

# The significance of the application of Hazard Analysis Critical Control Point System in hospital catering

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## Abstract

**Background:** The HACCP concept is a systematic approach to food safety management based on recognized principles which aim to identify the hazards that are likely to occur at any stage in the food supply stage and put into place controls that will prevent them from happening. Ensuring the safety of food is a challenge in all healthcare institutions from small residential units to large acute hospitals, long-stay psychiatric hospitals and nursing homes.

The aim of present study was to review the role of Hazard Analysis Critical Control Point (HACCP) application in hospital catering.

**Method and Material:** The method of this study included bibliography research from both the review and the research literature in several databases (Medline, Scopus and EMBASE) which referred to HACCP system applications in health care institution's catering facilities. The search was performed using the following key terms: *HACCP, hospitals, food safety, food hygiene*.

**Results:** The position of catering services within a hospital is often given low priority compared to high-profile medical services. However, catering is pivotal to the operation of the hospital. Unfortunately this is rarely recognized and while there are often fund-raising initiatives for a new coronary care unit, the need of the application of HACCP in a hospital catering does not generate the same level of interest. HACCP is a proven food safety management system based on prevention, that contributes to the reduction to an acceptable level or elimination of hazards in the field of food production in hospital catering.

**Conclusions:** The food safety challenges can vary between and within institutions, from neonatal intensive care units to geriatric wards. However, the basic requirements for good hygienic practices and effective food safety management systems are the same. A hygiene management system based on HACCP principles will help ensure the production of safe food in hospital catering and avoid a significant amount of financial cost.

**Keywords:** HACCP, hospitals, food safety, food hygiene.

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## Introduction

In the last decades, the epidemiology of foodborne diseases is changing with new or unexpected pathogens often emerging on a countrywide or worldwide scale, new foods expanding the range of potential vehicles of pathogens, wider social contexts being involved and new classes of individual being at higher risk<sup>1</sup>. These changes may be attributed to socio-economic and demographics factors, including dramatic qualitative changes in primary production, processing, distribution and handling of food and the increasing exposure of individual, like elderly, patients with impaired immunity and many hospitalized subject<sup>2</sup>.

A series of food - related problems, have placed food safety high on the agenda of policy makers and media. In the context of healthcare institutions, it is not new variant CJD or dioxin contamination that is contributing to morbidity and mortality but a range of bacteria, viruses and protozoa, causing illnesses that are easily preventable<sup>3</sup>.

Food poisoning may not cause major morbidity in robust adults but can be life-threatening in small infants, the frail elderly, or people suffering from concurrent morbidity<sup>4</sup>. The frail elderly and the ill often have lower immunity than healthy adults and the infectious dose to precipitate an infection is lower; therefore the application of an effective food safety management system is crucial in hospitals<sup>5</sup>.

The food safety issues in healthcare environments are different from food safety issues in commercial catering establishments. Certain high - risk foods should be excluded from all hospital menus. Undercooked foods, unpasteurized milk products that could contain pathogens have no place on the menu in a healthcare institution. For immunocompromised and other high - risk patients, in particular those with haematological malignancies, a low microbial diet (LMD) can be used. LMDs are not sterile, but are diets in which specific foods are excluded in an effort to reduce the risk of infection<sup>6</sup>.

Epidemiological and surveillance data suggest that faulty practices in food processing plants and food service establishments play a crucial role in the causal chain of foodborne diseases<sup>7</sup>.

HACCP is a logical, structured approach to the analysis and control of potential hazard points in a food operation<sup>8</sup>. By identifying where in the process the hazards are likely to occur it is possible to put into space the control measures required.

## Foodborne Disease Outbreaks in Healthcare Settings

Outbreaks of foodborne disease in hospitals constitute avoidable causes of illness and death in a vulnerable populations<sup>9</sup>. In a review of 50 hospital-based outbreaks of food poisoning in Scotland between 1972-1977, at least 1530 people eating hospital - prepared food were involved<sup>10</sup>. Thirty-one episodes were associated with *Clostridium perfringens*, eleven were due to foodborne salmonella infection, three to enterotoxigenic *Staphylococcus aureus*, and in five incidents the etiology was not determined.

In the UK since 1968, the number of reported salmonella outbreaks in hospitals has fallen from, on average, 53 per year<sup>11</sup> to 6 per year. The reason for this fall is likely to be multi-factorial and probably reflect better control of cross-infection on the one hand, coupled with improvements in food hygiene on the other.

One of the notable features of hospital outbreaks is that psychiatric wards and elderly-care wards (including psychogeriatric wards) are the units that tend to be most badly affected<sup>9</sup>. These patients group are, perhaps, especially vulnerable and preventing cross-infection following a foodborne disease outbreak can be a particular challenge. Although foodborne disease outbreaks in hospitals in the UK appear to be becoming less common, the mortality risk associated with these

outbreaks is still high. In Australia, Dalton and colleagues<sup>11</sup> reviewed 214 foodborne disease outbreaks and noted that 35% of deaths occurred in aged-care and hospital settings, despite the fact that only 5% of foodborne outbreaks and fewer than 3% of foodborne disease outbreak cases were reported in these settings. The case fatality rate was ten times higher in foodborne outbreaks in aged-care and hospital settings than in other foodborne outbreaks.

In a review by Abbott et al.,<sup>12</sup> of hospital outbreaks of gastrointestinal infection, in only 76 of 522 (36%) was the source of infection recorded; 24 outbreaks (32%) were considered to be foodborne. More than 20 years later, only 1,8% of outbreaks of gastrointestinal disease in hospitals in England and Wales were thought to be foodborne<sup>12</sup>.

Outbreak reports in the literature highlight a number of different causes of foodborne disease outbreaks in hospitals, such as: i. contaminated raw ingredients<sup>13</sup>, ii. commercially prepared, contaminated prepared, contaminated ingredients<sup>14</sup>, iii. inadequate cooking, handling and/or storage of food in hospital kitchen<sup>15</sup>, iv. cross - contamination of food in hospital kitchens<sup>16</sup>, v. contaminated food prepared outside the hospital<sup>17</sup> vi. contaminated enteral feed, powdered infant formula and human breast milk<sup>18, 19</sup> vii. Infected food handlers<sup>20</sup>.

#### Hazard Analysis Critical Control Point (HACCP)

The HACCP concept was introduced in the United States in 1971 at the Conference of Food Protection where it was "recommended for widespread use"<sup>21</sup>. During the initial period of space exploitation preparation by NASA it was recognised that absolutely safe food was required for the astronauts. A collaboration by the Pillsbury Company, NASA and the US Army laboratories proposed HACCP, that was based on the Failure, Mode and Effect Analysis (FMEA) as used by engineers in construction designs. In general the US food industry showed little interest, but microbiological problems with

low-acid canned foods, particularly mushrooms, led to the FDA promulgating specific regulations for control embodying HACCP principles. Their successful introduction in the canning industry inevitably led to pressure for their wider acceptance by the food industry. Subsequently, as a means of safe food production, it has been adopted world - wide as given in Codex Alimentarius Commission<sup>22</sup>.

In European Union legislative framework, HACCP concept was introduced by the EU Food Hygiene Directive 93/43/EEC<sup>23</sup>, that was repealed by Regulation (EC) 853/2004<sup>24</sup> on the hygiene of foodstuffs, as a tool to ensure food safety.

#### Prerequisite Programs

In order for a HACCP system to be effective, a strong foundation of procedures that address the basic operational and sanitation conditions within an operation must first be developed and implemented. These procedures are the "Prerequisite Programs", that provide the basic environmental and operating conditions that are necessary for the production of safe food and are defined as practices and conditions needed prior to and during the implementation of HACCP and which are essential for food safety.

Common prerequisite programs include, but are not limited to: facilities, supplier control, allergen management, equipments, cleaning and sanitation procedures, personal hygiene and training, chemical control, traceability, first -in- first out (FIFO) procedures (stock rotation), pest control programs.

All prerequisites programs should be documented, regularly audited and managed separately from the HACCP plan. Certain aspects, however, of a prerequisite program may be incorporated into a HACCP plan.

#### *HACCP principles*

The seven basic principles of HACCP were described by the Codex Alimentarius Commission<sup>25</sup> and endorsed by the US National Advisory Committee on

Microbiological Criteria for Foods (NACMSF)<sup>26</sup> in 1997 and are as follows:

*Principle 1: Conduct a Hazard Analysis. Prepare a list of steps in the process where significant hazards occur and describe the preventive measures.*

The purpose of conducting a hazard analysis by the HACCP team, is to develop a list of hazards which are of such significance that they are reasonably likely to cause injury or illness if not effectively controlled. The HACCP team is consisted of individuals who have specific knowledge and expertise appropriate to the process. Hazards that are not reasonably likely to occur would not require further consideration within a HACCP plan. It is important to consider in the hazard analysis the ingredients and raw material, each step in the process, product storage and distribution, the final preparation and use by the patients. If the hazard analysis is not done correctly and the hazards warranting control within the HACCP system are not identified, the plan will not be effective regardless of how well it is followed. This analysis provide a basis for determining CCPs.

The process of conducting a hazard analysis involves two stages. The first stage involves the hazard identification and can be regarded as a brain storming session. Based on this review, the team develops a list of potential biological, chemical or physical hazards, which may be introduced, increased or controlled at each step of the production process. Biological hazards include bacterial, viral and parasitic microorganisms that are commonly detected in cases of contaminated ingredients, improper cooling, insufficient cooking, poor sanitation, poor personal hygiene, cross-contamination and a combination of these. Physical hazards include foreign material items such as glass fragments, wood splinters, metal, stones, bone or plastic. Chemical hazards may be naturally occurring or may be added during processing (production, distribution and storage) of food. Some examples of chemical contamination in raw material are pesticides/herbicides, toxins (natural or microbial), allergens, antibiotics, hormone

residues, heavy metals, cleaning agents, refrigerants, pest control chemicals.

At the second stage the hazard evaluation is conducted. The HACCP team decides which potential hazards must be addressed in the HACCP plan and each potential hazard is evaluated based on its severity and its likely occurrence. Consideration of the likely occurrence is usually based on upon a combination of experience, epidemiological data and information in the technical literature.

For inclusion in the list, the hazards must be of such nature that their prevention, elimination or reduction to acceptable levels is essential to the production of a safe food. The HACCP team then must consider what preventive measures, if any, exist which can be applied for each hazard. Upon completion of the hazard analysis, the significant hazard associated with each step in the flow diagram should be listed along with any preventive measures to control hazards. This tabulation will be used in Principle 2 to determine CCPs.

*Principle 2: Determine the Critical Control Points (CCPs) in the process*

The HACCP team must identify the steps in the production process which are essential for the prevention, elimination or significant reduction to acceptable levels of the identified hazards. A CCP is defined as a point, step of procedure at which control can be applied and a food safety hazard can be prevented, eliminated, or reduced to acceptable levels. The informations developed during the hazard analysis should enable the HACCP team to identify which steps in the process are CCPs.

CCP relate to control of significant food safety hazard only. Sometimes there is a tendency to designate too many CCPs "to be of the safe side". This can undermine the system, losing credibility, and can make implementation more difficult to manage because resource is spread too thinly. On the other hand too few CCPs may result in the production of unsafe food.

Identification of CCPs can be carried out by using tools such as decision trees, that consist of a number of questions that are

applied to each identified hazard listed in the hazard analysis chart.

*Principle 3: Establish Critical Limit(s)*

Critical limits are the safety limits that must be met for each control measure at a CCP. These critical limits, that should be scientifically based, describe the difference between safe and unsafe products at each CCP. Each CCP will have one or more control measures to assure that the identified hazards are prevented, eliminated or reduced to acceptable levels. For each CCP there is at least one criterion for food safety that is to be met. The critical limits and criteria for food safety may be derived from sources, such as regulatory standards and guidelines, literature surveys, experimental results and experts.

*Principle 4: Establish CCP monitoring requirements. Establish procedures from the results of monitoring to adjust the process and maintain control.*

Monitoring is a planned sequence of observations or measurements to assess whether a CCP is under control and to produce an accurate record for future use in verification. The procedures for monitoring the CCPs will depend on the nature of the control measure and also on the capabilities of the monitoring device or method used. It is essential that the monitoring is able to detect loss of control, otherwise the system becomes invalid. The frequency of monitoring depend on the nature of the CCP and it must be determined as part of the control system. The assignment of the responsibility for monitoring is an important consideration for each CCP.

*Principle 5: Establish the corrective action to be taken when monitoring indicates a deviation from an established critical limit.*

The HACCP team must establish what remedial action need to be taken, and by whom, if the critical limit is not attained when there is a deviation from established critical limits, corrective action plans must be in place to a) determine the disposition of non - compliance product, b) fix or correct the cause of non-compliance to assure that the CCP is under control and c) maintain

records of the corrective actions that have been taken where there has been a deviation from critical limits.

*Principle 6: Establish procedures for verification to confirm that the HACCP system is working effectively.*

The application of this Principle is achieved through a number of activities which broadly fall into the two categories of validation and verification. Whilst validation is an one - off activity during the plan development it does need to be repeated should there be any change in the process. Verification however is an ongoing activity once the HACCP plan has been implemented.

Validation activities take place once the HACCP study is complete in order to confirm that all elements of the HACCP plan is effective before moving into the implementation.

Verification is the confirmation that the control measures have been met during the process and includes those activities, other than monitoring, that determine the validity of the HACCP plan and show that the system is operating according to the plan.

*Principle 7: Establish documentation concerning all procedures and records appropriate to these principles and their application.*

Maintaining documentation of the activities in a food safety management system based on HACCP principles is vital to its success. In the event that an establishment is implicated in a foodborne illness, documentation of activities related to monitoring and corrective actions can provide proof that reasonable care was exercised in the operation of the establishment. Documenting activities provides a mechanism for verifying that the activities in the HACCP plan were properly completed.

## HACCP application in Hospital

Hospital management's support and commitment in HACCP application is vital. Efforts to implement HACCP only at junior management levels are usually doomed to failure. In fact, a poorly developed or

supported HACCP program may give the company a false sense of security and may lead to many problems<sup>27</sup>.

Regardless of the size of institutions, the same preventable faults contribute to outbreaks of foodborne diseases and often several occur simultaneously. The risk factors associated with food preparation procedures and employee behaviour in hospitals are: a. improper holding/time and temperature (40,3%), b. contaminated equipment/protection from contamination (18,9%), c. poor personal hygiene (17,5%), d. chemical contamination (13,4%), e. inadequate cooking (6,3%), f. food from unsafe source(0,5%)<sup>28</sup>.

All these factors could be efficiently be controlled and monitored in order to eliminate or reduce to an acceptable level the hazards, in the framework of the implementation of a HACCP plan in the hospital.

Pinning down a food vehicle in hospital outbreak can be problematic. Because firstly by the time an outbreak comes to light it might be difficult to establish if contaminated food was likely to have been the source. The time taken to establish that an outbreak has occurred may be lengthened depending on the level of contamination in food, the distribution of patients across the institution, or the clinical diagnostic protocols used within hospitals to investigate patients with diarrhea. Secondly obtaining an accurate food history from elderly or infirm patients can be challenging. Experience has shown that mobile patients may also supplement their diet with food from hospital canteens or shops or with food brought in by relatives. Thirdly contaminated food might have been discarded.

In terms of controlling foodborne disease in healthcare institutions, it is essential that cases and/or outbreaks are detected early. It can be difficult to differentiate the various causes of diarrhea, such as antibiotics - associated diarrhea caused by *Clostridium difficile*, irritable bowel syndrome, or person-to-person spread of norovirus, from foodborne disease. Therefore all cases of diarrhea must be

documented, faecal samples should be sent for analysis, vigilance should be maintained for clusters of illness or any change in the normal pattern of bowel habit in individual patients or groups of patients<sup>4</sup>.

Many large hospitals have outsourced their catering and food provision to contractors who are believed to provide a better service, flexibility and value for money. In this situation meals may arrive precooked and chilled or frozen, and minimal handling take place in the healthcare institution. Furthermore, large health institutions often have shops, cafes and canteens on site that supply a range of foods. All the above needs to be included in the overall food safety program.

The hospital food - service system, when contracted out to an external caterer, is considered one of the most complicated production processes within the hospitality sector. Indeed, the diffusion of compulsory competitive tendering, the increasingly demanding, bureaucratic hospital administration, the stringent food costing, the standardization and mass production of meals could arise negative effects on both the safety and quality of food.

A food safety management system based on HACCP principles in the hospital provide a method of achieving active managerial control of multiple risk factors, it contributes to consistency in food preparation, and employee awareness and participation in food safety.

Anderson<sup>29</sup> reported on how the HACCP approach can be applied to enteral feeding and showed the major strengths of such system in minimizing or eliminating sources of bacterial contamination of feeds. Enteral tube feeding is a method used to provide nutritional support to individuals who are unable to feed orally, but whose digestive systems are still functional. Oliveira et al<sup>30</sup> analysed feed samples for microbiological quality, before and after the implementation of the HACCP system and they concluded that when control measures were applied and monitored, the hazard was reduced. Bacterial counts in feed were reduced from  $10^5$  cfu mL<sup>-1</sup> to  $<10^1$  cfu mL<sup>-1</sup>.

The results show that contamination of enteral feed may be reduced or eliminated if a systematic approach such as HACCP is applied effectively.

A report by Patchell et al.,<sup>31</sup> showed that training and improved hygienic practices, that consist sections of Prerequisites Programs needed prior to and during the implementation of HACCP system, reduced the incidence of contamination of enteral feeds after the introduction of the new feeding protocol.

Problems of implementing prerequisite programs and HACCP system in hospitals include lack of commitment by management, lack of financial resources, inadequate equipment and environment, mistranslation of HACCP principles and lack of scientifically validated risk assessment procedures and lack of food hygiene management training.

It should be mentioned that the common involvement in the role of food handlers, of nurses or domestic staff, not specifically trained about food hygiene and HACCP, may present a further cause of concern. Buccheri C. et al conducted a survey in 2005<sup>32</sup> in an acute general hospital and a paediatric hospital, where nursing staff was routinely involved in food service function. Among the respondents (nurses) there was a generalized lack of knowledge about etiologic agents and food vehicle associated to foodborne diseases and proper temperatures of storage of hot and cold ready to eat foods.

Staff is an institution's greatest asset, but untrained staff can be an institution's greatest liability. Despite the legislative requirements, training in itself is often not sufficient to deliver the behavioral changes necessary to work practices. The objective is to achieve competent staff.

The financial impact of foodborne disease outbreaks in hospitals

One way of judging the significance of foodborne disease outbreaks in hospitals is to look at the economic consequences. In Australia in 1996, 52 people were affected in

an outbreak of *S. Typhimurium* traced back to contamination of sandwiches prepared in the hospital kitchen<sup>33</sup>. Spearing and colleagues<sup>34</sup> estimated the direct costs incurred by the hospital associated with this outbreak. The medical cost amounted to some AU\$67,000. The costs of the investigation were in the region of AU\$37,000 whilst the cost of lost productivity were over AU\$15,000. Taking into account various miscellaneous items (external catering, telephone calls, etc) the costs of this one outbreak were substantial at over AU\$120,000. Indirect costs were not included in the calculations but are likely to have been considerable, comprising the expenses incurred by individuals affected in the outbreak and their relatives (suffering, loss of life and lost productivity), and the costs elsewhere in the healthcare system and in the community.

In an outbreak of Campylobacteriosis amongst 31 members of hospital staff in north of England, 46 working days were lost at an estimated cost of £3,000<sup>35</sup>, whilst the identifiable costs of an outbreak of Salmonellosis that affected 22 patients and seven staff in the hospital of England in 1993 were estimated to be in the region of £33,000<sup>7</sup>.

## Discussion

Food poisoning remains one of the most common causes of illness worldwide<sup>36</sup>. HACCP has become the internationally accepted means of assured safe food production. It is a management system in which food safety is addressed through the analysis and control for biological, chemical and physical hazards from raw material, production and handling to manufacturing, distribution and consumption of finished product<sup>37,38</sup>.

In most hospitals, food hygiene and safety efforts are directed towards inspection of food-handling practices, end-product bacteriological sampling and routine faecal screening of food handlers<sup>8</sup>. However, it has been emphasized that this approach is

not cost-effective and may not reduce the risk of foodborne outbreaks.

Foodborne disease outbreaks in hospitals are both avoidable and costly. The application of a food safety management system based on HACCP principles can help to prevent foodborne outbreaks. The HACCP approach is evolving and there is interest worldwide from the healthcare community. This practical and effective method of hazard control embodies the concept to active managerial control by providing an ongoing system of simple control measures that will reduce the occurrence or risk factors that lead to out-of-control hazards<sup>5</sup>.

In 2003, the Hellenic Food Authority (EFET) conducted an audit of 99 hospitals in Greece and revealed that only 4 hospitals had established a HACCP system. Angelillo I.F. et al.,<sup>39</sup> conducted a survey in 36 hospitals in Calabria, Italy and concluded that only 54% of the 27% responding hospitals were using the HACCP system.

Moreover various areas of infection control would benefit from a systematic exploration of hazard points<sup>40</sup> and an analysis of preventive measures. Such examples are the management of central intravenous and feeding lines, disinfection of endoscopes, venesection and the use of peripheral lines.

## Conclusion

The application of HACCP, as a preventive food safety management system, in hospital catering, could primarily contribute to the production of safe food and secondly to the avoidance of a significant high amount of financial costs.

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