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QUALITY SYSTEMS IN INSTITUTIONAL FOODSERVICE: REVIEW AND IMPROVEMENT PATHWAYS (HACCP, ISO 22000, GHP/GMP)

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Abstract: The article reviews technological practicesGood Hygienic Practices and Good Manufacturing Practices (GHP/GMP), Hazard Analysis and Critical Control Points (HACCP), and ISO 22000 and managerial solutions in institutional foodservice, with particular emphasis on leadership, allocation of responsibilities, food safety culture (FSC), supplier relationships, selected elements of digitalization, and the cost of quality (COQ). The aim of this study was to assess whether a low-cost, ISO 22000-aligned improvement package can measurably strengthen HACCP execution and related performance outcomes (PRP/OPRP discipline, incident responsiveness, supplier reliability, and COQ) in resource-constrained public foodservice units. A 6-month pre-post pilot was conducted in a school cafeteria (S1) and a hospital kitchen (H1). The intervention comprised micro-trainings, point-of-use visual standards, mobile checklists and temperature logs with alerts, KPI boards, and clarification of roles using a Responsibility Assignment Matrix (RACI) for critical control points (CCPs) and operational prerequisite programs (OPRPs). The analysis covered Food Safety Management System (FSMS) records, digital logs, delivery documentation (service level agreement/on-time-in-full; SLA/OTIF), and brief staff surveys. Results included a reduction in nonconformities per 1,000 meals by 43% (S1) and 40% (H1), a shortening of mean Corrective and Preventive Action (CAPA) closure time by ~47% and ~46%, a 55–57% reduction in temperature incidents, a 10-12 percentage-point increase in on-time monitoring and record completeness, a 23-24% decrease in COQ, and improved OTIF performance. The application of selected ISO 22000 elements (objective communication, management reviews, incident management), combined with unambiguous assignment of responsibilities, strengthened the PDCA cycle and enabled sustained performance improvement without increasing the documentation burden. The findings provide practical guidance for institutional foodservice managers (e.g., school and hospital kitchen supervisors), auditors and inspectors, and trainers/procedure designers when prioritizing low-cost interventions and defining a minimal, high-sensitivity KPI set.

Keywords: HACCP; ISO 22000; Food Safety Management Systems (FSMS); Food safety culture; Institutional foodservice

INTRODUCTION

Institutional foodservice in public settings (e.g., schools and hospitals) remains one of the most sensitive links in the food chain: it serves vulnerable populations daily (children, patients) amid high variability of raw materials, staff turnover, and operating conditions. The effectiveness of food safety assurance systems (GHP/GMP, HACCP, ISO 22000) depends not only on well-designed plans but equally on the maturity of prerequisite programs (PRP/OPRP), the quality of leadership, food safety culture, supplier relationships, and data discipline in routine supervision (Chen et al., 2020; Lee et al., 2021; Rihawi, 2024). Current reviews indicate that ISO 22000:2018 built around the PDCA cycle, interactive communication, and hazard analysis enhances the coherence of risk management and facilitates the integration of managerial tools (management review, objectives, incident management) with operational practice in institutional catering (Chen et al., 2020; Lee et al., 2021; Rihawi, 2024).

Concurrently, the importance of food safety culture (FSC) is growing as a “communicating vessel” linking leadership style, communication, training, and performance metrics. The latest empirical studies associate higher FSC maturity with lower cost of quality and improved compliance, which has direct implications for resource-constrained facilities (e.g., school and hospital kitchens) (Pai et al., 2024; Spagnoli et al., 2024). Despite the established status of HACCP, recent years reveal persistent gaps between staff knowledge and practice and uneven conformity with requirements in hospital and school kitchens; recommendations consistently emphasize systematic micro-trainings, visual standardization, and “lean” documentation supported by simple digital tools (Guennouni et al., 2022; Licata et al., 2024; Salvador et al., 2024; Castro et al., 2024). This is consistent with evidence on the combined effects of Lean routines and people’s behaviours on safety performance (Sá et al., 2025).

The digitalization of FSMS from mobile checklists, IoT sensors, and cloud-based records to blockchain-enabled solutions promises shorter response times, improved traceability, and more reliable data for management reviews, while posing implementation barriers (digital competencies, systems integration, costs) (Jang et al., 2024; Charlebois et al., 2024; Ingaldi & Ulewicz, 2025). In this context, the objectives of this article are threefold:

- to synthesize current technological (GHP/GMP, HACCP, ISO 22000) and managerial approaches (leadership, accountability, culture, supplier risk, digitalization, costs) in institutional foodservice;
- to position two Polish case studies (a school canteen and a hospital kitchen) against best practices; and
- to propose a roadmap with a minimal set of key performance indicators (KPI) tailored to resource-constrained conditions.

This study used a 6-month before-after (pre-post) pilot design (first half of 2025) in two Polish public institutional foodservice units: a school cafeteria (S1) and a hospital kitchen (H1). Baseline data were collected in months 1-2, followed by months 3-6 after implementing a low-cost package (micro-trainings, visual standards, mobile checklists and temperature logs with alerts, KPI boards, and a RACI responsibility matrix for CCP/OPRP ownership). Data sources included routine FSMS records, digital logs, purchasing/delivery documentation (SLA/OTIF), and short staff surveys; outcomes were assessed via a predefined KPI set (including normalization per 1,000 meals and timeliness/completeness

indicators). As a purposive two-site pilot without a control group, results are implementation-oriented and hypothesis-generating rather than statistically generalizable. Recent evidence from ready-to-eat and canned-meat production shows that integrating OHS with food safety programs-through structured training, risk analysis and process integration-reinforces leadership-driven cultures and operational discipline, which are also pivotal in institutional foodservice (Szczyrba & Szataniak, 2024). Institutional gastronomy is of great importance for maintaining the attractiveness of city centres for both residents and tourists (Kania & Hess, 2025; Kazanecka-Olejnik, 2025), while at the same time influencing the way the surroundings are visually shaped.

RESEARCH BACKGROUND

ISO 22000:2018 integrates FSMS requirements with HACCP principles and PRP/OPRP, emphasizing communication, the process approach, and the PDCA cycle. The refined hazard-analysis methods and the clearer distinction between PRP/OPRP and CCP better reflect the realities of institutional catering, where most nonconformities stem from PRP failures (hygiene, segregation, cleaning) rather than CCP errors (Chen et al., 2020; Lee et al., 2021). The use of simple decision tools to support CCP identification and risk prioritization improves implementation consistency and limits discretion (Rosak-Szyrocka & Abbase, 2020).

Recent reviews and pilot studies show that FSC maturity correlates with lower cost of quality and stronger inspection results; the differentiating factor is leadership-the role of management in setting objectives, conducting reviews, and maintaining two-way communication. FSC metrics embedded in the objectives-and-management-review system are recommended so that culture is monitored alongside process outcomes (Pai et al., 2024; Spagnoli et al., 2024). Agile managerial practices that foster short feedback loops and iterative improvement are aligned with PDCA and can accelerate CAPA closure in high-variability environments (Dziuba & Szczyrba, 2023).

Researches from 2020-2025 in hospital and school kitchens indicate:

- relatively strong self-reported knowledge but gaps in practice (hand hygiene, temperature control, allergens);
- the need for regular, short trainings complemented by on-the-job supervision and infrastructural/organizational support;
- sensitivity of outcomes to staff turnover and time pressure (Guennouni et al., 2022; Licata et al., 2024; Salvador et al., 2024; Castro et al., 2024).

Trend analyses in school foodservice emphasize that critical risk points concern procurement and thermal processing, thus requiring mature PRPs, clearly defined roles, and supplier collaboration (Li et al., 2024). Product-level indicators e.g., test results for raw materials (including herbs/spices) - can serve as an “early warning” layer for HACCP plans (Polańczyk et al., 2024).

Supplier qualification and development (SLA, audits, periodic assessments) are critical to risk reduction within the FSMS; the literature underscores the need to combine qualitative/relational metrics with price in order to minimize safety risks and supply discontinuities (Urbaniak, 2021). Wartime contexts further intensify procurement fragility and require SCP-oriented supplier strategies (e.g., diversified/local sourcing, conservation of critical inputs), as observed across industrial settings (Kuzior et al., 2025)

Ongoing FSMS digitalization - from mobile checklists, through IoT and cloud records, to selected blockchain applications improves data completeness and timeliness

(temperature monitoring, lot traceability, CAPA closure time), while revealing implementation barriers (digital competencies, systems integration, cost). Gradual, "lightweight" deployments consistent with the logic of Agri-food 4.0 (Dadi et al., 2021) are recommended, especially for budget-constrained facilities (Jang et al., 2024; Charlebois et al., 2024).

Current approaches group food-safety KPIs into three categories: process (e.g., record completeness, % of monitoring performed), product (e.g., microbiological/quality testing results of raw materials), and organizational (e.g., training metrics, food safety culture components). This structure facilitates defining a "minimum indicator set" for small teams and clear assignment of accountability (Polańczyk et al., 2024).The literature indicates that although specific elements HACCP implementation barriers (Jendza et al., 2019), the role of FSC (Pai et al., 2024), and the benefits of digitalization (Dakhia, 2025) are well documented, there is a lack of studies integrating these three perspectives within the specific context of Polish institutional foodservice. Through a synthesis of the literature and analysis of two case studies (hospital, school), this paper examines how selective integration of managerial elements (from ISO 22000 and FSC) and simple digital tools can tangibly enhance an existing HACCP system. We ask which interventions (e.g., micro-trainings, KPI boards, clear responsibility matrices) deliver the best benefit-to-cost ratio under resource constraints typical of publicly funded facilities.

RESEARCH AND RESULTS

The study was conducted in the first half of 2025 in two units: one school cafeteria (S1) and one hospital kitchen (H1). A pre-post design was used (months 1-2 baseline; months 3-6 after the implementation of a "low-cost" intervention comprising micro-trainings, visual standards, mobile checklists and temperature logs, and KPI boards). Data were sourced from:

- FSMS operational records (CCP/OPRP monitoring, control cards, CAPA),
- digital logs (checklists, temperature alerts),
- purchasing and delivery documentation (SLA/OTIF), and
- short staff surveys (participation in micro-trainings, near-miss reporting).

The research is pilot in nature and subject to the following limitations: a small, purposive sample (1 school, 1 hospital) limits generalizability, the absence of a control group entails a possible Hawthorne effect and the influence of parallel organizational initiatives, data quality depends on the completeness and reliability of staff records. The findings should therefore be treated as implementation-oriented and hypothesis-generating.

In both units S1 and H1 there was a significant decrease in the frequency of nonconformities per 1,000 meals (S1: −43%; H1: −40%) and a near-halving of average CAPA closure time (S1: −47%; H1: −46%). In parallel, timeliness of CCP/OPRP monitoring increased (S1: +10 pp; H1: +12 pp), as did data completeness (S1: +10 pp; H1: +12 pp). These patterns align with expectations from the ISO 22000:2018 framework: improved data discipline and review cadence strengthen the PDCA loop, yielding faster detection and closure of deviations. Clarifying responsibility (RACI) for CCPs/OPRPs reduced the "diffusion" of task ownership, a problem commonly diagnosed in institutional foodservice practice. Also notable were reductions in "temperature incidents" per 1,000 meals (S1: −55%; H1: −57%), accompanied by an increased share of deliveries meeting SLA/OTIF and improved quality of high-risk raw materials.

The most immediate benefits stemmed from implementing simple, consistently used artifacts: short mobile checklists with reminders, one-point lessons, and standardized task cards at workstations. Weekly reviews with RACI owners for CCPs/OPRPs established a stable rhythm for escalation and CAPA closure. From the perspective of HACCP theory and practice, this corresponds to recommendations to simplify the selection of CCPs/OPRPs and to assign responsibilities and acceptance criteria clearly (Rosak-Szyrocka & Abbase, 2020). These effects materialized more quickly in S1 (lower complexity), yet the relative magnitude of change in H1 was comparable despite greater dietary heterogeneity and peak-load pressures consistent with observations that ISO 22000:2018 streamlines communication and priorities in multi-line organizations.

Staff participation in micro-trainings exceeded 90% weekly in both units, near-miss reports increased in the first weeks and then stabilized, in parallel with a decline in actual deviations. This profile is typical of maturing food safety culture (FSC) environments, where cost of quality is reduced through better communication and proactivity (Pai et al., 2024; Spagnoli et al., 2024). Short, targeted training interventions proved more “adhesive” than longer, infrequent formal trainings, as corroborated by studies on kitchen staff knowledge practice gaps in institutional catering (Guennouni et al., 2022; Licata et al., 2024; Salvador et al., 2024; Castro et al., 2024).

The deployment of low-barrier digital tools (mobile checklists, temperature logs with alerts) improved the timeliness and completeness of records and shortened response time to deviations. This was “incremental” digitalization, consistent with the Agri-food 4.0 paradigm small, iterative improvements without extensive systems integration (Dadi et al., 2021) and with review findings on traceability and automated record-keeping (Jang et al., 2024; Charlebois et al., 2024). Importantly, simple if-then rules (e.g., automatic reminders for CCP monitoring, immediate temperature alerts) were sufficient to generate tangible savings in the cost of quality (COQ decreased by 23-24%).

The use of short review cycles and resource prioritization aligns with agile management logic, which in Polish organic food-processing enterprises has translated into higher responsiveness and shorter decision cycles (Dziuba & Szczyrba, 2023). Analogously, in the public units studied, “micro-iterations” (weekly) were sufficient to sustain improvement momentum without pressure to expand documentation, in the spirit of ISO 22000:2018 (Chen et al., 2020; Lee et al., 2021). In Table 1, the results obtained before and after the intervention are presented.

Table 1
Key Performance Indicators (KPIs)-Pre- vs Post-Intervention)

Nonconformities per 1,000 meals			
	Baseline	Post-intervention	Change
S1	2.8	1.6	- 43%
H1	3.5	2.1	- 40%
Average CAPA closure time (Baseline = % tasks closed on time)			
	Baseline (% on time)	Post-intervention	Change
S1	88%	98%	+10pp
H1	84%	96%	+12pp
KPIs			
	% of samples meeting quality criteria	% of samples meeting quality criteria	Deliveries within SLA (OTIF)

S1 - Baseline	92%	1.1	93%
S1 - Post	97%	0.5	97%
H1 - Baseline	90%	1.4	91%
H1 - Post	96%	0.6	95%
Culture and behaviors			
	Participation in micro-trainings (% of staff/week)	Near-miss reports/month	
S1 - Baseline	62%	3	
S1 - Post	95%	7	
H1 - Baseline	58%	5	
H1 - Post	92%	11	
Cost of Quality (COQ)			
	Change		
S1 - Post	-24%		
H1 - Post	-23%		

Table 1 consolidates baseline versus post-intervention outcomes for a focused KPI set covering: compliance (nonconformities per 1,000 meals; monitoring timeliness and record completeness), responsiveness (CAPA performance and temperature-incident reduction), supplier performance (SLA/OTIF), selected culture signals (micro-training participation and near-miss reporting), and the cost of quality (COQ). In both units (S1 and H1), the dominant pattern is strengthened operational control: nonconformities decreased by ~40% (S1: -43%; H1: -40%), while timeliness and completeness indicators improved by 10-12 percentage points, signalling higher process discipline and better evidentiary quality for PDCA-based reviews. A second, operationally critical trend concerns deviation handling: CAPA effectiveness improved and temperature incidents were reduced by 55-57%, consistent with clearer ownership (RACI) and faster escalation enabled by simple digital logs/alerts. Importantly, improvements extended beyond internal routines OTIF and input-quality compliance increased suggesting that supplier-interface management contributes materially to FSMS effectiveness in institutional kitchens. Finally, the parallel COQ decrease (23-24%) provides an economic rationale for prioritizing low-cost digitalization and accountability mechanisms under resource constraints typical of public-sector foodservice.

CONCLUSIONS AND PRACTICAL IMPLICATIONS

The study confirms that the effectiveness of HACCP in institutional foodservice is directly contingent on the maturity of prerequisite activities Operational Prerequisite Program (PRP)/Operational Prerequisite Program (OPRP), unambiguous accountability, and data discipline. Even lightweight interventions micro-trainings, point-of-use visual standards, simple mobile checklists, and temperature logs with reminders significantly reduce nonconformities, shorten CAPA closure times, and improve record completeness. Both units also exhibited a favorable cost effect, suggesting that a well-structured PDCA (Plan-Do-Check-Act) loop and coherent communication emphasized in ISO 22000:2018 can be achieved without extensive documentation or costly system rollouts.

From a management perspective, the key takeaway is that ownership of critical control elements must be unequivocal. A simple RACI matrix, linked to process cards and checklists, curbs role diffusion and enables rhythmic, short reviews that effectively close the information loop. Within this arrangement, micro-trainings become the mechanism that

fuses food safety culture with operational practice: they translate lessons from near-misses and incidents to the point of work, strengthening the agency of frontline teams. The result is an initial rise in early-risk signalling, followed by a decline as practices mature. A second conclusion concerns the value of incremental digitalization. Applications for checklists and temperature logging paired with simple decision thresholds (who responds, within what time, when Corrective and Preventive Action - CAPA is opened) are sufficient to noticeably shorten response times and raise the evidentiary quality of management reviews. This model fits public-sector realities: it develops the FSMS through short iterations and limits the risk of organizational overload.

Third, the "minimum" indicator set should include a product component and supplier performance. This is particularly relevant for commodity inputs where mislabeling or category non-compliance has been reported under retail market conditions (Polańczyk et al., 2025). Regular verification of higher-risk raw materials and quarterly mini-assessments of SLA/OTIF stabilize process parameters and reduce temperature-excursion events, thereby strengthening CCP/OPRP control and facilitating corrective-action planning. In practice, a narrow yet sensitive KPI set performs well: monitoring timeliness, record completeness, nonconformities per 1,000 meals, CAPA time, temperature excursions, OTIF, and a simple culture indicator (micro-training participation, near-miss counts) aligned with contemporary approaches to FSMS performance assessment.

Given the study's limitations (small sample, no control group, short observation window), the conclusions are implementation-oriented and hypothesis-generating; however, their convergence with the literature and the observed cost effect suggest high practical utility. For public-sector decision-makers, the recommended sequence is: first Responsibility Assignment Matrix (RACI) and a cadence of micro-reviews, in parallel minimal digitalization of records, and then systematic strengthening of food safety culture via short, contextual trainings and KPI boards visible at the gemba. This sequence balances the requirements of GHP/GMP-HACCP-ISO 22000 with resource constraints and consistently lowers risk at an acceptable operating cost.

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