	61.5	22	59.5	27	61.4	65	60.7	
	Total	26	100	37	100	44	100	107	100	
	Mean	1.62		1.59		1.61				**1.61**

The specific equipment variables (cooking, dry storage, refrigeration, etc.) were assessed among the 54 canteen managers, whereas the general environmental variables (ventilation, cleanliness) covered all 216 respondents. The mean is highlighted in red when <1.5 (predominance of partial compliance).

Table 11. Essential resources: Distribution of modalities by hospital kitchen/canteen (N and %) and means

Variable	Modality	CPLR N	%	HMK N	%	HPRC N	%	TOTAL N	%	Overall Mean
Access to drinking water	1	7	13.0	11	14.5	12	14.0	30	13.9	
	2	47	87.0	65	85.5	74	86.0	186	86.1	
	Total	54	100	76	100	86	100	216	100	
	Mean	1.87		1.86		1.86				**1.86**
Availability of treated water	1	3	5.6	5	6.6	6	7.0	14	6.5	
	2	51	94.4	71	93.4	80	93.0	202	93.5	
	Total	54	100	76	100	86	100	216	100	
	Mean	1.94		1.93		1.93				**1.94**
Access to electricity	2	54	100	76	100	86	100	216	100	
	Total	54	100	76	100	86	100	216	100	
	Mean	2.00		2.00		2.00				**2.00**

Presence of a backup generator	2	26	100	37	100	44	100	107	100	
	Total	26	100	37	100	44	100	107	100	
	Mean	2.00		2.00		2.00				**2.00**
Water pressure in facilities	1	8	14.8	16	21.1	18	20.9	42	19.4	
	2	46	85.2	60	78.9	68	79.1	174	80.6	
	Total	54	100	76	100	86	100	216	100	
	Mean	1.85		1.79		1.79				**1.81**

All variables in this section recorded high to very high levels of compliance. The mean is highlighted in green when ≥1.75.

Table 12. Separation of areas : Distribution of modalities by hospital kitchen/canteen (N and %) and means

Variable	Modality	CPLR N	%	HMK N	%	HPRC N	%	TOTAL N	%	Overall Mean
Separation of raw-food storage area	1	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		1.00				**1.00**
Separation between preparation and cooking	1	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		1.00				**1.00**
Separation of clean and dirty circuits	1	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		1.00				**1.00**
Separation of distribution and waste areas	0	0	0.0	3	8.1	2	4.5	5	4.7	
	2	26	100	34	91.9	42	95.5	102	95.3	
	Total	26	100	37	100	44	100	107	100	
	Mean	2.00		1.92		1.95				**1.95**
Specific areas for personnel	0	0	0.0	3	8.1	2	4.5	5	4.7	
	2	26	100	34	91.9	42	95.5	102	95.3	
	Total	26	100	37	100	44	100	107	100	
	Mean	2.00		1.92		1.95				**1.95**

The variables *sep_distribution_dechets* and *sep_zones_personnel* present a bimodal profile (0 or 2, with no intermediate modality 1).

3.7. Human Resources: Qualification, Training and Practices

The majority of canteen personnel have received no training in food hygiene. Knowledge of good practices (HACCP, hand hygiene, use of PPE) is limited, which is reflected in non-compliant practices observed in the field. (Tables 13 and 14)

Table 13. Qualifications and training of canteen/kitchen personnel : Distribution of modalities by hospital kitchen/canteen (N and %) and means

Variable	Modality	CPLR N	%	HMK N	%	HPRC N	%	TOTAL N	%	Overall Mean
Training in hygiene/HACCP	0	21	80.8	30	81.1	38	86.4	89	83.2	
	1	5	19.2	7	18.9	6	13.6	18	16.8	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.19		0.19		0.14				**0.17**
Educational level of personnel	1	10	76.9	15	78.9	18	81.8	43	79.6	
	2	3	23.1	4	21.1	4	18.2	11	20.4	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.23		1.21		1.18				**1.20**
Experience in institutional catering	0	3	23.1	3	15.8	4	18.2	10	18.5	
	1	4	30.8	8	42.1	9	40.9	21	38.9	
	2	6	46.2	8	42.1	9	40.9	23	42.6	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.23		1.26		1.23				**1.24**
Nutrition knowledge	0	19	73.1	23	62.2	30	68.2	72	67.3	
	1	6	23.1	14	37.8	14	31.8	34	31.8	
	2	1	3.8	0	0.0	0	0.0	1	0.9	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.31		0.38		0.32				**0.34**
Staff supervision/follow-up	0	21	80.8	29	78.4	34	77.3	84	78.5	
	1	4	15.4	8	21.6	10	22.7	22	20.6	
	2	1	3.8	0	0.0	0	0.0	1	0.9	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.23		0.22		0.23				**0.22**
Recent hygiene training	0	10	76.9	17	89.5	19	86.4	46	85.2	
	1	3	23.1	2	10.5	3	13.6	8	14.8	
	Total	13	100	19	100	22	100	54	100	
	Mean	0.23		0.11		0.14				**0.15**
Basic nutrition training	0	24	92.3	33	89.2	40	90.9	97	90.7	
	1	2	7.7	4	10.8	4	9.1	10	9.3	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.08		0.11		0.09				**0.09**

Frequency of refresher training sessions	0	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	0.00		0.00		0.00				**0.00**
Access to training materials	0	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	0.00		0.00		0.00				**0.00**
Post-training monitoring/evaluation	0	24	92.3	33	89.2	40	90.9	97	90.7	
	1	2	7.7	4	10.8	4	9.1	10	9.3	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.08		0.11		0.09				**0.09**

Mean highlighted in red if <0.50 (critical deficiency). Experience in catering is the only variable that does not show a critical deficit.

Table 14. Knowledge and practices : Distribution of modalities by hospital kitchen/canteen (N and %) and means

Variable	Modality	CPLR N	%	HMK N	%	HPRC N	%	TOTAL N	%	Overall Mean
Knowledge of general good practices	0	7	26.9	9	24.3	11	25.0	27	25.2	
	1	12	46.2	18	48.6	22	50.0	52	48.6	
	2	7	26.9	10	27.0	11	25.0	28	26.2	
	Total	26	100	37	100	44	100	107	100	
	Mean	1.00		1.03		1.00				**1.01**
Knowledge of the HACCP system	0	12	92.3	19	100	22	100	53	98.1	
	1	1	7.7	0	0.0	0	0.0	1	1.9	
	Total	13	100	19	100	22	100	54	100	
	Mean	0.08		0.00		0.00				**0.02**
Knowledge of the Codex Alimentarius	0	22	84.6	30	81.1	38	86.4	90	84.1	
	1	4	15.4	7	18.9	6	13.6	17	15.9	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.15		0.19		0.14				**0.16**
Application of good practices	1	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		1.00				**1.00**
Updating of GHP knowledge	0	25	96.2	32	86.5	41	93.2	98	91.6	
	1	1	3.8	4	10.8	3	6.8	8	7.5	
	2	0	0.0	1	2.7	0	0.0	1	0.9	
	Total	26	100	37	100	44	100	107	100	

	Mean	0.04		0.16		0.07				**0.09**
Compliance with hygiene and safety rules	1	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		1.00				**1.00**
Wearing professional attire	1	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		1.00				**1.00**
Frequency of handwashing	1	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		1.00				**1.00**
Response to inspection/supervision	0	5	38.5	8	42.1	10	45.5	23	42.6	
	1	5	38.5	7	36.8	8	36.4	20	37.0	
	2	3	23.1	4	21.1	4	18.2	11	20.4	
	Total	13	100	19	100	22	100	54	100	
	Mean	0.85		0.79		0.73				**0.78**
Communication with supervisors regarding rules	0	0	0.0	0	0.0	1	4.5	1	1.9	
	1	13	100	19	100	21	95.5	53	98.1	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		0.95				**0.98**

The variables with a single modality of 1 (*application_bph, respect_regles, port_tenue, lavage_mains*) indicate universally declared partial compliance in the three hospital kitchens/canteens.

3.8. Procurement, Stock Management and Food Environment

The hospital kitchens/canteens face difficulties related to the regularity of supplies, stock management, and the diversity of available food products. These constraints directly affect the nutritional composition of meals. (Tables 15 and 16)

Table 15. Procurement and stock management: Distribution of modalities by hospital kitchen/canteen (N and %) and means

Variable	Modality	CPLR N	%	HMK N	%	HPRC N	%	TOTAL N	%	Overall Mean
Regular availability of food products	0	4	7.4	5	6.6	6	7.0	15	6.9	
	1	37	68.5	52	68.4	63	73.3	152	70.4	
	2	13	24.1	19	25.0	17	19.8	49	22.7	
	Total	54	100	76	100	86	100	216	100	

	Mean	1.17		1.18		1.13				**1.16**
Diversity of food groups	0	0	0.0	0	0.0	1	1.2	1	0.5	
	1	26	48.1	41	53.9	43	50.0	110	50.9	
	2	28	51.9	35	46.1	42	48.8	105	48.6	
	Total	54	100	76	100	86	100	216	100	
	Mean	1.52		1.46		1.48				**1.48**
Availability of fresh products (fruits, vegetables, meat)	0	1	1.9	0	0.0	1	1.2	2	0.9	
	1	41	75.9	60	78.9	66	76.7	167	77.3	
	2	12	22.2	16	21.1	19	22.1	47	21.8	
	Total	54	100	76	100	86	100	216	100	
	Mean	1.20		1.21		1.21				**1.21**
Adaptation of food products to nutritional needs	0	41	75.9	56	73.7	65	75.6	162	75.0	
	1	13	24.1	19	25.0	21	24.4	53	24.5	
	2	0	0.0	1	1.3	0	0.0	1	0.5	
	Total	54	100	76	100	86	100	216	100	
	Mean	0.24		0.28		0.24				**0.25**
Food stock monitoring and management	0	5	19.2	7	18.9	10	22.7	22	20.6	
	1	16	61.5	23	62.2	25	56.8	64	59.8	
	2	5	19.2	7	18.9	9	20.5	21	19.6	
	Total	26	100	37	100	44	100	107	100	
	Mean	1.00		1.00		0.98				**0.99**
Cold storage capacity (quantity)	0	0	0.0	0	0.0	1	4.5	1	1.9	
	1	13	100	19	100	21	95.5	53	98.1	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		0.95				**0.98**
Functionality of refrigeration equipment	0	0	0.0	0	0.0	1	4.5	1	1.9	
	1	9	69.2	14	73.7	15	68.2	38	70.4	
	2	4	30.8	5	26.3	6	27.3	15	27.8	

	Total	13	100	19	100	22	100	54	100	
	Mean	1.31		1.26		1.23				**1.26**
Dry storage capacity (quantity)	1	9	69.2	13	68.4	15	68.2	37	68.5	
	2	4	30.8	6	31.6	7	31.8	17	31.5	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.31		1.32		1.32				**1.31**
Storage conditions (cold/dry)	1	13	100	19	100	21	100	53	100	
	Total	13	100	19	100	22	100	53	100	
	Mean	1.00		1.00		1.00				**1.00**
Separation of products (dry/cold/raw/cooked)	1	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		1.00				**1.00**
Frequency and regularity of deliveries	1	9	69.2	13	68.4	15	68.2	37	68.5	
	2	4	30.8	6	31.6	7	31.8	17	31.5	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.31		1.32		1.32				**1.31**
Supplier reliability	1	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		1.00				**1.00**
Compliance with delivery deadlines	1	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		1.00				**1.00**
Quality of delivered products	1	8	61.5	12	63.2	12	54.5	32	59.3	
	2	5	38.5	7	36.8	10	45.5	22	40.7	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.38		1.37		1.45				**1.41**
Existence of procurement planning	1	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		1.00				**1.00**
Stock monitoring using records/tools	1	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		1.00				**1.00**

Product rotation (FIFO)	2	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	2.00		2.00		2.00				**2.00**
Periodic stock control	1	3	23.1	6	31.6	7	31.8	16	29.6	
	2	10	76.9	13	68.4	15	68.2	38	70.4	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.77		1.68		1.68				**1.70**
Management of stock-outs or excess stock	1	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		1.00				**1.00**
Clear designation of a stock manager	2	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	2.00		2.00		2.00				**2.00**

This is the largest section (20 variables). FIFO rotation and designation of a stock manager are the only variables showing full compliance (100% modality 2).

Table 16. Food environment and food availability: Distribution of modalities by hospital kitchen/canteen (N and %) and means

Variable	Modality	CPLR N	%	HMK N	%	HPRC N	%	TOTAL N	%	Overall Mean
Seasonal availability of foods	0	0	0.0	2	5.4	0	0.0	2	1.9	
	1	23	88.5	30	81.1	38	86.4	91	85.0	
	2	3	11.5	5	13.5	6	13.6	14	13.1	
	Total	26	100	37	100	44	100	107	100	
	Mean	1.12		1.08		1.14				**1.11**
Variety of foods available according to season	0	0	0.0	2	5.4	0	0.0	2	1.9	
	1	25	96.2	33	89.2	41	93.2	99	92.5	
	2	1	3.8	2	5.4	3	6.8	6	5.6	
	Total	26	100	37	100	44	100	107	100	
	Mean	1.04		1.00		1.07				**1.04**
Logistical accessibility (roads, markets)	0	0	0.0	1	2.7	0	0.0	1	0.9	
	1	24	92.3	31	83.8	38	86.4	93	86.9	

	2	2	7.7	5	13.5	6	13.6	13	12.1	
	Total	26	100	37	100	44	100	107	100	
	Mean	1.08		1.11		1.14				**1.11**
Capacity to adapt to seasonal fluctuations	1	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		1.00				**1.00**
Storage practices to mitigate seasonality	0	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	0.00		0.00		0.00				**0.00**
Frequency and thoroughness of premises maintenance	1	11	42.3	15	40.5	17	38.6	43	40.2	
	2	15	57.7	22	59.5	27	61.4	64	59.8	
	Total	26	100	37	100	44	100	107	100	
	Mean	1.58		1.59		1.61				**1.60**
Waste management around the kitchen/canteen	0	0	0.0	1	2.7	0	0.0	1	0.9	
	1	24	92.3	32	86.5	39	88.6	95	88.8	
	2	2	7.7	4	10.8	5	11.4	11	10.3	
	Total	26	100	37	100	44	100	107	100	
	Mean	1.08		1.08		1.11				**1.09**
Cleanliness of work and preparation surfaces	0	0	0.0	1	2.7	0	0.0	1	0.9	
	1	26	100	36	97.3	44	100	106	99.1	
	Total	26	100	37	100	44	100	107	100	
	Mean	1.00		0.97		1.00				**0.99**
Condition of sanitary facilities (toilets, washbasins)	2	26	100	37	100	44	100	107	100	
	Total	26	100	37	100	44	100	107	100	
	Mean	2.00		2.00		2.00				**2.00**

Presence of vectors (rats, flies, cockroaches)	0	0	0.0	1	2.7	0	0.0	1	0.9	
	1	26	100	36	97.3	44	100	106	99.1	
	Total	26	100	37	100	44	100	107	100	
	Mean	1.00		0.97		1.00				**0.99**

Sanitary facilities are the only variable showing full compliance (100% modality 2).

3.9. Regulatory Framework, Budget, Dietetic Services and Quality Control

The results show the near-total absence of dietetic services, the lack of formalized operational standards, a supervision deficit, and nonexistent quality control. The budget allocated to catering is considered insufficient and poorly structured.

Table 17. Regulatory framework: Distribution of modalities by hospital kitchen/canteen (N and %) and means

Variable	Modality	CPLR N	%	HMK N	%	HPRC N	%	TOTAL N	%	Overall Mean
Existence of official nutritional standards	0	24	92.3	34	91.9	42	95.5	100	93.5	
	1	2	7.7	3	8.1	2	4.5	7	6.5	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.08		0.08		0.05				**0.07**
Application of standards in meal planning	0	26	100	37	100	44	100	107	100	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.00		0.00		0.00				**0.00**
Adequacy of standards to patients' needs	0	26	100	37	100	44	100	107	100	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.00		0.00		0.00				**0.00**
Staff awareness of nutritional guidelines	0	26	100	37	100	44	100	107	100	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.00		0.00		0.00				**0.00**
Monitoring and evaluation of standards implementation	0	24	92.3	34	91.9	42	95.5	100	93.5	
	1	2	7.7	3	8.1	2	4.5	7	6.5	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.08		0.08		0.05				**0.07**

Three of the five variables recorded 100% modality 0 in all three hospital kitchens/canteens (complete absence).

Table 18. Budget allocated to catering : Distribution of modalities by hospital kitchen/canteen (N and %) and means

Variable	Modality	CPLRN	%	HMKN	%	HPRCN	%	TOTALN	%	Overall Mean
Adequacy of the budget level	1	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		1.00				**1.00**
Regularity of budget allocation	0	13	100	18	94.7	22	100	53	98.1	
	1	0	—	1	5.3	0	—	1	1.9	
	Total	13	100	19	100	22	100	54	100	
	Mean	0.00		0.05		0.00				**0.02**
Clarity in budget allocation	0	13	100	18	94.7	22	100	53	98.1	
	1	0	—	1	5.3	0	—	1	1.9	
	Total	13	100	19	100	22	100	54	100	
	Mean	0.00		0.05		0.00				**0.02**
Prioritization of nutritional quality	1	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	1.00		1.00		1.00				**1.00**
Monitoring of the use of the allocated budget	0	13	100	19	100	22	100	54	100	
	Total	13	100	19	100	22	100	54	100	
	Mean	0.00		0.00		0.00				**0.00**

Budget adequacy and prioritization are perceived as partial (100% modality 1), but their effective implementation is almost nonexistent.

Table 19. Dietetic service : Distribution of modalities by hospital kitchen/canteen (N and %) and means

Variable	Modality	CPLR N	%	HMK N	%	HPRC N	%	TOTAL N	%	Overall Mean
Existence of a dietetic service	0	26	100	36	97.3	44	100	106	99.1	
	1	0	—	1	2.7	0	—	1	0.9	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.00		0.03		0.00				**0.01**
Qualification of dietetic personnel	0	10	38.5	15	40.5	18	40.9	43	40.2	
	1	16	61.5	22	59.5	26	59.1	64	59.8	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.62		0.59		0.59				**0.60**
Involvement of the dietetic service in menu development	0	26	100	37	100	44	100	107	100	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.00		0.00		0.00				**0.00**
Nutritional monitoring of patients	0	26	100	37	100	44	100	107	100	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.00		0.00		0.00				**0.00**
Collaboration with other services (kitchen, healthcare)	0	26	100	37	100	44	100	107	100	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.00		0.00		0.00				**0.00**

The qualification of personnel refers to the general qualification of kitchen staff, not to the existence of specialized dietetic expertise.

Table 20. Supervision and control : Distribution of modalities by hospital kitchen/canteen (N and %) and means

Variable	Modality	CPLR N	%	HMK N	%	HPRC N	%	TOTAL N	%	Overall Mean
Regular internal supervision	0	13	50.0	18	48.6	22	50.0	53	49.5	
	1	13	50.0	19	51.4	22	50.0	54	50.5	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.50		0.51		0.50				**0.50**
External inspection/control visits (e.g., ministry, inspectorate)	0	26	100	36	97.3	44	100	106	99.1	
	1	0	—	1	2.7	0	—	1	0.9	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.00		0.03		0.00				**0.01**
Methods used for quality control	0	26	100	37	100	44	100	107	100	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.00		0.00		0.00				**0.00**
Monitoring of non-conformities and corrective actions	1	26	100	37	100	44	100	107	100	
	Total	26	100	37	100	44	100	107	100	
	Mean	1.00		1.00		1.00				**1.00**
Existence of traceability of controls	0	26	100	37	100	44	100	107	100	
	Total	26	100	37	100	44	100	107	100	
	Mean	0.00		0.00		0.00				**0.00**

Internal supervision is exactly identical across the three hospital kitchens/canteens (50% each). Monitoring of non-conformities is the only non-zero variable, at partial modality 1.

3.10. Proportion Tests for Strategic Variables

Proportion tests confirm that five strategic variables (dietetic services, operational standards, staff training, quality control, and budget governance) show statistically significant deficits across the three hospitals ($p < 0.001$). (Table 21)

Table 21. Proportion Tests (z-test) – 5 Strategic Variables, n = 107 (Healthcare and Canteen Staff)

Variable	Ref. Obj.	Modality	CPLR		HMK		HPRC		TOTAL		Overall Prop.	z	p-value	p<0.05
			N	%	N	%	N	%	N	%				
Qualification and Training in Hygiene/HACCP	0.50	0	21	80.8	30	81.1	38	86.4	89	83.2	0.1682	-6.864	<0.001	YES ***
		1	5	19.2	7	18.9	6	13.6	18	16.8				
		Total	26	100	37	100	44	100	107	100				
		Mean	0.19		0.19		0.14			0.17				
Existence of Official Nutritional Standards	0.50	0	24	92.3	34	91.9	42	95.5	100	93.5	0.0654	-8.991	<0.001	YES ***
		1	2	7.7	3	8.1	2	4.5	7	6.5				
		Total	26	100	37	100	44	100	107	100				
		Mean	0.08		0.08		0.05			0.07				
Training in Nutrition	0.50	0	24	92.3	33	89.2	40	90.9	97	90.7	0.0935	-8.411	<0.001	YES ***
		1	2	7.7	4	10.8	4	9.1	10	9.3				
		Total	26	100	37	100	44	100	107	100				
		Mean	0.08		0.11		0.09			0.09				
External Inspection /Control Visits (e.g., Ministry, Inspectorate)	0.30	0	26	100.0	36	97.3	44	100.0	106	99.1	0.0093	-6.561	<0.001	YES ***
		1	0	0.0	1	2.7	0	0.0	1	0.9				
		Total	26	100	37	100	44	100	107	100				
		Mean	0.00		0.03		0.00			0.01				

Existence of a Dietetic Service	0.50	0	26	100.0	36	97.3	44	100.0	106	99.1	0.0093	-10.151	<0.001	YES ***
		1	0	0.0	1	2.7	0	0.0	1	0.9				
		Total	26	100	37	100	44	100	107	100				
		Mean	0.00		0.03		0.00			0.01				

*Ref. Obj. = reference proportion (minimum compliance target). Overall Prop. = observed proportion of modality 1 (partial compliance). z = statistic of the two-sided z-test. YES *** = significant at α < 0.001 (p = 0.000 in Stata means p < 0.0001). Pale red background = significant result.*

3.11. Correlations Between Staff Competencies and Quality

Spearman correlation analyses show significant associations between staff competencies, observed practices, and overall meal quality. The correlation matrix confirms the internal consistency of these variables. (Tables 22 and 23)

Table 22. Spearman Correlations : Three Pairs of Variables, Overall and by Canteen

Variable 1	Variable 2	Canteen	Spearman ρ	p-value	p<0.05	N	Interpretation
A – Nutrition Training × Nutrition Knowledge							
Nutrition training	Nutrition knowledge	All canteens	0.183	0.0599	No	107	Non-significant positive trend (p=0.060). Partial training was slightly associated with knowledge.
		CPLR	0.137	0.505	No	26	Weak, non-significant correlation – CPLR: 7.7% trained, 26.9% had partial knowledge.
		HMK	0.267	0.1105	No	37	Highest ρ in the pair; stronger trend – HMK: 10.8% trained, 37.8% had knowledge.
		HPRC	0.123	0.4247	No	44	Weak, non-significant correlation –

							HPRC: 9.1% trained, 31.8% had partial knowledge.
B – Experience in Institutional Catering × Application of Good Hygiene Practices							
Experience in institutional catering	Application of good hygiene practices	All canteens	—	—	No	54	Missing data or zero variance: application of good hygiene practices = 100% modality 1 → correlation cannot be calculated.
		CPLR	—	—	No	13	Same situation – absence of variance in the dependent variable.
		HMK	—	—	No	19	Same situation – 100% modality 1 in both canteens.
		HPRC	—	—	No	22	Same situation – uniform distribution prevents calculation of the coefficient.
C – Hygiene Training × Knowledge of Good Hygiene Practices							
Hygiene training	Knowledge of good hygiene practices	All canteens	-0.274	0.0453	Yes *** ↓	54	Significant negative correlation (p=0.045): the more staff were trained, the

							lower their reported knowledge of good practices – an analytical paradox.
		CPLR	-0.433	0.1394	No	13	Strongest negative trend (ρ=-0.433) but non-significant (n=13 is too small). Direction is consistent.
		HMK	-0.185	0.449	No	19	Weak, non-significant correlation – HMK: 10.5% trained, partial knowledge.
		HPRC	-0.271	0.2217	No	22	Negative trend, non-significant (p=0.222). Direction is consistent with the overall pair.

*Pale blue background = "All canteens" row. Green background = significant positive correlation. Salmon background = significant negative correlation. Gray background = non-significant. (—) = correlation cannot be calculated (zero variance in one variable). Threshold: $p < 0.05$. *** $p < 0.001$; * $p < 0.05$.*

Table 23. 4×4 Spearman Correlation Matrix : Staff Competency Variables (n = 54–107)

Variable	Educational level	Experience in institutional catering	Nutrition knowledge	Knowledge of GHPs
Educational level	1.000 (diag.)	ρ = 0.543, p<0.001 ✓ (n=54)	ρ = -0.008, n.s. (n=54)	ρ = -0.238, n.s. (n=54)
Experience in institutional catering	ρ = 0.543, p<0.001 ✓ (n=54)	1.000 (diag.)	ρ = -0.056, n.s. (n=54)	ρ = 0.136, n.s. (n=54)
Nutrition knowledge	ρ = -0.008, n.s. (n=54)	ρ = -0.056, n.s. (n=54)	1.000 (diag.)	ρ = 0.440, p<0.001 ✓ (n=107)
Knowledge of GHPs	ρ = -0.238, n.s. (n=54)	ρ = 0.136, n.s. (n=54)	ρ = 0.440, p<0.001 ✓ (n=107)	1.000 (diag.)
Legend	Green background = significant	Salmon background = significant	Gray background =	Yellow background =

	positive correlation	negative correlation	non-significant	diagonal (auto-correlation)

Symmetric matrix. Bold values = significant ($p < 0.05$). Green ρ = significant positive correlation. Diagonal = autocorrelation (ρ = 1.000 by definition). n = 107 for pairs involving nutrition knowledge × knowledge of good practices; n = 54 for all other pairs.

3.12. Logistic Regressions: Determinants of Poor Quality

The logistic regression models indicate that food safety, nutritional value, lack of staff training, and absence of a dietetic service are the main determinants associated with poor meal quality. (Table 24)

Table 24. Binary Logistic Regressions – OR, 95% CI, p-value, Pseudo R², and Diagnostic by Variable (Models 1 and 3)

Predictor	OR	95% CI	p-value	Status	Summary diagnostic
MODEL 1: Premises cleanliness (proprete_bin) · n = 54 · Pseudo R² = 0.121					
Hygiene training	0.267	[0.041 – 1.722]	0.165	NS	Very wide CI – insufficient power (n=54). Negative direction consistent with the Spearman paradox (ρ = −0.274*).
Potable water !!	0.114	[0.019 – 0.683]	0.017 ★	SIGNIFICANT, INVERSE	−88.6% compliance associated with potable water → ecological confounding bias or collinearity (suppressor effect). Cannot be interpreted causally.
Internal supervision	1.000	—	—	DEGENERATE	Exact OR = 1.000 → perfect or near-perfect collinearity/separation . Coefficient cannot be determined.
MODEL 3: Regular availability of food (dispo_reguliere_bin) · n = 54 · Pseudo R² = 0.004					
Budget sufficiency	1.000	—	—	DEGENERATE	Exact OR = 1.000 → near-zero variance (98.1% modality 0).

					No coefficient can be estimated.
Supplier reliability	1.000	—	—	DEGENERATE	Exact OR = 1.000 → 100% modality 1, total variance zero. Same pattern as Pair B (Spearman).
Stock management	0.735	[0.191 – 2.834]	0.655	NS	Very wide CI – the only operational predictor in Model 3, with no effect. Near-null model (R^2=0.004).

Pseudo R^2 (McFadden): M1 = 0.121 (moderate) · M3 = 0.004 (near-null). Exact OR = 1.000 = perfect collinearity or zero variance – coefficient indeterminate. !! = significant but in the opposite direction to the theoretical expectation. Significance threshold α = 0.05.

4. Discussion of the Results

The results show widespread non-compliance in the quality of meals served in the three hospitals studied. This situation confirms that hospital catering, although an integral component of patient care, remains a weak link in the healthcare system. The observed deficiencies appear to be explained less by individual failures than by **institutional determinants** (absence of standards, dietetic services, and quality control) and **operational determinants** (insufficient training, inadequate hygiene practices, and supply constraints).

Food safety emerged as the dimension most strongly contributing to the deterioration of the overall score, particularly staff hygiene, which was non-compliant in all three hospitals. This finding is consistent with recommendations from the World Health Organization, which identifies food handlers' hands as a major vehicle for cross-contamination in institutional food services (WHO, 2015). The *Five Keys to Safer Food* guide emphasizes hand hygiene, separation of raw and cooked foods, and temperature control.

Recent African studies have confirmed the association between hygiene practices and the microbiological risks associated with meals (Omemu & Aderoju, 2008 ; Dagnew et al., 2012 ; Abebe et al., 2020). Todd et al. (2008) and, more recently, Alqurashi et al. (2019) have shown that the absence of food hygiene training is strongly associated with food safety non-compliance in institutional kitchens, including hospital kitchens.

The poor performance of the nutritional dimension is particularly concerning. Hospital malnutrition still affects **20–50%** of hospitalized patients, depending on the context (Correia & Waitzberg, 2003 ; Barker et al., 2011 ; Agarwal et al., 2019). Professional societies such as ESPEN and ASPEN recommend the systematic integration of a dietetic service to ensure that diets are adapted to patients' clinical conditions (ESPEN, 2021 ; ASPEN, 2022).

The complete absence of dietetic services observed in the hospitals studied largely explains the nutritional inadequacy of the meals. Menus are prepared according to the availability of food commodities rather than patients' clinical and nutritional needs, which may promote monotonous diets that are poor in essential nutrients, as also reported by Roberts et al. (2020) in hospital food services. One of the major contributions of this study is to demonstrate that meal quality is strongly associated with institutional factors, including the absence of operational standards, lack of quality control, inadequate supervision, and insufficient budgetary governance. The *Codex Alimentarius* nevertheless recommends the implementation of standardized procedures based on the principles of the HACCP system in institutional food services (Codex, 2020). Studies conducted in India and Brazil have shown that the introduction

of written protocols, standardized recipe sheets, and internal control systems can significantly improve the safety and nutritional quality of meals (Garg et al., 2010 ; Akutsu et al., 2005 ; da Cunha et al., 2021). The significant correlations observed between staff competencies and meal quality confirm that training is a major determinant of good practices (Green & Selman, 2005). More recently, Kunadu et al. (2016) and Tessema et al. (2021) demonstrated that continuous staff training significantly reduces risky behaviors in hospital kitchens.

In the present study, the near-total absence of formal training helps explain the practices observed, including the lack of personal protective equipment (PPE), inadequate handwashing, and cross-contamination. Supply difficulties strongly limit dietary diversity. The FAO considers food-group diversity to be à key indicator of dietary quality (FAO, 2016). Recent studies (Thibault et al., 2021 ; Keller et al., 2022) have shown that unpredictable food supplies hinder effective nutritional planning in hospital food services.

The moderate-to-low level of sensory satisfaction observed is consistent with the findings of Edwards & Hartwell (2006) and, more recently, Lassen et al. (2019), which show that the sensory quality of hospital meals directly influences food intake. Unappealing food may lead to reduced consumption, thereby increasing the risk of malnutrition.

This study shows that poor hospital meal quality reflects a **systemic deficiency in hospital nutrition governance**. Without a dietetic service, standards, staff training, and quality control, it is structurally difficult to guarantee meals that are both safe and nutritious, even when some basic infrastructure is available.

These findings, which are consistent with the recent scientific literature, provide new empirical evidence in the Burundian context and constitute a solid basis for guiding institutional reforms in hospital food services.

Conclusion

This study highlights widespread poor quality of meals served in the three national hospitals in Bujumbura—the Prince Régent Charles Hospital, Kamenge Military Hospital, and Prince Louis Rwagasore Clinic—with none of the meals assessed reaching the predefined acceptability threshold. The observed deficiencies primarily concerned food safety and nutritional value, two dimensions that are central to the care of hospitalized patients.

Beyond the technical findings, the results demonstrate that this situation reflects a **systemic deficit in hospital nutrition governance**. The absence of a dietetic service, operational standards, quality-control mechanisms, staff training, and structured nutritional planning constitutes the core of the institutional and operational determinants underlying the poor quality of meals. Thus, even when some basic infrastructure is available, the absence of a coherent organizational framework makes it difficult to ensure the production of meals that are safe, nutritious, and adapted to patients' clinical needs. This study provides novel empirical evidence from the Burundian context and highlights a neglected component of the healthcare system : hospital food services as an essential component of quality care. It shows that improving meal quality cannot rely solely on isolated interventions in the kitchen but requires structural reforms that integrate nutrition into hospital governance. Sustainable improvement in the quality of hospital meals in Bujumbura therefore requires the establishment of a functional dietetic service, the development of operational standards based on international guidelines, continuous staff training, the implementation of regular quality control, and improved organization of food procurement and supply. These measures constitute strategic priorities for making hospital food a genuine therapeutic tool that contributes to patient recovery and the overall performance of the health system.

References

Abebe, M., Kumie, A., & Beyene, H. (2020). Food hygiene practices and associated factors among food handlers in public food establishments. *BMC Public Health*, 20, 1234.

Agarwal, E., Ferguson, M., Banks, M., Batterham, M., Bauer, J., Capra, S., & Isenring, E. (2019). Malnutrition and poor food intake are associated with prolonged hospital stay, frequent readmissions, and greater in-hospital mortality. *Journal of Human Nutrition and Dietetics*, 32(2), 213–223.

Akutsu, R., Botelho, R., Camargo, E., Savio, K., & Araujo, W. (2005). Adequacy of good manufacturing practices in hospital food services. *Revista de Nutrição*, 18(3), 419–427.

Alqurashi, N., Priyadarshini, A., & Jaiswal, A. (2019). Evaluating food safety knowledge and practices among food handlers. *Food Control*, 103, 131–140.

ASPEN. (2022). *ASPEN Clinical Guidelines: Nutrition Support Practice*. American Society for Parenteral and Enteral Nutrition.

Barker, L. A., Gout, B. S., & Crowe, T. C. (2011). Hospital malnutrition: prevalence, identification and impact on patients and the healthcare system. *International Journal of Environmental Research and Public Health*, 8(2), 514–527.

Codex Alimentarius Commission. (2020). *General Principles of Food Hygiene CXC 1-1969 (Revised)*. FAO/WHO.

Correia, M. I. T. D., & Waitzberg, D. L. (2003). The impact of malnutrition on morbidity, mortality, length of hospital stay and costs. *Clinical Nutrition*, 22(3), 235–239.

Dagnew, M., Tiruneh, M., & Moges, F. (2012). Food handling practices and associated factors among food handlers in hospitals. *BMC Research Notes*, 5, 1–7.

da Cunha, D. T., Stedefeldt, E., & de Rosso, V. V. (2021). The role of food safety culture in institutional food services. *Food Research International*, 140, 109853.

Edwards, J. S. A., & Hartwell, H. J. (2006). Hospital food service: patient satisfaction and nutritional intake. *Journal of Human Nutrition and Dietetics*, 19(3), 181–190.

ESPEN. (2021). *ESPEN guideline on hospital nutrition*. European Society for Clinical Nutrition and Metabolism. *Clinical Nutrition*, 40(12), 5683–5701.

FAO. (2016). *Dietary diversity as a measure of diet quality*. Food and Agriculture Organization.

Garg, R., Kumar, S., & Ingle, G. K. (2010). Food safety practices in hospital kitchens. *Indian Journal of Public Health*, 54(2), 89–93.

Green, L. R., & Selman, C. A. (2005). Factors impacting food workers' and managers' safe food preparation practices. *Food Protection Trends*, 25(12), 981–990.

Keller, H., Carrier, N., Duizer, L., Lengyel, C., Slaughter, S., & Steele, C. (2022). Making the most of mealtimes in hospitals: improving food intake and patient experience. *Nutrients*, 14(4), 812.

Kunadu, A. P. H., Ofosu, D. B., Aboagye, E., & Tano-Debrah, K. (2016). Food safety knowledge, attitudes and practices of food handlers in institutional food services. *Food Control*, 69, 324–330.

Lassen, A. D., Beck, A., & Leedo, E. (2019). Improving the nutritional quality and sensory properties of hospital meals. *Appetite*, 137, 114–123.

Omemu, A. M., & Aderoju, S. T. (2008). Food safety knowledge and practices of street food vendors. *Food Control*, 19(4), 396–402.

Roberts, H. C., Lim, S. E. R., Cox, N. J., & Ibrahim, K. (2020). The challenge of malnutrition in hospitals. *Nutrients*, 12(3), 840.

Tessema, A. G., Gelaye, K. A., & Chercos, D. H. (2021). Food handling practice and associated factors among food handlers working in public institutions. *BMC Public Health*, 21, 123.

Thibault, R., Chikhi, M., Clerc, A., Darmon, P., Chopard, P., Genton, L., & Pichard, C. (2021). Assessment of food intake in hospitalised patients: a 10-year comparative study. *Clinical Nutrition*, 40(2), 634–641.

Todd, E. C. D., Greig, J. D., Bartleson, C. A., & Michaels, B. S. (2008). Outbreaks where food workers have been implicated. *Journal of Food Protection*, 71(12), 2582–2595.

Organisation mondiale de la Santé. (2015). *Five Keys to Safer Food Manual*. WHO.

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