Policy Research Journal
ISSN (E): 3006-7030 ISSN (P) : 3006-7022 Volume 4, Issue 3, 2026

EVALUATING FOOD SUPPLY CHAIN AND INFORMATION MANAGEMENT IN HEALTHCARE: A COMPARATIVE STUDY OF PAKISTAN AND AUSTRALIA

Abdur Rauf Azam[*1], Zohaa Naveed[2], Mashhood Basit[3]

*[*1]Master of Agricultural Information Management, Leaders Institute, Sydney Campus (Bankstown), Australia*
[2]BS Human Nutrition and Dietitics, Department of HND, Riphah International University Islamabad, Pakistan
[3]MS Project Management, Department of Bahria Business School, Bahria University E-8 Islamabad Campus, Pakistan

[*1]abdurraufazam48924@gmail.com, [2]zohaanaveed2023@gmail.com, [3]mashhoodbasit@gmail.com

DOI: http://doi.org/10.5281/zenodo.24152341

Keywords
healthcare food supply chain, information management, hospital food services, food safety, traceability, food waste, Pakistan, Australia.

Article History
Received: 31 January 2026
Accepted: 16 March 2026
Published: 30 March 2026

Copyright @Author
Corresponding Author: *
Abdur Rauf Azam

Abstract

Healthcare food supply chains require effective procurement, inventory management, food safety controls, information sharing, and coordination between logistics personnel and clinical nutrition services. Inefficiencies in these processes can contribute to food waste, supply interruptions, incomplete traceability, and discrepancies between patient dietary requirements and meals delivered. This study proposes a comparative assessment of food supply chain and information management practices in healthcare institutions in Pakistan and Australia. It aims to identify how regulatory arrangements, organisational capacity, supplier coordination, and digital information systems influence the management of hospital food services. The study adopts a comparative documentary research design using peer-reviewed studies, official food safety standards, and published institutional evidence. Descriptive statistical analysis is used where numerical data are available, while qualitative thematic synthesis is applied to documentary findings. Published Australian evidence provides quantitative examples: an audit of 105 food products in a Victorian healthcare network found that 32% were imported, 25% originated locally within Victoria, and 43% originated elsewhere in Australia (Carino et al., 2023), while an audit of 200 food items at an Australian public hospital found that the specific geographic origin of most spending on "Australian" foods was unknown (Faulkner et al., 2022). Published hospital food-waste studies report plate-waste and production-waste figures in Australia (Ni et al., 2026) and Iran (Anari et al., 2024). A separate qualitative study involving 12 Pakistani hospital supply chain professionals identified six broad categories of supply chain risk (Sajjad et al., 2026). These findings illustrate different analytical dimensions but are not directly comparable measures of food supply chain performance.The proposed framework integrates procurement, inventory, information management, food safety, traceability, and sustainability. It establishes measurable indicators for future institutional comparisons, including stockout frequency, delivery reliability, record completeness, food waste per patient-day, and traceability response time. The study contributes an evidence-informed framework for evaluating healthcare food supply chains without assuming uniform performance within either country.

1. INTRODUCTION

Healthcare food supply chains are important to hospital operations because institutions must provide safe, timely, and nutritionally appropriate meals while managing costs, supplier relationships, storage conditions, and resource utilisation. Unlike ordinary commercial food distribution, hospital food services must also coordinate meal delivery with patients' clinical requirements, including allergies, prescribed diets, and other nutritional restrictions. The reliability of these processes depends on both the physical movement of food and the information used to manage it. Food supply chain management includes purchasing, supplier selection, receiving, storage, inventory control, preparation, distribution, consumption monitoring, and waste disposal. Information management connects these activities through purchase orders, stock records, supplier documentation, batch identifiers, temperature logs, expiry dates, meal orders, and waste reports. If these records are incomplete or disconnected, healthcare institutions may struggle to forecast demand, prevent stockouts, identify unsafe products, or verify that meals correspond to patients' dietary requirements.

Research has demonstrated that hospital food services have environmental and economic implications throughout the supply chain. Carino et al. (2020), in a systematic review, examined sustainability across procurement, distribution, preparation, consumption, and waste management. Their work indicates that food service should be evaluated as a connected system rather than as a kitchen-level activity alone. The comparison between Pakistan and Australia is useful because healthcare institutions operate within different regulatory, financial, technological, and organisational contexts. In Pakistan, a qualitative study by Sajjad et al. (2026) examined supply chain risks through interviews with 12 hospital supply chain professionals and identified six risk categories: organisational, political and regulatory, external, financial, supplier, and demand risks. These findings concern hospital supply chains generally; they should not be interpreted as measured food-specific risks or as estimates of their prevalence across Pakistani hospitals.

Australia provides a formal regulatory reference for hospital food safety. Food Standards Australia New Zealand (FSANZ) identifies Standard 3.3.1 as requiring food safety programs for relevant food businesses serving vulnerable people, including hospital patients. However, the existence of a regulatory requirement does not independently establish compliance or superior operational performance. More specific quantitative examples come from Australian audits. Carino et al. (2023) audited 105 food products in a Victorian healthcare network and reported that 32% were imported, 25% were sourced locally from Victoria, and 43% came from elsewhere in Australia. Faulkner et al. (2022) audited 200 food items at an Australian public hospital and found that almost 80% of the food budget was spent on items containing at least 75% Australian-grown ingredients, yet the specific geographic origin of 55% of the budget spent on "Australian" foods was unknown. These figures illustrate how product-origin information can be used to examine procurement patterns, but they represent single institutions or networks and single audit periods, not the Australian hospital sector as a whole.

Food waste is a second area in which hospital studies report measurable quantities. Australian audits have quantified kitchen and plate waste (Ni et al., 2026), and a cross-sectional study in three Iranian educational hospitals reported that around half of the food served was discarded (Anari et al., 2024). Such studies show that waste can be measured by mass, meal type, cost, and environmental burden, although their results cannot be transferred to other settings. The research gap is therefore not simply the absence of general literature on hospital supply chains. It is the limited availability of directly comparable evidence linking food procurement, logistics, information integration, traceability, and waste management across Pakistani and Australian healthcare institutions.

The study aims to develop a structured comparison of these processes. Its objectives are to examine food procurement and inventory practices, assess information management and digital integration, compare relevant food safety and traceability arrangements, review published

evidence on food origin and food waste, identify documented operational barriers, and propose measurable indicators for future comparative research.

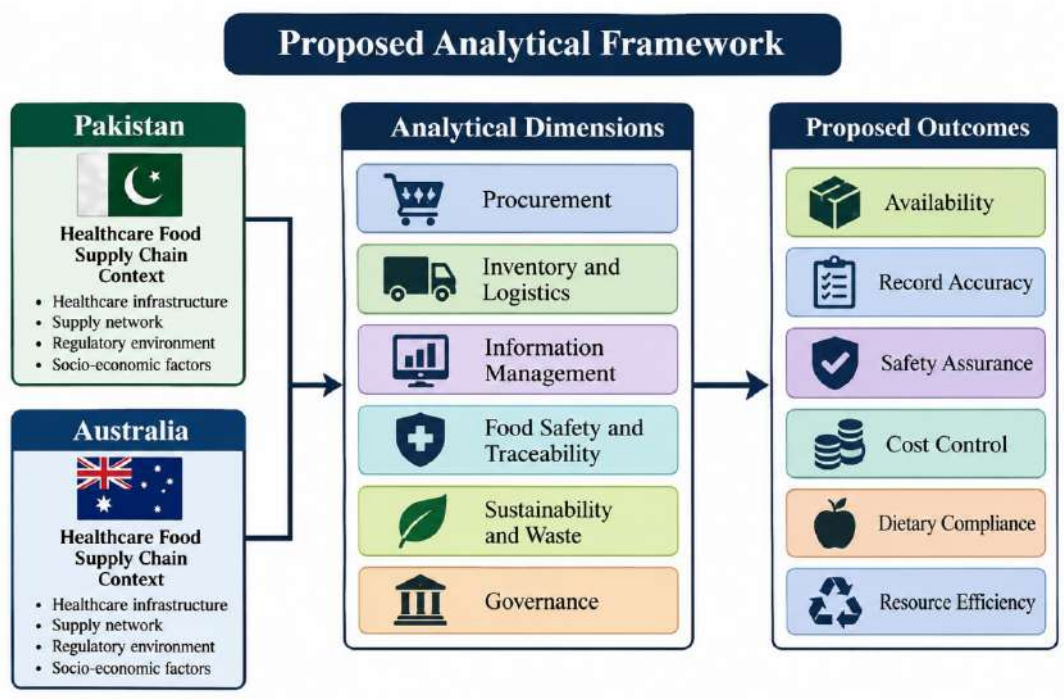


Figure 1. Research logic linking the comparative context, operational dimensions, evidence sources, and proposed outcomes.

2. Literature Review

2.1 Healthcare food supply chain management

Hospital food supply chains involve multiple stages, each of which affects the availability, safety, quality, and cost of food. Procurement decisions determine which suppliers are selected, what products are purchased, and how deliveries are scheduled. Inventory management then ensures that products remain available while minimising expiry, spoilage, and unnecessary storage costs. Carino et al. (2020) reviewed environmental sustainability across hospital food supply chains and considered impacts and interventions across procurement, distribution, preparation, consumption, and waste management. Their review supports a whole-system perspective in which decisions at one stage can affect outcomes elsewhere. For example, purchasing larger quantities may reduce the frequency of deliveries but can also increase spoilage if storage capacity and demand forecasting are inadequate.

Local procurement is another relevant issue. In their Australian healthcare network study, Carino et al. (2023) used food labels and product information to identify the origins of fresh and minimally processed foods. They found that 25% of audited products were sourced locally from Victoria, while 43% originated elsewhere in Australia and 32% were imported. Interviews with 23 patients, staff, and suppliers also identified higher costs for some local products, inconsistent supply, variable quality, difficulties accessing origin information, and limited hospital autonomy as procurement challenges. Faulkner et al. (2022) similarly found that, although most food spending went to products with substantial Australian-grown content, the precise geographic origin was often unknown. These findings illustrate that sourcing decisions involve trade-offs and data-quality problems rather than a simple choice between local and imported products.

2.2 Information management and digital integration

Information management enables healthcare institutions to coordinate purchasing, storage, food preparation, and patient meal delivery.

Relevant data include supplier identities, purchase quantities, product batches, delivery dates, stock levels, expiry dates, temperature records, dietary orders, and food waste measurements.

The potential value of digital integration lies in linking these records. For example, a purchasing system may show when a product was received, while a stock management system records its location and expiry date. If the records are connected to preparation and distribution information, staff may be better able to identify which meals or departments could be affected by a product recall.

However, digitisation alone does not guarantee effective information management. Incomplete records, incompatible software, inconsistent product identifiers, weak access controls, and insufficient training may limit the benefits of digital systems. The proposed comparison therefore examines actual information functions and data quality rather than treating the presence of software as evidence of effective integration.

2.3 Supply chain risks and institutional constraints

The Pakistani hospital study by Sajjad et al. (2026) offers relevant contextual evidence. Its 12 interviews produced six thematic categories of supply chain risk: organisational, political and regulatory, external, financial, supplier, and demand risks. The study describes challenges such as staff turnover, policy uncertainty, financial fluctuations, supplier concentration, and changing demand.

The distribution of interviewees across these themes was not reported in the source information used here. Consequently, the six themes should be presented as qualitative findings, not converted into frequencies or percentages of participants. One cannot infer, for example, that one-sixth of participants experienced each risk merely because six themes were identified.

These broader supply chain risks are relevant to food service because healthcare institutions depend on regular deliveries, reliable suppliers, predictable purchasing arrangements, and appropriate storage. Nevertheless, their specific effects on hospital food availability and food safety require food-focused investigation.

2.4 Food safety and traceability

Food safety management requires controls over food receipt, storage, handling, preparation, transport, and service. Traceability records help institutions identify product origins, follow movements through the supply chain, and respond to potential safety incidents.

In Australia, FSANZ provides standards and guidance for food safety management. Standard 3.3.1 specifically addresses food safety programs for food service to vulnerable persons. The associated guidance identifies hospitals among the settings in which food safety is particularly important because patients may be vulnerable to foodborne illness.

For a valid Pakistan–Australia comparison, formal requirements must be distinguished from implementation. The existence of a written policy does not establish that all hospitals have complete records, conduct equivalent audits, or achieve the same food safety outcomes. The study should therefore compare available implementation evidence and explicitly record where comparable evidence is absent.

2.5 Food waste and sustainability

Food waste may arise from inaccurate demand forecasts, excessive purchasing, inappropriate storage, unsuitable menus, incorrect meal distribution, or uneaten food. Measuring waste can help managers identify where losses occur, but reductions should not be pursued at the expense of nutritional adequacy or patient satisfaction.

Cook et al. (2023) reviewed food and food-related waste management strategies in hospital food services. Their review supports examining waste prevention and recovery strategies alongside practical implementation barriers. Carino et al. (2020) similarly place waste within the broader environmental and economic performance of hospital food services.

Primary audits illustrate how waste can be quantified. Ni et al. (2026) audited an Australian tertiary hospital and distinguished unserved kitchen food, preparation waste, spoilage, and patient plate waste, reporting differences in plate waste by diet type. A two-centre Australian comparison published in Nutrition & Dietetics (2025) showed that total waste and waste per overnight bed-day can rank

hospitals differently. Anari et al. (2024) measured waste by meal period in three Iranian educational hospitals and linked it to financial and environmental indicators. An effective comparison should therefore consider food waste alongside food availability, meal quality, dietary compliance, and the accuracy of information used in procurement and meal planning.

2.6 Specific research gap

Existing studies provide evidence on hospital food sustainability, food origin, hospital food waste, general hospital supply chain risks, and Australian food safety requirements. However, the sources reviewed here do not establish a common dataset that compares food procurement, information integration, traceability, and operational outcomes across Pakistani and Australian hospitals.

The present study addresses this gap by developing a common analytical framework, extracting available numerical evidence without combining incompatible datasets, and identifying indicators that can be measured consistently in future institution-level research.

3. Conceptual and Theoretical Framework

The study combines supply chain management principles with a socio-technical perspective on information systems.

Supply chain management explains how suppliers, purchasing, logistics, inventory, and demand forecasting interact. The socio-technical perspective recognises that information systems depend on technology, staff, organisational procedures, and institutional governance. Together, these perspectives help explain why purchasing and logistics improvements may be limited when records are unreliable or departments do not share information effectively.

The framework proposes that institutional and regulatory context shapes food supply chain practices. These practices may, in turn, influence food availability, food safety assurance, traceability, costs, dietary accuracy, and sustainability. Digital integration is treated as a potential enabling mechanism whose contribution must be evaluated against documented operational outcomes.

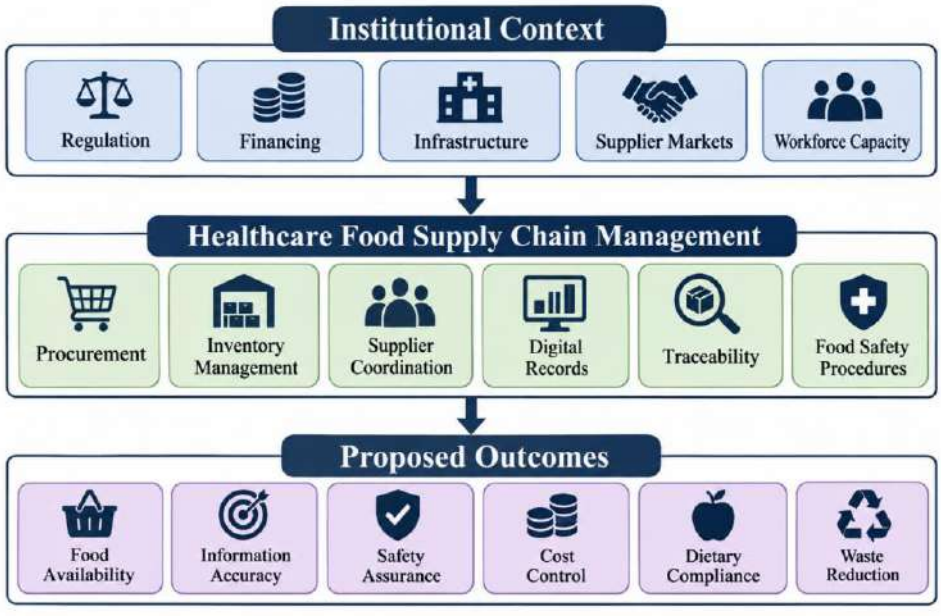


Figure 2. Proposed relationship between institutional context, supply chain processes, information management, and healthcare food service outcomes.

Table 1. Operational dimensions of the proposed comparative framework

Dimension	Key information to examine	Proposed indicators
Procurement	Supplier selection, contracts, prices, product origin	Supplier delivery reliability; documented origin
Inventory and logistics	Stock levels, expiry dates, delivery schedules	Stockout frequency; inventory accuracy
Information management	Digital records, system integration, data quality	Record completeness; proportion of linked records
Food safety	Handling procedures, audits, temperature records	Required food safety records completed
Traceability	Batch identifiers, supplier records, recall documentation	Time required to retrieve relevant batch records; origin traceability rate
Sustainability	Food waste, disposal, resource use	Kilograms of food waste per patient-day or bed-day
Governance	Responsibilities, staff training, corrective action	Audit completion and corrective action closure

4. Methodology

4.1 Research design

A comparative documentary research design is proposed to examine healthcare food supply chain and information management in Pakistan and Australia. The study uses published research and official documents as secondary sources. It is not presented as a completed systematic review or as an original empirical survey.

4.2 Data sources and selection criteria

Relevant sources include peer-reviewed journal articles, government publications, food safety standards, and institutional reports. Searches cover PubMed, Scopus, Web of Science, and official regulatory websites.

Search terms combine concepts such as hospital food procurement, healthcare food supply chain, hospital food waste, food traceability, information management, digital integration, Pakistan, and Australia. Sources should be included if they provide evidence relevant to at least one analytical dimension. Studies of general healthcare supply chains should be identified as contextual rather than food-specific evidence. Studies from other countries (for example, Iran) may be included as international comparators but must be labelled as such. Official standards should be used to document regulatory requirements, not as substitutes for evidence of implementation. A reproducible review should record the search date, database, search string, number of records retrieved, duplicates removed, full texts assessed, and reasons for exclusion. These counts must be filled in after the actual search is conducted.

4.3 Data extraction

A structured extraction sheet should record the country, study design, institution or population, sample size where reported, observation period, analytical method, numerical results, relevant limitations, and the food supply chain dimension addressed.

Numerical results should retain their original denominators and units. Percentages should be recalculated only where the underlying counts are available or can be derived transparently from reported counts and rounded percentages.

5. Results: Published Evidence and Descriptive Statistical Analysis

5.1 Food origin and traceability in Australian healthcare settings

Carino et al. (2023) audited 105 fresh and minimally processed food products in a healthcare network in Victoria, Australia. Their published headline findings identified three broad product-origin categories: imported products (32%), products sourced locally from Victoria (25%), and products sourced from elsewhere in Australia (43%). Table 2 presents the audit by the five origin categories and the counts reported for each.

Table 2. Geographic origin of food products supplied to an Australian healthcare network (N = 105)

Product-origin category	Number of products	Percentage
Imported	33	31.4%
Australian, but specific origin unknown	16	15.2%
From other Australian states	14	13.3%
From Victoria and other Australian states	16	15.2%
From Victoria	26	24.8%
Total	105	100.0%

Counts as listed for Carino et al. (2023); percentages are calculated from the counts and rounded to one decimal place. Because the headline percentages (32%, 25%, 43%) were published as rounded values for three broader categories, they differ slightly from the count-based figures above (for example, 33/105 = 31.4% versus 32%). The counts and category definitions should be checked against the original article before submission. The table describes one audited product set, not the Australian hospital sector.

Percentages follow Equation (1), with n in place of f_i. For example, for products from Victoria:

$$P=\frac{26}{105}\times 100=24.8\%$$

Interpretation. Nearly one-third of audited products were imported, while the origin of a further 15.2% was identified only as "Australian" without a specific location. This illustrates the importance of reliable supplier-origin records and traceability in healthcare procurement. The findings also show why the definition of local sourcing matters: products from Victoria were distinguished from those from other Australian states. The study does not establish that local products were cheaper, safer, or more sustainable than imported products.

A second Australian audit provides complementary evidence on expenditure. Faulkner et al. (2022) audited 200 food items at an Australian public hospital over an eight-day menu cycle (Table 3).

Table 3. Food procurement expenditure and origin traceability at an Australian public hospital

Indicator	Published finding
Food items audited	200
Audit period	Eight-day menu cycle
Food budget spent on products with at least 75% Australian-grown content	Almost 80%
Budget spent on entirely imported food	11%
Budget for "Australian" foods with specific geographic origin unknown	55% of the budget spent on "Australian" foods
Budget spent on entirely Victorian-grown food	3%

Interpretation. A high share of spending on food with Australian-grown content did not mean that the precise geographic origin was known. The findings highlight the distinction between broad domestic sourcing and detailed supply-chain traceability.

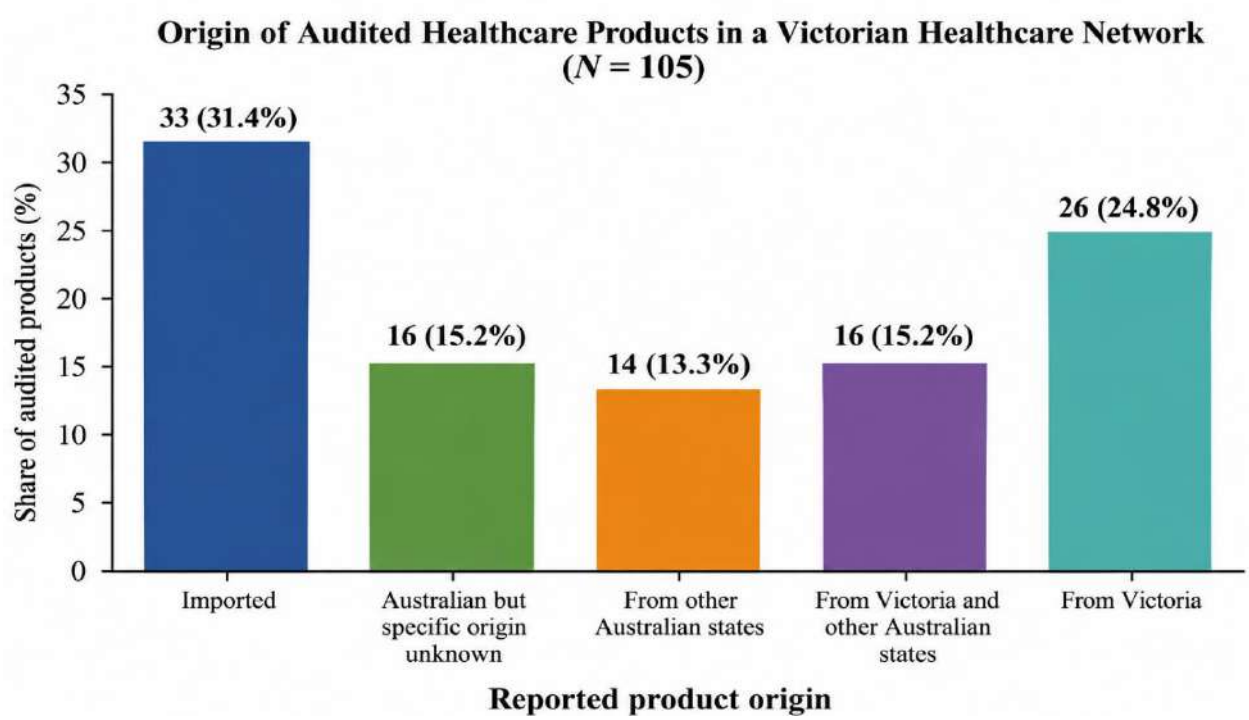


Figure 3. Distribution of audited food products by reported origin in a Victorian healthcare network.

5.2 Stakeholder interviews and qualitative evidence

Australian stakeholder perspectives. In addition to the product audit, Carino et al. (2023) interviewed 23 patients, healthcare and purchasing staff, and suppliers about local food procurement. Table 4 describes the interview sample.

Table 4. Characteristics of participants in an Australian healthcare food procurement study

Participant group	Characteristic	Frequency (n)	Percentage (%)
Patients (N = 13)	General medical ward	7	53.8
Patients (N = 13)	Surgical ward	4	30.8
Patients (N = 13)	Specialty medicine ward	2	15.4
Patients (N = 13)	Age 20–30 years	2	15.4
Patients (N = 13)	Age 40–50 years	2	15.4
Patients (N = 13)	Age 50–60 years	3	23.1
Patients (N = 13)	Age over 60 years	6	46.2
Patients (N = 13)	Female	9	69.2
Patients (N = 13)	Male	4	30.8
Healthcare and purchasing staff (N = 7)	Female	2	28.6
Healthcare and purchasing staff (N = 7)	Male	5	71.4
Healthcare and purchasing staff (N = 7)	Less than 5 years in role	5	71.4
Healthcare and purchasing staff (N = 7)	More than 10 years in role	2	28.6
Suppliers (N = 3)	Female	3	100.0
All participants	Total interviewed	23	100.0

The percentages use Equation (1). For example, the percentage of patients aged over 60 years was:

$$P=\frac{6}{13}\times 100=46.2\%$$

The participant characteristics provide context for interpreting the stakeholder perspectives reported by Carino et al. (2023). Patients represented 13 of the 23 interviewees, while healthcare and purchasing staff accounted for seven and suppliers for three. Within the patient group, six participants (46.2%) were over 60 years of age. The staff group included five participants (71.4%) who had been in their roles for fewer than five years. These data describe the composition of a purposively recruited qualitative sample. They should not be interpreted as estimates of the prevalence of particular opinions or as representative statistics for Australia. The study's value lies in bringing together perspectives from patients, staff, and suppliers to identify practical challenges in food procurement, including product-origin information, supply consistency, cost, and institutional purchasing arrangements.

Pakistani hospital supply chain evidence. Sajjad et al. (2026) conducted semi-structured interviews with 12 supply chain professionals working in Pakistani hospitals. Their thematic analysis identified six categories of risk: organisational, political and regulatory, external, financial, supplier, and demand risks. The study examined hospital supply chains broadly rather than food supply chains specifically, and the number of participants who raised each theme was not reported in the evidence used here.

It would therefore be misleading to calculate 6/12×100=50% and describe the result as the percentage of participants experiencing risk. The numerator represents themes, while the denominator represents interviewees; these quantities measure different things. The six themes are categories generated through qualitative analysis, not six mutually exclusive groups of participants. For a future study that records the number of participants mentioning each theme, the relevant percentage could be calculated as:

$$P_j=\frac{n_j}{N}\times 100 \qquad (8)$$

where n_j is the number of participants who explicitly mentioned theme j and N is the number of participants whose responses were coded.

5.3 Cross-study comparison

The Australian and Pakistani studies contribute different forms of evidence. The Australian studies provide numerical information about product origin and expenditure in particular healthcare settings. The Pakistani study provides qualitative information about general hospital supply chain risks.

Table 5. Statistical comparability of the two published studies

Characteristic	Australia: Carino et al. (2023)	Pakistan: Sajjad et al. (2026)
Primary focus	Food origin and local procurement	General hospital supply chain risks
Evidence type	Product audit and stakeholder interviews	Semi-structured interviews
Reported sample information	105 food products audited; 23 interviewees	12 supply chain professionals interviewed
Quantitative result	Product-origin counts and percentages (Table 2)	No participant-level theme frequencies used in this comparison
Main analytical contribution	Demonstrates a way to quantify food procurement origins	Identifies six categories of hospital supply chain risk
Can national performance be compared directly?	No	No

These studies cannot be combined into a pooled percentage, effect estimate, or country ranking. Their populations, units of analysis, research questions, and outcome measures differ.

5.4 Published evidence on hospital food waste and resource use

Hospital food waste has been quantified in several published studies. Three are summarised here: a cross-sectional study in three Iranian educational hospitals (Anari et al., 2024), an audit of one Australian tertiary hospital (Ni et al., 2026), and a seven-day comparison of two Australian healthcare centres with different foodservice models (Nutrition & Dietetics, 2025). They differ in country, measurement unit, and method, and are presented side by side for illustration only.

Table 6. Published quantitative evidence on hospital food waste and resource use in Iran

Indicator	Published result	Sample or denominator	Source
Meals evaluated	398	Meals across three educational hospitals in Iran	Anari et al. (2024)
Average food served	Approximately 1,000 g per patient-day	Patient-day	Anari et al. (2024)
Average food discarded	539.5 g per patient-day	Patient-day	Anari et al. (2024)
Overall food waste	50.1% of food served	Food mass served	Anari et al. (2024)
Breakfast waste	148.9 g (SD = 130.1 g)	Breakfast observations	Anari et al. (2024)
Breakfast waste as a share of food served	45.7% (SD = 36.9 percentage points)	Breakfast observations	Anari et al. (2024)
Lunch waste	364.3 g (SD = 257.2 g)	Lunch observations	Anari et al. (2024)
Lunch waste as a share of food served	51.4% (SD = 36.1 percentage points)	Lunch observations	Anari et al. (2024)
Snack waste	80.2 g (SD = 101.5 g)	Snack observations	Anari et al. (2024)
Snack waste as a share of food served	62.4% (SD = 53.2 percentage points)	Snack observations	Anari et al. (2024)
Estimated food preparation cost	US$1.80 per patient-day	Patient-day	Anari et al. (2024)
Estimated cost of discarded food	US$0.80 per patient-day	Patient-day	Anari et al. (2024)
Land-use footprint of food waste	8.1 m² per kg wasted	Kilogram of food waste	Anari et al. (2024)
Greenhouse gas emissions associated with food waste	1.4 kg CO_2-equivalent per kg wasted	Kilogram of food waste	Anari et al. (2024)
Water footprint of food waste	Approximately 1,003 L per kg wasted	Kilogram of food waste	Anari et al. (2024)

Calculations based on Table 6. The overall waste proportion follows Equation (5):

$$\text{Food waste (\%)} = \frac{\text{Food discarded}}{\text{Food served}} \times 100$$

Using the published values:

$$\frac{539.5}{\approx 1000} \times 100 \approx 53.95\%$$

This rough calculation does not reproduce the published 50.1% because the reported average food served is rounded to approximately 1,000 g; the article's reported estimate of 50.1% is therefore retained. The estimated cost of discarded food relative to food preparation cost is:

$$\text{Waste cost share} = \frac{0.80}{1.80} \times 100 = 44.4\%$$

This is a calculation from the study's two reported average cost estimates, not a separately reported result, and should be described as an approximate ratio of estimated waste cost to preparation cost, not as a percentage of total hospital expenditure.

Interpretation. Across 398 meals evaluated in three Iranian educational hospitals, average discarded food was reported as 539.5 g per patient-day, representing 50.1% of the food served. Lunch had the greatest mean waste by weight, whereas snacks showed the highest percentage of food discarded (62.4%), followed by lunch (51.4%) and breakfast (45.7%). These results show the potential value of meal-level waste monitoring, but cannot be transferred directly to Pakistan or Australia because menus, patient populations, meal service models, and measurement procedures may differ.

Table 7. Food waste in an Australian acute-care hospital

Indicator	Published result
Patient plates audited	2,214
Total kitchen food waste	134.1 kg/day
Kitchen waste per meal produced	170.4 g
Unserved food waste	149.3 g/meal
Preparation waste	20.7 g/meal
Spoilage waste	0.4 g/meal
Patient plate waste	0.7 kg/patient/day
Plate waste as a share of food served	41%
Plate waste: special diets	49%
Plate waste: regular diets	36%
Plate waste: puréed diets	72%

Interpretation. Unserved food was the largest reported component of kitchen waste, while patient plate waste varied by diet type. These results suggest that demand forecasting, flexible meal ordering, portion adjustment, and better matching of meals to patient needs deserve attention.

Table 8. Comparison of food production waste in two Australian healthcare centres

Indicator	Hospital A	Hospital B
Hospital bed capacity	800	60
Foodservice model	Cook-on-demand, fresh, à la carte room service	Cook-chill, retherm, scheduled meals
Observation period	7 days	7 days
Food wasted during production	916.4 kg	69.7 kg
Reported food-waste cost	AUD 6,937.22	AUD 417.10
Waste per overnight bed-day	0.15 kg	0.30 kg
Edible share of food waste	78.6%	93.5%
Packaging waste	199.5 kg	32.2 kg
Packaging waste per overnight bed-day	0.03 kg	0.14 kg

Interpretation. Hospital A recorded greater total production waste, but its waste per overnight bed-day was half that of Hospital B. This demonstrates why comparisons should account for hospital size and activity rather than relying on total kilograms alone (Equation 6). The different foodservice models may be relevant, but a two-hospital observational study cannot establish that the model alone caused the difference.

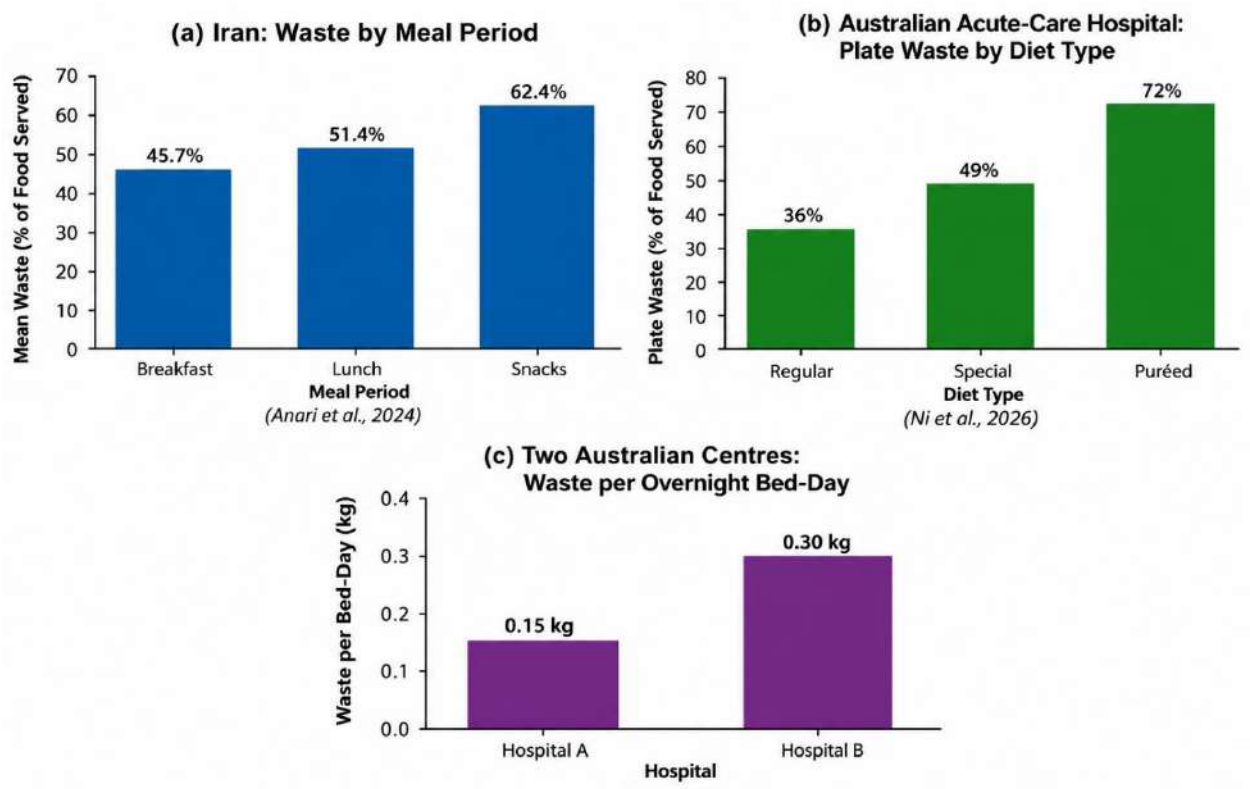


Figure 4. Published food waste indicators from selected hospital studies, shown separately by study and unit.

6. Discussion

The published evidence highlights the importance of treating healthcare food supply chains as systems that combine physical logistics with information management. The Australian product audits show that procurement origin can be quantified when product records and definitions are available, and that broad domestic sourcing does not guarantee that specific origin is known (Carino et al., 2023; Faulkner et al., 2022). The Pakistani qualitative study shows that hospital supply chains may be affected by several categories of institutional and external risk (Sajjad et al., 2026). Neither body of evidence independently establishes how food logistics or information management performs across the two national systems.

A key implication is that comparative research should use common operational definitions. For example, "local procurement" may refer to food produced within a city, province, or country. The Australian studies distinguished products sourced from Victoria from those originating elsewhere in Australia. A Pakistani comparison would need to define an equivalent geographical boundary before reporting differences in local procurement percentages.

The findings also illustrate the distinction between numerical and thematic evidence. The Australian product audit provides counts and percentages with a known denominator, and the participant profile (Table 4) describes who was interviewed. In contrast, the six themes in the Pakistani study cannot be converted into participant percentages without knowing how many interviewees mentioned each theme and how the coding was conducted. Statistical precision should follow the structure of the evidence rather than the desire to produce more numbers.

The waste studies add a further lesson about denominators. The two-centre Australian comparison shows that the hospital with the greater total waste had the lower waste per overnight bed-day, so totals alone can mislead (Table 8). Plate waste in the Australian acute-care audit ranged from 36% for regular diets to 72% for puréed diets (Table 7), indicating that diet type may matter for meal planning. The Iranian study reports a waste share of around half of food served, with snacks highest by percentage and lunch highest by weight (Table

6). These results come from different countries, methods, and units, and none can serve as a Pakistani or Australian national benchmark.

Information management provides a potential connection between these evidence types. A well-documented procurement system can identify product origin, supplier reliability, and delivery performance. Inventory records can help track stockouts and expiry dates. Batch identifiers and receiving records can support traceability, while links between meal orders and dietary information can help monitor whether the correct meals reach patients. These are plausible operational mechanisms, but their effects need to be measured rather than assumed.

Food safety requirements provide another important comparison dimension. FSANZ standards establish specific requirements for relevant Australian food businesses serving vulnerable people. A rigorous cross-country study should examine the applicable requirements in Pakistan and the extent to which implementation can be documented in each setting. It should not infer food safety performance from the existence of a regulation alone.

Finally, food waste and sustainability should be assessed alongside nutritional adequacy, patient satisfaction, and supply reliability. Lower purchasing expenditure does not necessarily represent improved performance if it leads to stockouts or inadequate meals. A balanced evaluation should combine process indicators with patient-centred outcomes and documented safety controls.

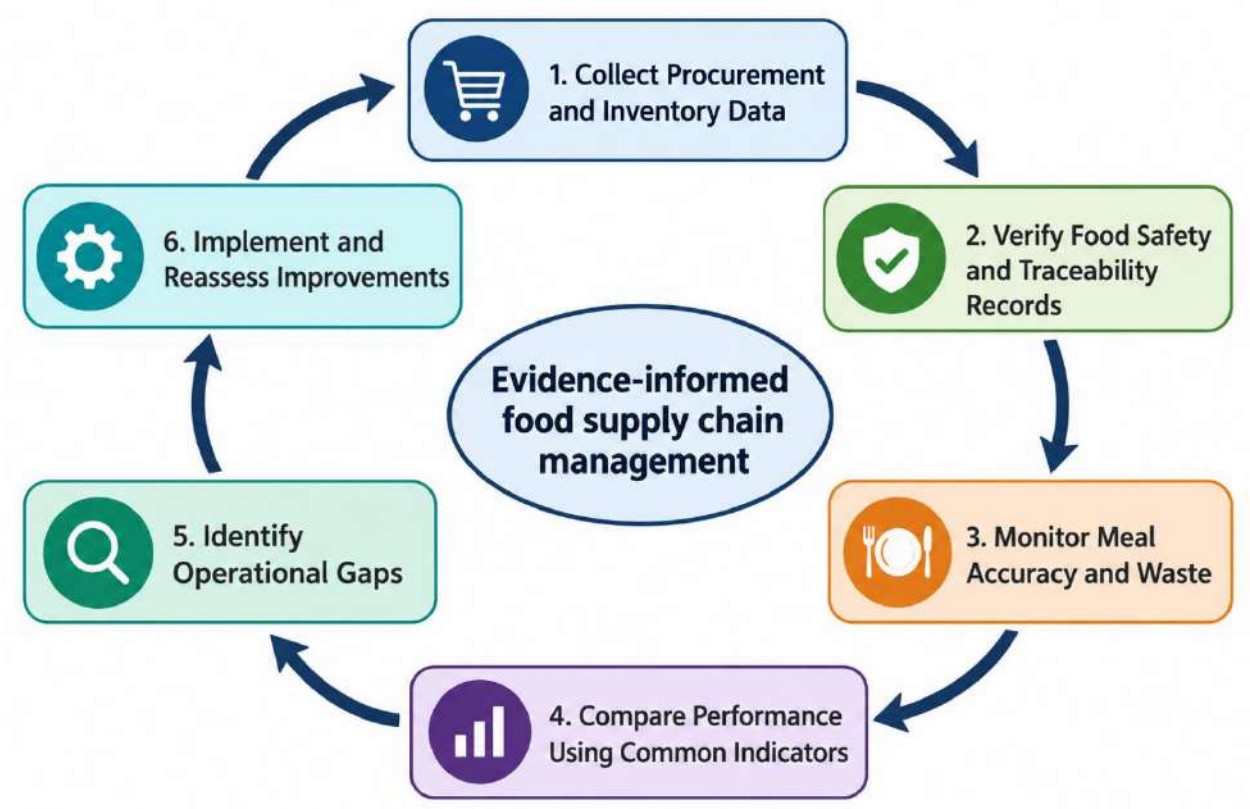


Figure 5. Proposed integrated monitoring cycle for healthcare food supply chains.

7. Implications

7.1 Policy implications

Healthcare policymakers should promote consistent documentation of food procurement, food safety, traceability, and institutional performance. In Pakistan, future policy evaluation could examine supplier reliability, infrastructure constraints, workforce capacity, and the availability of food-specific monitoring data. In Australia, researchers could examine how existing food safety requirements and institutional quality systems are implemented in practice, including how completely product origin is recorded.

Both countries would benefit from clearer reporting of food service indicators, provided

definitions and reporting requirements are appropriate to their institutional contexts.

7.2 Managerial implications

Hospital managers should connect purchasing forecasts, stock records, delivery documentation, expiry-date monitoring, and meal planning wherever feasible. Supplier assessments should consider reliability, food quality, traceability, and compliance alongside price.

Managers can also introduce routine measurement of food waste, stockouts, and meal accuracy. Before comparing results across hospitals, institutions should standardise observation periods, denominators (patient-days or overnight bed-days), and reporting procedures.

7.3 Information technology implications

Digital systems should support practical functions such as stock visibility, batch identification, temperature records, expiry alerts, and communication between procurement and dietary services. Investment should be accompanied by staff training, data governance, access controls, and contingency procedures for system outages.

7.4 Sustainability implications

Food waste monitoring should identify whether losses occur during purchasing, storage, preparation, distribution, or consumption, and by meal period or diet type where possible. Waste prevention, appropriate stock rotation, menu improvement, and safe food recovery may be considered where suitable.

The effectiveness of these interventions should be assessed against food safety, nutritional adequacy, patient satisfaction, and operational costs rather than waste reduction alone.

8. Limitations and Future Research

The principal limitation is the lack of a directly comparable dataset covering hospital food supply chains in Pakistan and Australia. The Australian audits, the Iranian waste study, and the Pakistani hospital supply chain study examine different populations and research questions. They provide contextual evidence but cannot support a direct country-level performance ranking.

The available evidence is also insufficient to calculate national averages, confidence intervals, regression coefficients, or statistical significance for differences between the two countries. Most quantitative figures come from single hospitals, single networks, or short audit periods (for example, a seven-day observation in the two-centre study and an eight-day menu cycle in the Faulkner et al. audit). The waste data come from Iran and Australia, not Pakistan. Percentages in Table 2 differ slightly from the published headline percentages because of rounding and category grouping, and the qualitative themes from the Pakistani study cannot be converted into participant frequencies without further data.

Future research should collect standardised information from a defined sample of hospitals in both countries. A mixed-methods design could combine procurement records, inventory audits, food safety documentation, food waste measurements, and interviews with procurement managers, dietitians, food service staff, and information technology personnel.

Researchers should establish the sampling strategy and observation period before data collection. They should also report missing data, institutional characteristics, operational definitions, and uncertainty estimates where appropriate. These steps would enable a more robust assessment of how information integration and organisational context relate to food supply chain performance.

9. Conclusion

Healthcare food supply chains depend on coordinated procurement, reliable suppliers, effective inventory management, safe food handling, and accurate information. Evidence from Australian healthcare settings demonstrates that food procurement origin and food waste can be quantified through audits, while research involving Pakistani hospital supply chain professionals identifies organisational, regulatory, financial, supplier, external, and demand-related risks.

These findings support a comparative research framework that integrates food logistics, information management, traceability, and sustainability. However, they do not establish that either country has superior healthcare food supply chain performance. That conclusion

would require comparable institutional data and consistent indicators.

The proposed framework offers a practical foundation for such research. By measuring delivery reliability, stockouts, inventory accuracy, food safety record completeness, dietary order accuracy, origin traceability, traceability response time, and food waste intensity, future studies can move beyond general descriptions towards reproducible comparisons. The ultimate objective is to strengthen food safety, nutritional service, operational accountability, and resource efficiency within healthcare institutions.

11. REFERENCES

Alberdi, G., & Begiristain-Zubillaga, M. (2021). Identifying a sustainable food procurement strategy in healthcare systems: A scoping review. Sustainability, 13(4), 2398. https://doi.org/10.3390/su13042398

Antasouras, G., Vasios, G. K., Kontogiorgis, C., Ioannou, Z., Poulios, E., Deligiannidou, G.-E., Troumbis, A. Y., & Giaginis, C. (2023). How to improve food waste management in hospitals through focussing on the four most common measures for reducing plate waste. The International Journal of Health Planning and Management, 38(2), 296–316. https://doi.org/10.1002/hpm.3586

Astill, J., Dara, R. A., Campbell, M., Farber, J. M., Fraser, E. D. G., Sharif, S., & Yada, R. Y. (2019). Transparency in food supply chains: A review of enabling technology solutions. Trends in Food Science & Technology, 91, 240–247. https://doi.org/10.1016/j.tifs.2019.07.024

Beck, A. M., Balknäs, U. N., Fürst, P., Hasunen, K., Jones, L., Keller, U., Melchior, J. C., Mikkelsen, B. E., Schauder, P., Sivonen, L., Zinck, O., Øien, H., & Ovesen, L. (2001). Food and nutritional care in hospitals: How to prevent undernutrition—Report and guidelines from the Council of Europe. Clinical Nutrition, 20(5), 455–460. https://doi.org/10.1054/clnu.2001.0494

Berardy, A., Egan, B., Birchfield, N., Sabaté, J., & Lynch, H. (2022). Comparison of plate waste between vegetarian and meat-containing meals in a hospital setting: Environmental and nutritional considerations. Nutrients, 14(6), 1174. https://doi.org/10.3390/nu14061174

Bux, C. (2026). Conventional and digital technologies for measuring and monitoring food waste in the healthcare foodservice. Journal of Foodservice Business Research, 29(4), 689–711. https://doi.org/10.1080/15378020.2024.2394730

Chatzipavlou, M., Karayiannis, D., Chaloulakou, S., Georgakopoulou, E., & Poulia, K. A. (2024). Implementation of sustainable food service systems in hospitals to achieve current sustainability goals: A scoping review. Clinical Nutrition ESPEN, 61, 237–252. https://doi.org/10.1016/j.clnesp.2024.03.030

Cook, N., Collins, J., Goodwin, D., & Porter, J. (2022). A systematic review of food waste audit methods in hospital foodservices: Development of a consensus pathway food waste audit tool. Journal of Human Nutrition and Dietetics, 35(1), 68–80. https://doi.org/10.1111/jhn.12928

Ellahi, R. M., Wood, L. C., & Bekhit, A. E.-D. A. (2023). Blockchain-based frameworks for food traceability: A systematic review. Foods, 12(16), 3026. https://doi.org/10.3390/foods12163026

Eriksson, M., Malefors, C., Bergström, P., Eriksson, E., & Persson Osowski, C. (2020). Quantities and quantification methodologies of food waste in Swedish hospitals. Sustainability, 12(8), 3116. https://doi.org/10.3390/su12083116

Fallahnezhad, M., Langarizadeh, M., & Vahabzadeh, A. (2024). Key performance indicators of hospital supply chain: A systematic review. BMC Health Services Research, 24, Article 1610. https://doi.org/10.1186/s12913-024-11954-5

Faulkner, K., Collins, J., Gilbertson, H. R., & Porter, J. (2023). Local food procurement by hospitals: A scoping review. Journal of Human Nutrition and Dietetics, 36(6), 2219–2233. https://doi.org/10.1111/jhn.13178

Food and Agriculture Organization of the United Nations, & World Health Organization. (2023). General principles of food hygiene (CXC 1-1969). Codex Alimentarius Commission. https://doi.org/10.4060/cc6125en

Garcia-Garcia, G., Woolley, E., Rahimifard, S., Colwill, J., White, R., & Needham, L. (2017). A methodology for sustainable management of food waste. Waste and Biomass Valorization, 8(6), 2209–2227. https://doi.org/10.1007/s12649-016-9720-0

Ishangulyyev, R., Kim, S., & Lee, S. H. (2019). Understanding food loss and waste—Why are we losing and wasting food? Foods, 8(8), 297. https://doi.org/10.3390/foods8080297

MacKenzie-Shalders, K., Maunder, K., So, D., Norris, R., & McCray, S. (2020). Impact of electronic bedside meal ordering systems on dietary intake, patient satisfaction, plate waste and costs: A systematic literature review. Nutrition & Dietetics, 77(1), 103–111. https://doi.org/10.1111/1747-0080.12600

McCray, S., Maunder, K., Barsha, L., & Mackenzie-Shalders, K. (2018). Room service in a public hospital improves nutritional intake and increases patient satisfaction while decreasing food waste and cost. Journal of Human Nutrition and Dietetics, 31(6), 734–741. https://doi.org/10.1111/jhn.12580

Ofei, K. T., Werther, M. N., Thomsen, J. D., Holst, M., Rasmussen, H. H., & Mikkelsen, B. E. (2015). Reducing food waste in large-scale institutions and hospitals: Insights from interviews with Danish foodservice professionals. Journal of Foodservice Business Research, 18(5), 502–519. https://doi.org/10.1080/15378020.2015.1093457

Rajput, D. V., More, P. R., Adhikari, P. A., & Arya, S. S. (2025). Blockchain technology in the food supply chain: A way towards circular economy and sustainability. Sustainable Food Technology, 3, 930–946. https://doi.org/10.1039/D5FB00065C

Rinninella, E., Raoul, P., Maccauro, V., Cintoni, M., Cambieri, A., Fiore, A., Zega, M., Gasbarrini, A., & Mele, M. C. (2023). Hospital services to improve nutritional intake and reduce food waste: A systematic review. Nutrients, 15(2), 310. https://doi.org/10.3390/nu15020310

Sathiaraj, E., Priya, K., Chakraborthy, S., & Rajagopal, R. (2019). Patient-centered foodservice model improves body weight, nutritional intake and patient satisfaction in patients undergoing cancer treatment. Nutrition and Cancer, 71(3), 418–423. https://doi.org/10.1080/01635581.2018.1506490

Strotmann, C., Friedrich, S., Kreyenschmidt, J., Teitscheid, P., & Ritter, G. (2017). Comparing food provided and wasted before and after implementing measures against food waste in three healthcare food service facilities. Sustainability, 9(8), 1409. https://doi.org/10.3390/su9081409

Vasileiou, M., Kyrgiakos, L. S., Kleisiari, C., Lappas, P. Z., Tsinopoulos, C., Kleftodimos, G., Ntemou, A., Kateris, D., Moulogianni, C., & Vlontzos, G. (2026). Digital transformation of food supply chain management using blockchain: A systematic literature review towards food safety and traceability. Business & Information Systems Engineering, 68, 919–946. https://doi.org/10.1007/s12599-025-00948-0

Vu, N., Ghadge, A., & Bourlakis, M. (2021). Blockchain adoption in food supply chains: A review and implementation framework. Production Planning & Control, 32(7), 506–523. https://doi.org/10.1080/09537287.2021.1939902

Yona, O., Goldsmith, R., & Endevelt, R. (2020). Improved meals service and reduced food waste and costs in medical institutions resulting from employment of a food service dietitian—A case study. Israel Journal of Health Policy Research, 9, Article 5. https://doi.org/10.1186/s13584-020-0362-0

IEER
Institute for Excellence in Education & Research